A Four-Dimensional Product Innovativeness Typology

Introducing Seven New Product Project Types for the Study of Innovation Management

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Abstract

Product innovativeness is a key moderating variable for the study of innovation management (Song & Montoya-Weiss 1998, p. 124). For this reason, some empirical studies of innovation management examine new product processes, critical success factors, and market learning practices for *incremental* versus *discontinuous* new product projects (Song & Montoya-Weiss 1998; Atuahene-Gima 1995; Veryzer 1998a; Lynn et al. 1996; O'Connor 1998; Rice et al. 1998). By looking at both these types of new product development projects, empirical observations are likely to be more realistic than those of studies that do not discriminate between more or less innovative projects.

Even so, a dualistic view of the matter does not capture the nuances (Green et al. 1995)[1] of the relationship between product innovativeness and innovation management practices. Hence, there is a need for richer innovativeness typologies that go beyond the dichotomous view and, thereby, lend themselves to a more fine-grained study of innovation management practices for different types of new product projects.

In fact, various innovativeness typologies exist that include more than two product types. Notably, the typology by Booz, Allen & Hamilton (1982)[2] introduces two dimensions: *newness to the market* and *newness to the company,* resulting in six products types (with various combinations of high, medium and low newness). An alternative set of typologies differentiates between the product's *technological newness* and its *market newness,* for example Abernathy & Clark's (1985) typology with four new product types; Leonard-Barton's (1995) five product types; and Veryzer's (1998a) four types in a two-by-two matrix.

Interestingly, these two meta-perspectives on product innovativeness (i.e. 1. new to the market and/or new to the company and 2. technological and/or market newness) are generally not included within the same typology in extant literature. For example, discussions of the technological and/or market newness of a product, often leave out the question of whether that newness is in the eyes of the industry and market (exogenous newness) or only for the focal firm itself (endogenous newness). More broadly, it can be stated that "…little continuity exists in the new product literature regarding from *whose* perspective this degree of newness is viewed and *what* is new" (Garcia & Calantone 2002, p. 112).

[1] In Danneels & Kleinschmidt (2001).
[2] In Johne (1994).

The problem with this is that, even as innovation management practices are different when making products that are new in technological and/or market terms, they also differ depending on whether the firm is a pioneer (exogenous newness) or the firm is either a late mover in a product category or is developing a new platform. In the latter cases (the late mover and the new platform), the product can be considered novel more in terms of the focal firm's product lines, processes and competences (endogenous newness) than in the eyes of the industry and market (exogenous newness).

In fact, Garcia & Calantone (2002) explicitly include these two meta-perspectives (new to whom? and new in what way?) in their discussion of innovativeness. However, the typology they propose only includes three categories, since technologically new products (with low market newness) are lumped together with those that have high market newness (and low technological newness). What is more, the typology does not distinguish between the individual firm's incremental products and those that have high newness to the firm – albeit low exogenous newness. Hence, the typology may well be useful for sector-level analysis of product innovativeness, but, for the reasons mentioned above, it is inadequate as a means to open up the application of the two meta-perspectives to fine-grained studies innovation management practices new product projects with different innovativeness profiles.

Therefore, this paper introduces a more elaborate innovativeness typology based on four dimensions that are a corollary of the two meta-perspectives: 1) exogenous technological newness; 2) exogenous market newness; 3) endogenous technological newness; and 4) endogenous market newness.

Based on a review of extant literature, each of the four newness dimensions is defined, conceptualized and measured in terms of four underlying indicators. For example, the indicators of Newness Dimension 1 (exogenous technological newness) are: 1) a new technological principle; 2) a technological performance leap; 3) a major cost reduction; and 4) required technological changes in the industry (i.e. winning the standards battle and/or creating a technological paradigm shift).

The typology itself is derived from combining all four Newness Dimensions and collapsing or removing some of the potential or hypothetical combinations. Notably, the typology is built on the tenet that projects with high exogenous newness, by implication, also have high endogenous newness[3] (Garcia & Calantone 2002), which leaves out some hypothetical combinations of the four dimensions.

[3] For example, developing a fuel-cell car would qualify for a high level of exogenous newness, which implies that by nature it would also be considered highly new from the endogenous (focal firm) perspective. Of course, the high level of endogenous newness would be of an even more dramatic nature for, say, IBM to engage in such a venture that it is for GM (Garcia & Calantone 2002).

The combinations of the four newness dimensions result in seven new product project types.

Three of the projects are *breakthrough* in nature, since they have either high *exogenous* technological newness or high *exogenous* market newness or both: the Really New Technology Architecture; the Really New Market Approach; or the Discontinuous Value Proposition.

Three intermediate project typess are either *imitations* or new *product platforms* that have high *endogenous* technological newness or high *endogenous* market newness or both: the New Technology Platform; the New Market Initiative; or the New Business Domain).

The final new product project type is the *incremental* project which has a low degree of newness on all four Newness Dimensions: the Evolutionary Product Development project type.

In that sense, the typology is somewhat akin to that of Wheelwright & Clark (1992), which distinguishes between *breakthrough, platform* and *derivative* projects. The two-fold difference, however, is that: 1) three variations of both 'breakthrough' and 'platform' projects are introduced here (i.e. high technological newness or high market newness or both); and 2) the intermediate category in the typology proposed here consists of projects that have high *endogenous* newness and relatively low exogenous newness, which is not identical in definition to *platform* projects (which are defined as introducing medium level product and process change), but rather the three project types with high endogenous (and low exogenous) newness imply first and foremost a firm that is not a pioneer, but enters an existing market with a product imitation (arguably, though, this also constitutes a new platform for the firm – albeit in a market that is new to the firm).

To exemplify how the innovativeness typology works, a product with high exogenous market newness may be built from relatively mundane technology (i.e. low exogenous technological newness), such as the first Sony Walkman, which would mean that the product is a Really New Market Approach in the typology (see Figure 1 in the paper). On the other hand, late entrants to an industry (e.g. AMD with its first microprocessor), or incumbent players who introduce a new architecture (e.g. Intel's first Pentium chip), may experience a relatively high degree of newness developing the product (i.e. high *endogenous* newness), but the product does not qualify as a breakthrough innovation (i.e. it cannot claim to have high *exogenous* newness), for which reason the product is labeled a New Market Initiative. Even if the New Market Initiative does not have high endogenous newness, it involves more uncertainty than incremental new products and the innovation management approach, therefore, needs to be more experimental in nature, for which reason the intermediate category of product innovativeness is worthwhile including in an innovativeness typology.

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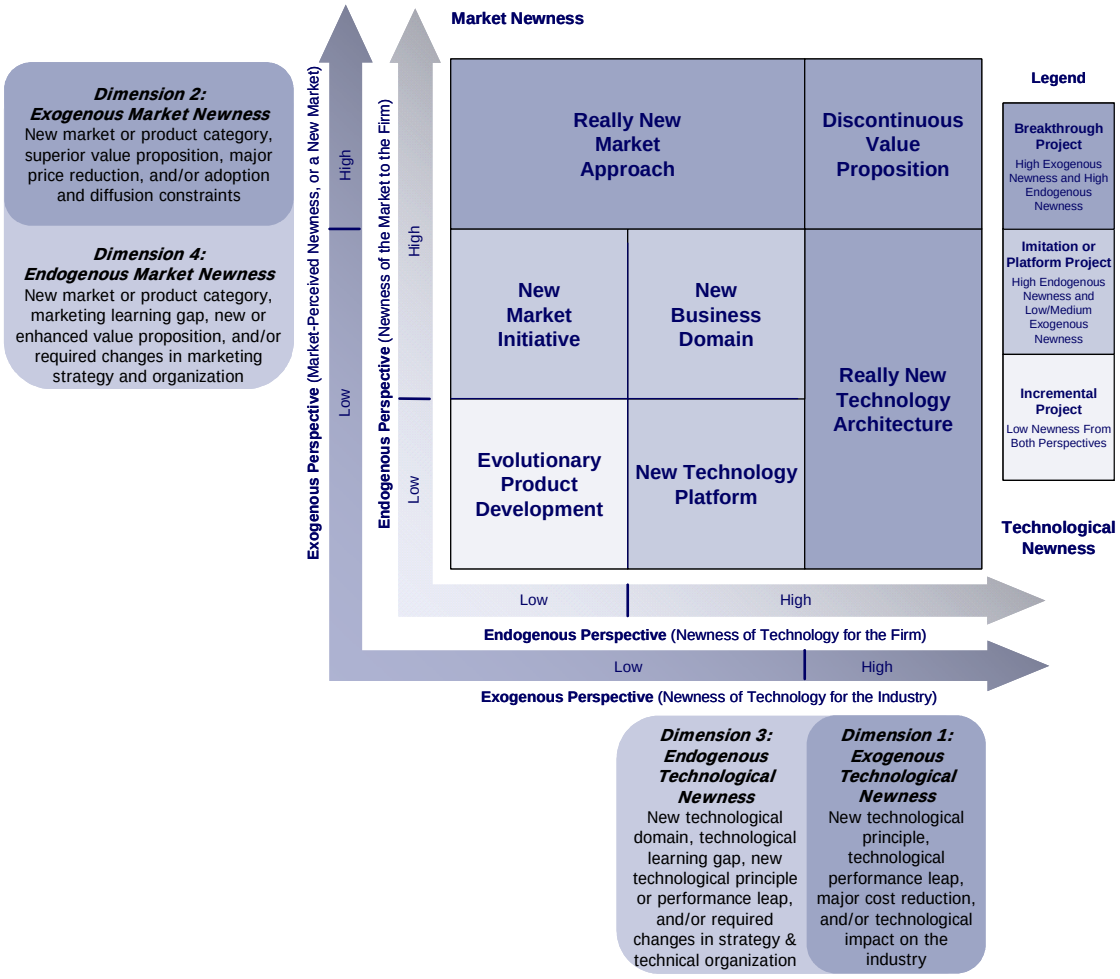
Introduction

What works well in developing one type of new product project is not necessarily right for another type of project. For this reason, a contingency view is likely to be rewarding for the study of innovation management. To this end, a typology of new product projects is proposed here, as shown in Figure 1.

In the opening section of this paper, it is argued that innovativeness is an important moderating variable for the study of innovation management and market learning in product innovation (see Figure 2). It is further argued that it is not sufficient to think of innovativeness in terms of the classical dichotomy of radical and incremental product innovation. Rather, there is a need to open up the innovativeness construct by looking at the two meta-perspectives: 1) "new to whom?" and 2) "new in what way?". This leads to four dimensions of product newness. Each of these four dimensions is further conceptualized in terms of four indicators that emerge from a review of definitions and measures in extant innovation literature. The seven new product project types in the typology differentiate themselves from each other in terms of their score on each of the four newness dimensions (based on the underlying indicators of each dimension).

Figure 1. The Four-Dimensional Innovativeness Typology

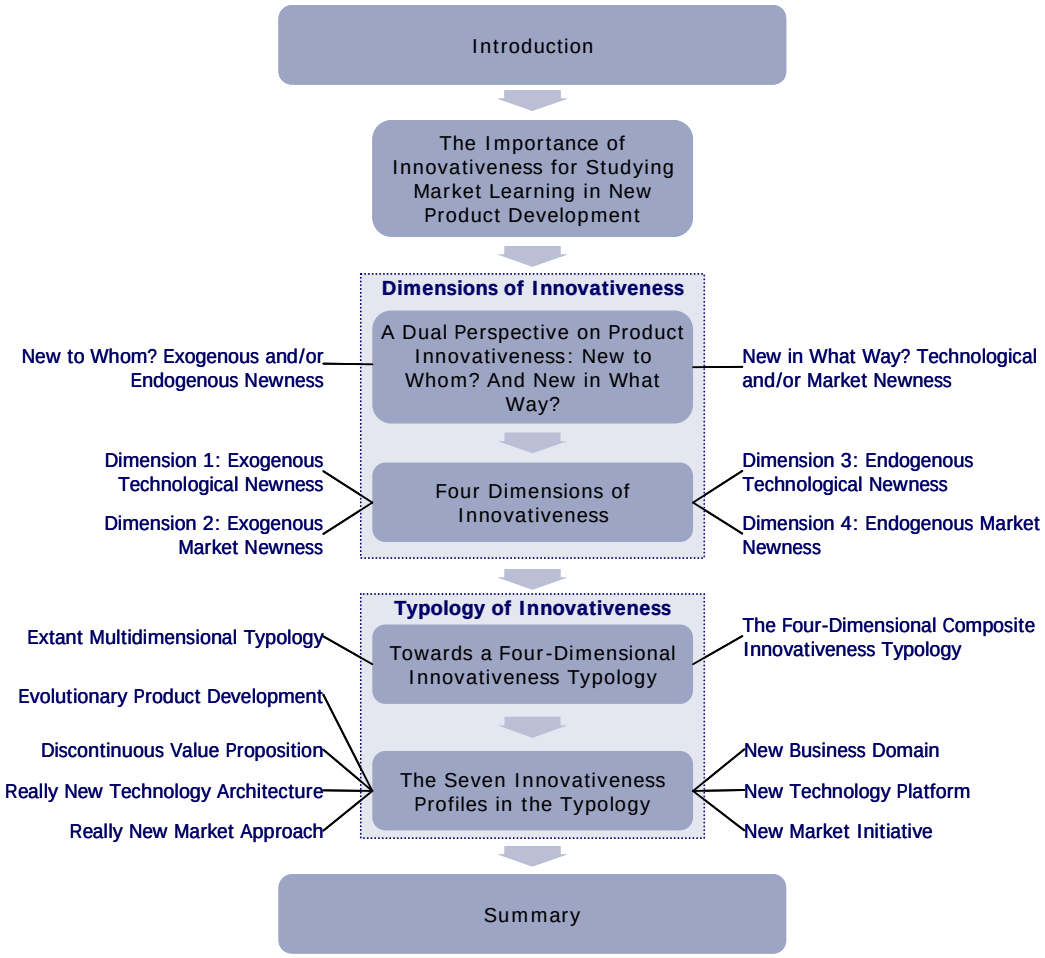


Own Development

Most innovativeness typologies include only two of the four newness dimensions (combined in one way or the other in two-by-two matrices). The typology by Garcia & Calantone (2002), however, includes all four dimensions (although in a different format). Even so, their typology collapses many of the potential combinations into three distinct types of new products. In particular, their typology leaves out the distinction between technological and market(ing) newness (i.e. "new in what way?"), even though the centrality of this perspective for studying innovativeness is underscored by the authors themselves. What is more, the typology lumps together all the four quadrants in the lower left hand corner of Figure 1. While leaving out these additional categories may have the benefits of parsimony for sector-level analysis, it is lamentable in a classification scheme for studying innovation management, since there is a notable difference in the degree of technology and/or market learning required to develop these four different product types.

Therefore, a new product innovativeness typology is proposed here, and seven innovativeness profiles are identified to serve as a backbone for contingency-based research into appropriate innovation management practices for each new product project type.

Figure 2. Structure of the Working Paper



Own Development

The Importance of the Innovativeness Construct for the Study of Innovation Management

A sizable body of literature on new product development details the process steps, the key success factors, the use of customer feedback, and the consequent performance of new products in the market, without any mention of the degree of innovativeness of the new product in question (Song & Montoya-Weiss 1998, p. 124). Often the implicit focus of new product process models (such as the stage-gate model, advocated by Cooper 1994), and of techniques proposed for market learning, is on incremental new products (O'Connor 1998, p. 152; McDermott & O'Connor 2002, 425). But when this is not built into the design of a study, and is left unwritten in prescriptive literature, results and recommendations become circumstantial. Instead, there is a need for research to pay explicit attention to the innovativeness of new product projects, as elucidated by Song & Montoya-Weiss (1998, 126) in their study of the moderating role of innovativeness for the use of market information in new product development (NPD):

> While there is general agreement as to the generic activities of NPD, it is not clear how the NPD process differs for different types of projects.

Hart, Tzokas and Saren (1999, p. 25) mention two important contingency factors for market learning in product innovation (the stage in the process and the *new product type*, in terms of innovativeness):

> In addition to the stage of the NPD process, another important factor influencing the utility of market information in uncertainty reduction is the type of new product in question.

Further corroborating the centrality of the innovativeness construct to the study of innovation management in general and market learning in particular, Veryzer (1998b, p. 136) stresses that:

> …the key factors that affect customers' evaluations of radically new products differ from those for incremental innovations.

It is, therefore, heartening that an emerging body of research provides indications on the contingencies of innovation management for different new product project types: A few surveys look at *critical success factors* in new product development using *innovativeness as a moderating variable* (e.g. Song & Montoya-Weiss 1998; Atuahene-Gima 1995). Some case studies, that have emerged in the past decade or so, focus specifically on *new product processes* of *radical innovation* (e.g. Veryzer 1998a; Lynn et al. 1996). A subset of this literature on *radical innovation* details the general role of *market information* in such projects (e.g. Veryzer 1998b; Lynn et al. 1996; O'Connor 1998; Rice et al. 1998). Yet other contributions explain the *market learning techniques* for *radical innovation* projects (Leonard & Rayport 1997; Veryzer 1998b; Lynn et al. 1996; Ulwick 2002).

What is clear from these studies is that marked differences exist between incremental and radical innovation projects in terms of the development process they go through, the critical success factors, and the role of market information during product development. For example, radical innovation is likely to have a longer front-end of technology discovery than incremental projects, and to be further removed from the market in terms of familiarity and time (typically they take more than ten years to bring to market); they typically run in fits and

starts, are very experimental in orientation, and are sparked by a convergence of technologies and environmental factors (Leifer et al. 2000; Veryzer 1998a).

It is, therefore, not easy to engage customers in a dialogue about radically new products – particularly when the market application for the technology is not yet clarified. Hence, market learning is likely to be more exploratory and experimental (Lynn et al. 1996), rely on techniques such as prototyping and observation studies (Lynn et al. 1996; Veryzer 1998b; Leonard & Rayport 1997), and focus more on the potential value of the product for the market than a careful assessment of market size and growth numbers (Rice et al. 1998; Leifer et al. 2000).

Hence, studies of innovation management must take a differentiated view of new products according to their degree of innovativeness. Of course, an alternative possibility is to focus exclusively on the more formal, disciplined and predictable process of incremental new products, for which the use of market information is more well-documented and easier to discuss, plan and make prescriptions for. But innovative new products are vital to the long-term growth of the firm and have a dramatic impact on the firm's competitive position. Hence, there are good reasons for research to make a special effort to embrace the peculiarities of radical innovation in studying innovation, and for managers to make an effort to create an amenable climate for their germination.

The vital role of radical innovation is highlighted by Veryzer (1998a, p. 136), who states that: "Really new or discontinuous new products play an important role in building competitive advantage and can contribute significantly to a firm's growth and profitability (Ali, 1994; Calantone and di Benedetto, 1998; Kleinschmidt & Cooper, 1991)." Similarly, Danneels & Kleinschmidt (2001, p. 357) explain:

> The innovativeness of a new product is important for several reasons. Innovative products present great opportunities for firms in terms of growth and expansion into new areas. Significant innovations allow firms to establish competitively dominant positions, and afford new-comer firms an opportunity to gain a foothold in the market. However they are also associated with high risks and management challenges.

And Lynn (1998) makes it clear that in competitive, technology-intensive industries, success is achieved with discontinuous product innovation through the creation of entirely new products and businesses, whereas product line extensions and incremental improvements are necessary for *maintaining* leadership. Similarly, March (1991) points out the need for balancing *exploration* and *exploitation* and Kanter (1989) argues for *newstream* as well as *mainstream* new products.

By exploring the emerging body of literature on incremental product development, on radical new products, and on the role of innovativeness as a moderating variable, it is possible to draw tentative conclusions about innovation management in each of these two new product project types.

Yet, even a conscientious appraisal of the differences between incremental and radical new products is not a sufficient basis for understanding the moderating role of a product's innovativeness for innovation management, since a new product's innovativeness is not fully captured by this simple dichotomy. Rather, it will be argued in the following, innovativeness is a four dimensional construct. An innovativeness typology must, therefore, have a greater

number of discrete types. The four dimensions of newness follow directly from the two meta-perspectives on product innovativeness.

A Dual Perspective on Product Innovativeness: *New to Whom?* and *New in What Way?*

"A classification of projects as simply radical or incremental may be oversimplifying the construct," explain Green et al. (1995).[4] Indeed, on closer inspection, it is revealed that: 1) a product's degree of innovativeness *is in the eyes of the beholder*, and 2) a product can be *innovative in different ways.*

Based on these two fundamental aspects of innovativeness, it is proposed here that a study of innovativeness must look into the following issues: 1) Is the product new to the industry and market or only to the individual firm? 2) Is the product new in the sense that it is a technological breakthrough and/or in terms of delivering a new value proposition to the market (and is the product, indeed, opening up a new market that did not previously exist)? This conception of product innovativeness is closely related to the definition proposed by Garcia & Calantone (2002, p. 113):

> We thus maintain that product innovativeness is a measure of the potential discontinuity a product (process or service) can generate in the marketing and/or technological process. From a macro perspective, 'innovativeness' is the capacity of a new innovation to create a paradigm shift in the science and technology and/or market structure in an industry. From a micro perspective, 'innovativeness' is the capacity of a new innovation to influence the firm's existing marketing resources, technological resources, skills, knowledge, capabilities, or strategy.

Though these two aspects of innovativeness seem intuitively appealing, one or both of them are often left out in studies that refer to, or measure, product innovativeness, as noted by Garcia & Calantone (2002, p. 112): "…little continuity exists in the new product literature regarding from *whose* perspective this degree of newness is viewed and *what* is new."

It is, therefore, relevant to explicitly address these two aspects in a typology of product innovativeness, and in making tentative propositions about innovation management for different types of new product projects.

New to Whom? Exogenous and/or Endogenous Newness

The question of a product's newness is answered in different ways by different constituents. For example, a product that is only a mildly differentiated addition to available choices within an existing category is likely to be greeted without enthusiasm by the market. But for the new entrant to the industry, with little experience in prevailing technology applications, developing the product may require experimental, competence-building processes resembling those of discontinuous new products. In other words, newness is relative to the unit of analysis, as underscored by Johannessen et al. (2001, p. 23):

> the issue of ''how new'' is closely linked to the question, ''new to whom?'' That is, in order to operationalize the distinction between incremental and radical innovations, we must also determine the relevant unit of analysis.

[4] In Danneels & Kleinschmidt (2001).

The distinction is explicitly built into a survey by Atuahene-Gima (1995, pp. 278-279) of the impact of market orientation on new product performance. They use product newness as a moderating variable, which they define by its two aspects: product newness to *customers* (the compatibility of the new product to experiences and consumption patterns of potential customers) and product newness to the *firm* (degree of similarity of the product to those already marketed by the firm).

The distinction made by Garcia & Calantone (2002, pp. 118-119) is between the 'macro' and 'micro' perspectives, where the *macro* perspective is the evaluation of innovativeness based on factors exogenous to the firm, such as familiarity of the innovation to the world and industry or creation of new competitors from the introduction of new innovations. The *micro* perspective concerns discontinuities in a firm's marketing or R&D strategy, or in its sales approach.

While, this is not far from the above distinction, the curious nature of the micro perspective is that Garcia & Calantone (2002) include the firm's customers and distribution channels in the micro perspective. But since these are external to the firm and a part of the marketplace that passes judgment on a new product's innovativeness, the distinction made in this paper will, instead, explicitly be between the *exogenous* (industry and market) newness and the *endogenous* (focal firm) newness of products. Indeed, this seems to be in line with Garcia & Calantone's (2002, p. 124) original intention: "The most important distinction to keep in mind is that on a macro level, discontinuities are exogenous to the firm."

Exogenous (Industry and Market) Newness

Exogenous newness is closely related to the *macro* level perspective that transcends the individual firm with a view to broad scope changes, according to Garcia & Calantone (2002, p. 113): "'innovativeness' is the capacity of a new innovation to create a paradigm shift in the science and technology and/or market structure in the industry."

Other research on innovation, that takes an exogenous perspective to the study of product innovativeness, looks at newness to the world (Song & Montoya-Weiss 1998),[5] the adopting unit (Ettlie & Rubenstein 1987),[6] the industry (O'Connor 1998),[7] the market (Kleinschmidt & Cooper 1991; Meyers & Tucker 1989),[8] and the consumer (Atuahene-Gima 1995).

Innovations that are *new to the world* such as the Watt steam engine (1769), the telegraph (1840), and the World Wide Web (1980) exert an impact across business sectors (Garcia & Calantone 2002) and are discontinuous or radical by any yardstick. Here, though, it is considered sufficient for a product to be *new to the industry* and/or *new to the market* to warrant the title 'discontinuous'. This is because, it is not of focal concern to the study of innovation management whether the technology is radically new only for the industry and market or, indeed, the innovation exerts an impact across industries and markets. As examples of radical innovations, the Sony Walkman created a new market for mobile entertainment and

[5] In Garcia & Calantone (2002).
[6] In Garcia & Calantone (2002).
[7] In Garcia & Calantone (2002).
[8] In Garcia & Calantone (2002).

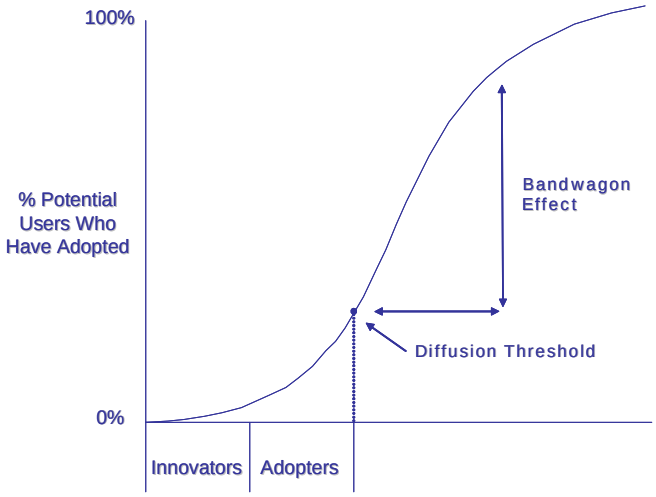
a new industry for miniaturized electronics, the compact disc standard scratched vinyl out of the music distribution market, and antilock brakes became the standard for new cars.

Deciding where to set the bar for considering an innovation highly new and discontinuous is, at the end of the day, a subjective concern. Later in this working paper, indicators will be listed to assess a new product project's degree of newness. As a primer, though, it is useful to consider McDermott & O'Connor's (2002, p. 425-426) definition of radical innovation as the ability of a new product to "offer an entirely new set of performance features, offer a five to 10-fold improvement in known performance features, or offer a significant (30-50%) reduction in costs."

Following the advent of an innovation that is radical from the exogenous perspective of the industry or the market, the pattern of adoption and diffusion of the innovation is typically captured by the classical S-curve, as shown in Figure 3. As a corollary, an innovation can be considered discontinuous in nature if it leads to adoption and diffusion in the form captured by the S-curve.

The S-shaped curve illustrates how the relative amount of users increases over time, with initial slow growth caused by a limited number of innovators and early adopters. The almost vertical extension that occurs after the diffusion threshold is reached and the bandwagon effect sets in implies disruptive change in the industry (Herbig 1991, p. 127). After that the curve gradually levels off. In other words, the steep part of the curve is the epidemic and revolutionary change pattern that characterizes a shift in paradigm.

Figure 3. The Adoption and Diffusion S-Curve



Source: Herbig (1991, p. 128)

It is noteworthy that even if the aggregate S-curve is relatively smooth in appearance, the decision by each individual firm to adopt (or reject) an innovation or technology platform is not smooth, but is more like a spike. Often the decision is caused by a small event, which functions like "the straw that breaks the camel's back and has a major effect upon behavior" (Herbig 1991, p. 129), for which reason the 'cusp catastrophe' model is considered an appropriate tool for describing an individual firm's adoption or rejection of an innovation (Herbig 1991, p. 127). In other words, what seems smooth at the industry-level of analysis can

be disruptive for the individual firm, which brings to light the significance of the endogenous perspective on innovation.

Endogenous (Focal Firm) Newness

If an innovation is new to the industry and market (exogenous newness), it is *ipso facto* also new to the individual firm (endogenous newness). If, on the other hand, a product is not all that new to the industry and market, it may yet be very new for the focal firm.

Essentially, it is only the first-mover with an innovative new product, who can be said to introduce a discontinuous innovation. Firms that follow in the pioneer's footsteps with an imitation of, and possibly even significant improvements to, the original idea do not earn the title of introducers of a radical new product.

Even so, the innovative process and the use of market learning for such followers (who may well have started developing the product before the *de jure* pioneer launched its first version in the market) takes place in a very different way from product improvements to existing product lines. In fact, the firm is likely to go down a twisted path of technology and market experimentation similar to that of any discontinuous innovation endeavor.

Still, if a pioneer has already launched a radical product onto the market, the potential exists for the follower to reverse-engineer the technology and learn from the market's reactions to the original product introduction. The fact that a technology has been discovered and developed and a market application for it has crystallized, can, in itself, eliminate many years of exploratory forays into technological possibilities and potential market usages, which are typical of the pioneering process of developing radical innovations.

Second-mover learning advantages can, in truth, make a decisive difference. This is evidenced by the failure of Apple Newton as a pioneering product that defined the market for handheld computers and in the subsequent success of the Palm Pilot (as well as other later versions introduced by 3Com and other players in the market). The market's response to Apple's Newton showed subsequent contestants that effective character recognition and a reasonably small device were critical success factors for personal digital assistants. Similarly, Windows was not the first operating system with a graphical user interface, but by imitating Apple's original product (the MacOS), and avoiding Apple's proprietary hardware platform, Microsoft became the standard for computer operating systems and achieved the network effects characteristic of a system lock-in strategy (Hax & Wilde II 1999).

So, an innovation may not be all that new from an exogenous perspective, but still be highly new from the endogenous point of view, requiring the innovating firm to climb a steep learning curve in order to develop technological and marketing skills. Additionally, the firm may need to adapt its strategy, organization and external relationships to carry through the new product project.

Another instance of high endogenous newness, coupled with low (or medium) exogenous newness, is that of a firm introducing a next generation product in its lineage of products. In other words, the firm upgrades its product line with a new platform or introduces a new product to its product line. These can be important events to the individual firm, and may

represent a high degree of newness, but the industry and market may not consider the new product all that unique or innovative.

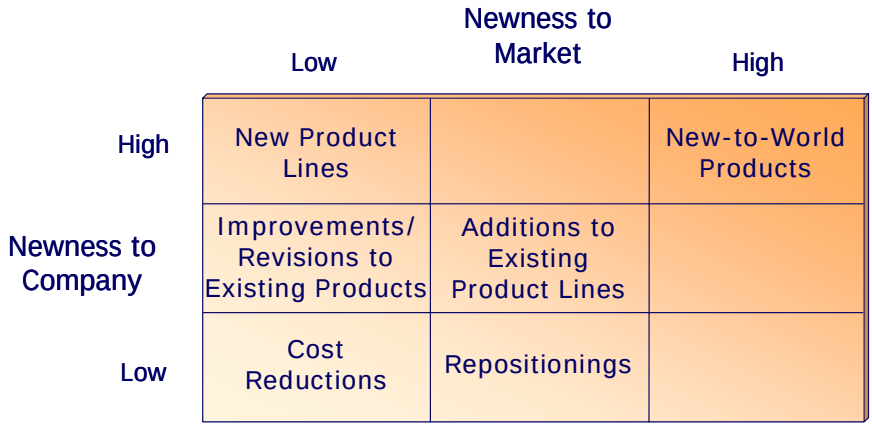
Booz, Allen & Hamilton's (1982) New Product Typology of Newness to the Market and the Firm

The first aspect of innovativeness, "new to whom?", is the core theme of the new product typology by Booz, Allen & Hamilton (1982),[9] which is the one most widely used (Danneels & Kleinschmidt 2001, p. 358).

The two dimensions in the matrix are: *newness to market* and *newness to company*. These are basically similar to the above dimensions of exogenous and endogenous newness (although exogenous newness also refers to newness for the industry in question).

As will appear from Figure 4, the nine-cell matrix proposes six new product types. The most innovative type of new product ranks high on both newness to the market and to the firm. Such products are called 'New-to-World Products'. At the opposite end, 'Cost Reductions' provide similar performance as existing products, but at a lower cost. In between these extremes, 'Repositionings' are existing products that target new markets; 'Additions to Existing Product Lines' are somewhat new to the market and to the firm; 'Improvements/Revisions to Existing Products' are somewhat new to the firm but not to the market; and 'New Product Lines' are new to the firm but not to the market.

Figure 4. Booz, Allen & Hamilton's New Product Typology of Market and Firm Newness



Source: Booz, Allen & Hamilton (1982) [10]

The six product types are elaborated upon by Cooper (2001, pp. 14-15), including examples and the relative distribution of products within each category (from a PDMA best practices study by Griffin 1997).[11] The explanations are recited here in table form (Table 4.1).

Some researchers (e.g. More 1982;[12] Johne 1994) have reduced the matrix to four cells, leaving out 'Cost Reductions' and 'Repositionings', which arguably are not really new

[9] In Johne (1994).
[10] In Johne (1994).
[11] In Cooper (2001).
[12] In Danneels & Kleinschmidt (2001).

product types, as explained by Johne (1994, p. 49), who shows that cost reductions and repositionings are intrinsic to all product development. The upper right-hand corner of the resulting matrix is, then, occupied by "New-to-World Products." Some researchers have also relabeled the different types (Danneels & Kleinschmidt 2001, p. 358).

Table 4.1. Characteristics and Examples of Each of the Six New Product Types

New Product Type	*Description*	*Number of Projects in Study*	*Examples*
New-to-the-world products	First of their kind, creating an entirely new market.	10%	Sony Walkman, first home CD player, and 3M's Post-It Notes.
New product lines	Allow a company to enter an established market for the first time.	20%	Canon's office version of the laser printer came later than HP's LaserJet, but was still a new product line for Canon with all the investment this entailed.
Additions to existing product lines	New items that nevertheless fit within an existing product line produced by the firm. It may also be a fairly new product to the market.	26%	HP's LaserJet 7P was a smaller and considerably less expensive version of its laser printers, suitable for home computers. Its small size and low cost was also somewhat novel to the market.
Improvements and revisions to existing products	Essentially replacements of existing products in a firm's product line. 'New and improved' value over 'old' products.	26%	Kennametal makes mostly small changes or improvements to its existing tools, such as drill bits.
Repositionings	New applications for existing products and retargeting of old products to new market segments for different applications.	7%	Faced with increasing competition, aspirin was repositioned as a preventer of blood clots, strokes and heart attacks.
Cost reductions	The least 'new' products. Designed to replace existing products in the line, but only yield similar benefits at lower cost.	11%	From a design and production viewpoint, they may actually represent significant change to the firm.

Adapted from Cooper (2001, pp. 14-15).

New in What Way? Technological and/or Market Newness

"Despite the varying perspectives for 'innovativeness' a single consistency does exist: it is always modeled as the degree of discontinuity in marketing and/or technological factors" explain Garcia & Calantone (2002, p. 112).

In support of this distinction, Veryzer (1998a, p. 307) conceives of innovation (mostly from the exogenous perspective) as consisting of: *technological capability*, which is the degree to which the product moves beyond existing technology boundaries to perform functions in ways that cannot be achieved by merely extending existing technology; and *product*

capability, which is the degree to which new benefits are perceived and experienced by the customer or user.

At the endogenous (firm) level, Danneels (1998)[13] found in field research that resources used in product innovation can be classified as either *technological resources,* which enable the firm to make the product, or *customer/market resources,* which enable the firm to serve certain customers. Newness of a product to a firm is, therefore, related to the extent to which the product can draw on customer and/or technological competences existing within the firm (see also Danneels & Kleinschmidt 2001, p. 361).

These two dimensions of newness recur in Green et al. (1995),[14] who measure the radicalness of product innovation in terms of: 1) technological uncertainty, 2) technical inexperience, 3) business inexperience, and 4) technology cost. In other words, in *technological terms* (1, 2, and 4) and in *business terms* (3).

Technological Newness

A technologically new product sets the stage for subsequent incremental product development, both at the exogenous level and for the individual firm.

Exogenous Technological Newness. A technology that is new to the industry *(the exogenous perspective)* serves as the architecture for subsequent entrants to the game, who build on, and modify, the original idea. The role of the technology architecture as a foundation for subsequent product development is brought out clearly by Rothwell and Gardiner (1988),[15] whose innovativeness typology contains two broad categories: 1) 'Innovations' are the rare and radically new inventions that result in landmark new products; 2) 'Reinnovations', on the other hand, are built from existing 'innovations' using existing technology to improve upon existing product design (incremental), new technology to improve existing products (generational), existing technology to create new products (new mark products), improved materials to improve existing products (improvements), or new technology to improve subsystems of existing products (minor details).

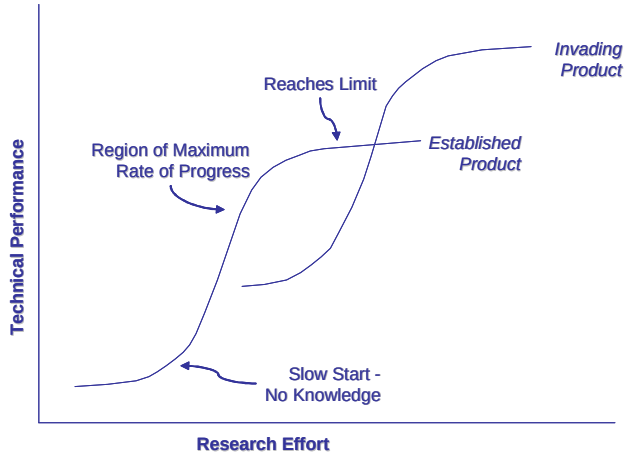
This course of events is captured by Foster's S-curve, which suggests that technological product performance moves along an S-curve until technical limitations cause research effort, time, and/or resource inefficiencies to result in diminishing returns (or a superior technology emerges). This, in turn, often marks the beginning of new innovations, that replace the old technology, and initiate a new S-curve (see Garcia & Calantone 2002, p. 122). The technology evolution of products is described by Foster (1986, p. 217)[16] as follows:

> early in an R&D program, knowledge bases need to be built, lines of inquiry must be drawn and tested and technical problems surfaced. Researchers need to investigate and discard unworkable approaches. Thus, until this knowledge has been acquired, the pace of progress toward technological limits is usually slow. But then it picks up, typically reaching a maximum when something like half the technical potential has been realized. At this point, the technology begins to be constrained by its limits, and the rate of performance improvement begins to slow.

[13] In Danneels & Kleinschmidt (2001).
[14] In Danneels & Kleinschmidt (2001).
[15] In Garcia & Calantone (2002).
[16] In Garcia & Calantone (2002).

In other words, a new technology that has led to the initiation of a technology S-Curve can, in retrospect, be conceived of as a discontinuous one. Thus, the S-Curve presented in Figure 5, serves as a yardstick for determining the technological newness of a (past) product innovation.

Figure 5. The S-Curve of Research Effort and Technology Performance



Source: Foster (1986).

A new technology S-curve may be initiated by a new product category, such as the first PCs, or by a new generation of products, such as the 3G handsets emerging in the mobile telecommunications arena.

Endogenous Technological Newness. For the individual firm *(the endogenous perspective)*, entering an existing industry or product category requires the firm to bridge the technological learning gap, but once its first product has made it through the development pipeline, it may serve as a platform for later product improvement.

Wheelwright and Clark (1992, p. 5) show that *new technological platforms* offer a better system solution and fundamental improvements in cost, quality, and performance over preceding generations. These are followed by *derivatives* that introduce changes along only one or two dimensions. Similarly, for Honda, developing the Civic model in 1990 served as an effective platform for subsequent years of refinements and reintroductions (Wheelwright & Clark 1992).

This also indicates that at the firm-level, it is possible to trace out similar S-curves to those found at the industry level, since each new generation of products may provide a foundation for the firm's continuous development effort, which, at some stage, is overtaken by a new platform.

Market Newness

Similarly, market newness can be understood from both the exogenous and the endogenous perspectives.

Exogenous Market Newness. By *opening up a new market* for mobile entertainment, and by starting an adoption and diffusion S-curve, the Sony Walkman became a breakthrough

innovation in market terms (Veryzer 1998a), not only for Sony itself, but also from an *exogenous point of view.* In other words, the newness of a product can be understood in terms of its ability to *open up a new market* by introducing a product category that did not previously exist. If a new product category starts an S-curve of adoption and diffusion, it can be said *ex post* that it was a highly innovative new product (from the *exogenous point of view).*

But a product can also be said to have high market newness if it introduces a leap in the value delivered to customers over existing products in the market. The market is the final arbiter of the newness of a product and judges whether it is innovative way that it is perceived as value creating. The market's perception of newness is not necessarily correlated with technological prowess, as witnessed by the success of the walkman which was, in fact, built from familiar technologies. As another case in point, Callaway Golf Clubs launched the 'Big Bertha' golf club in 1991, based on the simple idea of making the head bigger than those of existing golf clubs, in order to make it easier to hit the ball (Kim & Mauborgne 1999, p. 43). The idea paid off in phenomenal market share growth as well as the expansion of the golf club market as such (apparently a sizable group of people had just been waiting for a bigger golf club to enter the game).

A product that opens up a new market or creates a leap in customer value may yet be unsuccessful in the market. Indeed, the adoption and diffusion literature clarifies that the relative advantage of the product (e.g. product uniqueness or cost leadership, Porter 1980) is not a sufficient prerequisite for its adoption. First of all, four other innovation attributes exist: *compatibility*, *complexity*, *trialability* and *observability* (Rogers 1995). Further, the innovation may *require change in established behavior* by the customer. Finally, the customer may perceive certain *adoption risks* in the product: *uncertainty risk* (created by a lack of standards to evaluate the innovation), *performance risk* (whether the innovation will perform as expected), *social risk* (associated with the loss of social status by making an adoption mistake), and *physical risk* (risk of physical harm to the user), as enumerated by Gatignon & Robertson (1991).[17]

Endogenous Market Newness. For a later entrant like Aiwa, the mobile music entertainment market was new. In other words, Aiwa's first walkman was a case of endogenous market newness, but not exogenous market newness. A market may be very new to the firm, if is *unfamiliar* to the firm in terms of new customers, new customer needs, or a new product category. Also, the market may be very new to the firm if the new arena implies limited *synergy and fit* to the firm's existing skills and resources, including the ability to market and sell the new product by the existing sales force; the adequacy of current advertising and promotion people, skills and resources; the ability to gather requisite market information; and the ability of the firm's customer service people, skills and resources to handle the service needs of the product (Danneels & Kleinschmidt 2001, p. 366).

Veryzer's (1998a) New Product Typology of Technological Newness and Customer-Perceived Newness

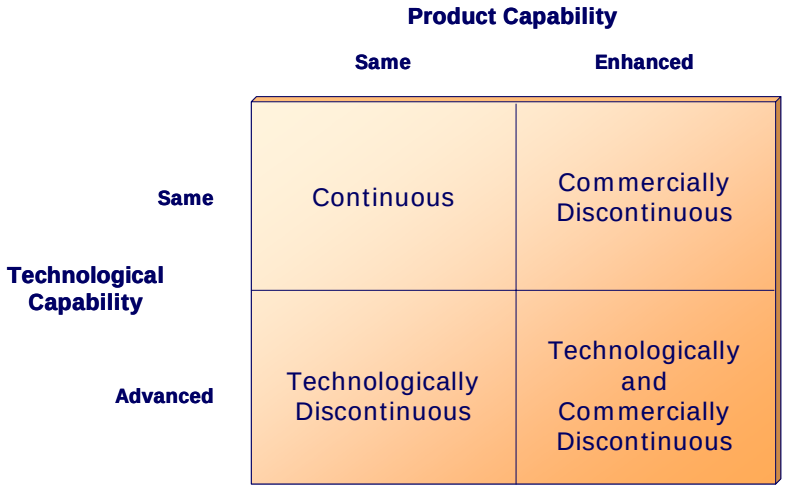
In the two-by-two matrix by Veryzer (1998a, p. 307), *technological capability* refers to the degree to which the product moves beyond existing technology boundaries to perform

[17] In Danneels & Kleinschmidt (2001).

functions in ways that cannot be achieved by merely extending existing technology. *Product capability*, on the other hand, refers to the benefit(s) perceived and experienced by the customer or user.

As shown in Figure 6, this leads to four types of innovation: *continuous* products utilize existing technology and provide the same benefits as existing products, they may be new, but they are not very innovative; *commercially discontinuous* products are perceived by customers as being really new, even if they do not utilize new technology, as witnessed in the example of the Sony Walkman, which offered new benefits, but was built with available technology; *technologically and commercially discontinuous* products deliver new benefits involving the application of a significantly new technology, such as PCs and pagers when they were first introduced; and finally *technologically discontinuous* innovations are the products that are perceived by customers as being essentially the same as previous products even though they employ highly advanced technology, as witnessed by the shift from vacuum tube television to solid state circuitry, which was a dramatic technological change, but did not really enhance product capability in terms of consumer benefits and use.

Figure 6. Veryzer's Innovativeness Typology



Source: Veryzer (1998a, p. 307).

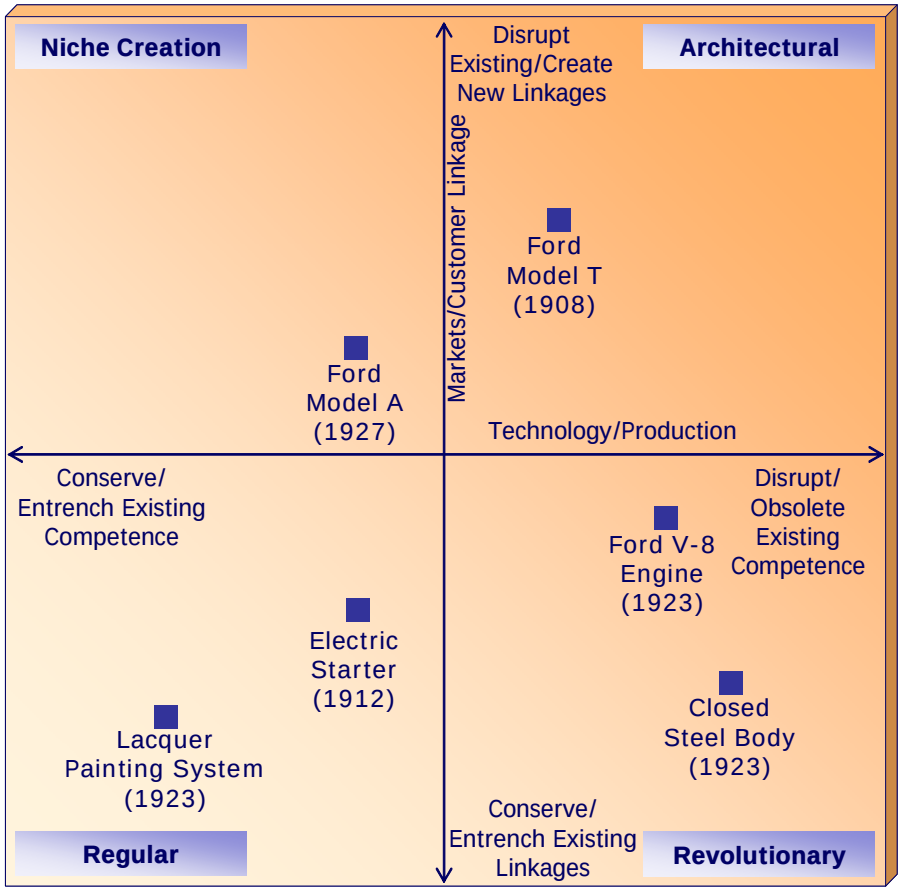
Abernathy & Clark's (1985) New Product Typology of Technology Competence and Market Environment

Another typology is that of Abernathy & Clark (1985), who focus on the competitive significance of innovations by mapping technology competence against market environments. The four resulting categories of innovations are 'architectural', 'niche creation', 'regular' and 'revolutionary' (see Figure 7).

Architectural innovations depart from existing technological competences and systems of production and open up new linkages to markets and users. Such innovation may lead to the creation of new industries and the reformation of old ones. It is the kind of innovation that defines the basic configuration of products and processes, and sets the technical and marketing agendas to guide subsequent development: "In effect, it lays down the architecture of the industry, the broad framework within which competition will occur and develop" (Abernathy & Clark 1985, p. 8).

Examples include the creation of the xerography and radio industries as well as the reformulation of the printing industry through photo typesetting and document digitization. Ford's model T had some disruptive elements in its technology, but its genius lay in a creative synthesis of existing technology to develop a utilitarian vehicle that was easy to maintain, thereby making it possible to open up the greater rural market and create new distribution channels and new types of aftermarket support.

Figure 7. Abernathy & Clark's Typology for Mapping the Competitive Implications of Change



Source: Abernathy & Clark (1985, p. 8)

In *niche creations*, stable and well-specified existing technology is refined, improved, or changed to support a new market position. These refinements build on established technical competence and improve product applicability in emerging market segments. The example of the Sony Walkman again comes to mind, because of its use of established technologies to create a new product category in the personal audio market (Abernathy & Clark 1985, p. 10). Similarly, the fashion industry introduces changes in ornamentation, color, configuration, fabrics and finishes to create profitable, and mostly transitory, market niches. Hence, 'niche creation' may imply a trivial change in technology, or it may refer to competition on features, technical refinements, and even minor technological shifts. But in any case it involves established technical competence, and the ability to refine technology and its application to customer needs in emerging market segments.

As a niche creation, Ford introduced the Model A in late 1927 with great success. It was the company's first completely redesigned model in 20 years: "its appeal stemmed from the combination of features, the refinements and improvements in existing design concepts, and major advances in performance and styling. The new engine was light, but powerful. The car was capable of high speed, yet offered a smooth and quiet ride... In its overall configuration, the Model A gave definition to an emerging market segment (the moderately priced family car – good performance, modern styling, comfortable, convenient) through incremental innovation" (Abernathy & Clark 1985, p. 11).

Regular innovations build on established technical and production competences targeted to existing markets and customers. Such innovations may be more or less invisible or individually minor and yet have significant cumulative effects on product performance, reliability, and cost. This has been witnessed in research on rocket engines, synthetic fibers and personal computers (e.g. more gigabytes on the hard disk, higher performance microprocessors, and longer duration batteries). Such 'regular' innovations within existing technology architectures also include improvements in process technology.

From 1908 to 1926, the price of the Model T fell from $1200 to $290, while the productivity of labor and capital increased markedly. These cost reductions were the result of numerous changes in the process, most of which Ford himself thought to be too insignificant to recount.

Finally, *revolutionary innovations* disrupt and render obsolete established technical and production competence but target existing markets and customers. For example, the reciprocating engine in aircraft, mechanical calculators, and vacuum tubes (again) are examples of established technologies that were overthrown by a revolutionary design. During the 1920s and early 1930s, General Motors, Chrysler, and other car manufacturers focused on revolutionary innovations in suspensions, body forming and transmission. Meanwhile Ford was engaged in the pursuit of regular innovations to achieve higher volume and performance as well as lower cost within the existing Model T design. In fact, the innovation that contributed more than any other to changing the competitive and technical emphasis was the closed steel body, a departure from the previous open, wooden bodies with no solid top or sides. This was first marketed by Hudson in the 1921 Essex model.

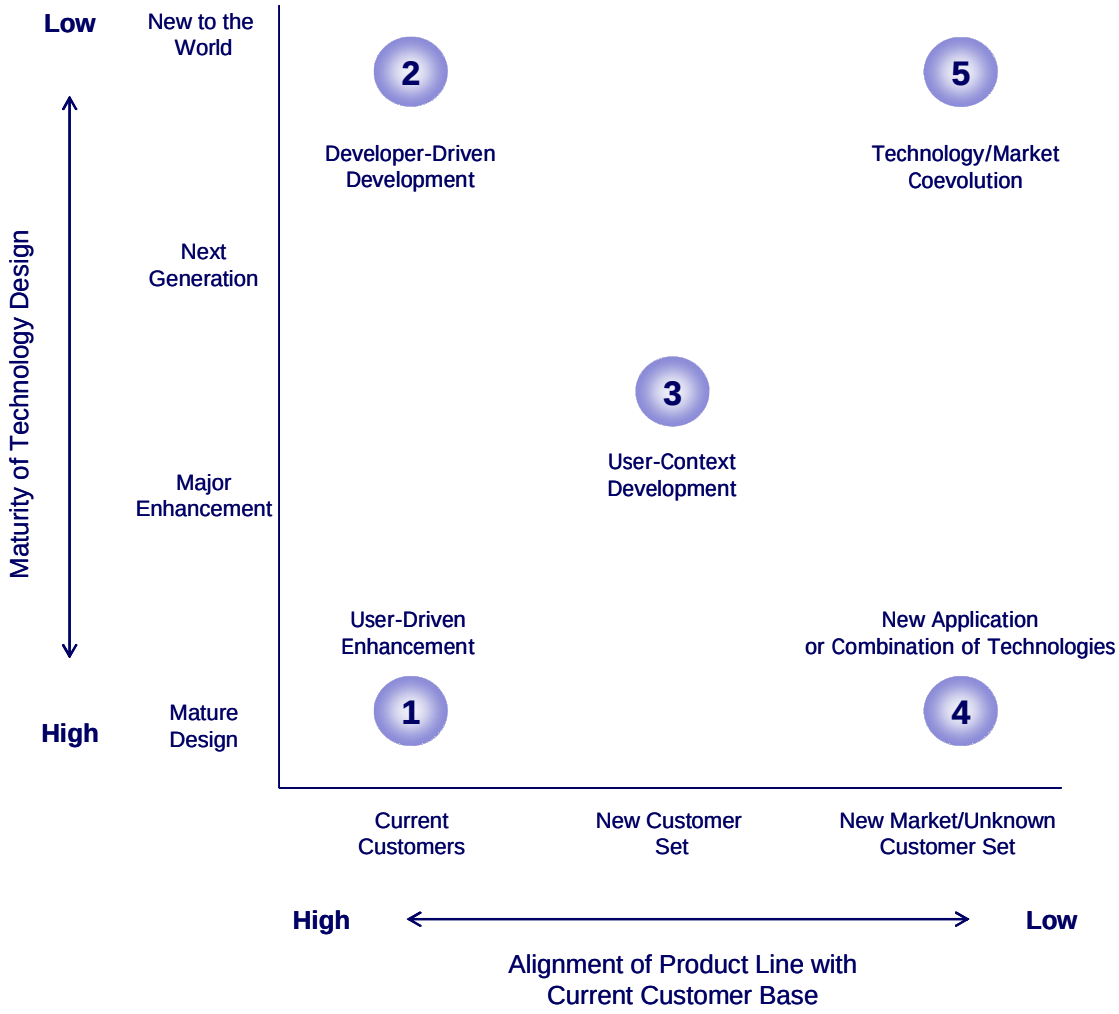
Leonard-Barton's (1995) New-Product Definition Situations for Market Input

Leonard-Barton (1995) distinguishes between five situations, in which distinct kinds of user input are required, organized in a matrix with two axes:

Vertical Axis: Technological Design Maturity within a Firm. When science is first being harnessed and the product concept is completely novel, the concern is with developing something that is new to the world. Subsequently, the focus shifts to producing the next generation product, the next leap in performance, and finally making incremental changes.

Horizontal Axis: Market Alignment. The left-hand side of the axis is the making of products for the firm's current customers. Next comes a new customer set and to right are the new markets.

Figure 8. Leonard-Barton's New Product Definition Situations



Source: Leonard-Barton (1995, p. 184)

The five types can be described as follows (Leonard-Barton 1995, pp. 184-188):

1. *User-Driven Enhancement (An Improved Solution to a Known Need).* This is the kind of incremental changes, where explicit customer demand drives technological improvements along known performance parameters for current products.
2. *Developer-Driven Development (A New Solution to a Known Need).* Developers proactively introduce leaps in performance that no competitors have attempted and no users have directly requested.
3. *User-Context Development (A New Solution to an Unexpressed Need).* A latent need and a new technology, that is not breakthrough in nature, come together as in the case of the 3M Post-it Notes, which users generally had not thought to ask for.
4. *New Application or Combination of Technologies (A Novel Solution to an Identified Need).* Technology potential rather than market demand drives product development. Developers take a mature application of technology form one domain and apply it in a different one.
5. *Technology/Market Coevolution (An Evolving Solution to an Uncertain Need.* Technologists may imagine or stumble upon a whole new market for a new technology.

Four Dimensions of Product Innovativeness

The question "new to whom?" opens up the need to look at both exogenous and endogenous newness. And the question "new in what way?" directs attention to the technological and market aspects of newness. From this discussion, then, four newness dimensions arise: 1) Exogenous technological newness; 2) exogenous market newness; 3) endogenous technological newness; 4) and endogenous market newness. Through a review of literature, it is possible to establish four key indicators for each dimension. These are summed up in Figure 9 and explained in more detail below.

Figure 9. Indicators of the Four Newness Dimension

Own Development

Dimension 1: Exogenous Technological Newness

As can be seen above, a product rates high on exogenous technological newness if it introduces a technological paradigm shift in the world, industry or marketplace. This typically means that the new technology becomes the architecture for subsequent product introductions by a growing number of players, including the pioneer and later entrants to the game. The adoption and diffusion of the discontinuous new technology by other players follows an S-curve with technological disruption of the industry taking place at the steep stage of the curve.

Technological improvements that follow the introduction of the new product concept also tend to assume an S-curve shape (Foster 1986) with technology enhancements gathering momentum and then gradually veering off once a new (disruptive) technology gathers momentum.

Hence, Garcia & Calantone (2002) propose that exogenous technological newness can be judged by the ability of the new technology to trigger technology development in an S-curve scenario. This would appear to be a reasonable *ex post* measure of exogenous technological newness that has achieved success in the industry.

Yet, for the purposes of adapting new product processes and market learning to the needs of new product projects, *ex ante* evaluation of exogenous technological newness is required. Such assessment should focus on exploring the newness of the technological principle, its performance enhancement, its ability to create major cost reductions, and its likely impact on the industry.

Extant Definitions and Measures of Exogenous Technological Newness

Emerging research on radical innovations and innovativeness includes definitions and measures of technological innovativeness useful for the purposes of this study (e.g. Leifer et al. 2000; Song & Montoya-Weiss 1998; Salomo 2003). Key themes of these definitions and measures are: The introduction of a new technological principle, the creation of a leap in performance, the reduction of costs, and the impact of the innovation on the technology paradigm and standards in the industry.

1. New Technological Principle, 2. Performance Leap and 3. Cost Reduction. The definition by Leifer McDermott, O'Connor, Rice & Veryzer (2000) is basically identical to the one by McDermott & O'Connor's (2002, p. 425-426), introduced earlier in this paper. It encompasses the ability of the innovation to introduce a new technological concept, its enhanced performance and/or its reduced costs. Leifer et al. (2000) explain that radical innovations are those "with the potential to produce one or more of the following: an entirely new set of performance features, improvements in known performance features of five times or greater, a significant (30% or greater) reduction in cost."

1. New Technological Principle. In the typology of three new product projects – *breakthrough, platform* and *derivative* projects – proposed by Wheelwright & Clark (1992, p. 5), the highest level of innovativeness is achieved by those products that that introduce a new generation of products: "*Breakthrough projects* […] involve significant changes to existing products and processes. Successful breakthrough projects establish core products and processes that differ fundamentally from previous generations. Like compact disks and fiber-

optics cable, they create a whole new product category that can define a new market… breakthrough products often incorporate revolutionary new technologies or materials… ."

1. New Technological Principle and 4. Required Technological Changes in the Industry. In the definition by Song & Montoya-Weiss (1998, p. 126) of a 'really new' innovation, which is an 'entirely new product category', the notion of a new technological principle reappears, and it is added that it must have a significant impact on the industry: "A really new product is one that: (1) relies on technology never used in the industry before; (2) has an impact on or causes significant changes in the whole industry; and (3) is the first of its kind and totally new to the market."

4. Required Technological Changes in the Industry. The impact on the technological paradigm of the industry also features strongly in Garcia & Calantone's (2002, p. 113) definition of the macro perspective of innovation: "From a macro perspective, 'innovativeness' is the capacity of a new innovation to create a paradigm shift in the science and technology and/or market structure in an industry."

3. Cost Reduction. The ability to reduce costs is connected to raw materials, but also, importantly, to production processes. In a broad sense, this is included in the simple point made by Porter (1996, p. 62): "…cost advantage arises from performing particular activities more efficiently than competitors."

1. New Technological Principle, 2. Performance Leap, and 4. Required Technological Changes in the Industry. In a study by Salomo (2003) – that adopts and expands upon Garcia & Calantone's (2002) innovativeness dimensions (macro-micro and technology-marketing) – it is proposed, and empirically verified, that the macro technology dimension of innovativeness (basically similar to the 'exogenous technological newness' dimension here) is determined, again, by: A new technological principle, a leap in performance, and an impact on industry technology standards. More specifically, the three measures proposed by Salomo (2003, p. 12) are as follows (translated from German):

- A totally new technological principle is used for the task
- The technology enables a quantum leap in performance
- The innovation supplants existing technology (e.g. DVDs vs. video)

The definitions and measures introduced above are enumerated in Table 4.2, subsumed under the four main indicators of exogenous technological newness.

Table 4.2. Indicators of Exogenous Technological Newness

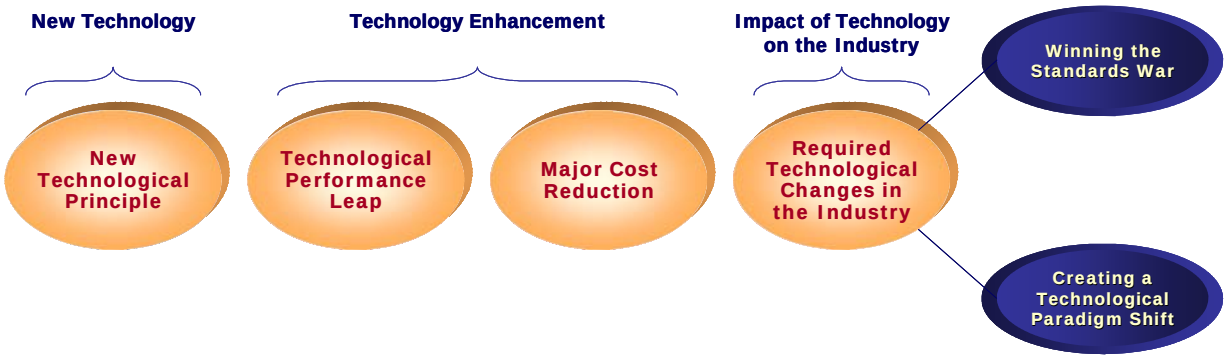
Indicators of Exogenous Technological Newness	*Definitions and Measures Adapted From Literature*	*Authors*
New Technological Principle	Is the first of its kind and totally new to the market	Song & Montoya-Weiss (1998)
	Relies on technology never used in the industry before	Song & Montoya-Weiss (1998)
	A totally new technological principle is used for the task	Salomo (2003)
	An entirely new set of performance features	Leifer et al. (2000); McDermott & O'Connor (2002)
	Core products and processes that differ fundamentally from previous generations	Wheelwright & Clark (1992)
	A whole new product category that can define a new market	Wheelwright & Clark (1992)
	Incorporates revolutionary new technologies or materials	Wheelwright & Clark (1992)
Technological Performance Leap	Five times or greater improvement in known performance features	Leifer et al. (2000); McDermott & O'Connor (2002)
	The technology enables a quantum leap in performance	Salomo (2003)
Major Cost Reduction	A significant (30% or greater) reduction in cost	Leifer et al. (2000); McDermott & O'Connor (2002)
	Cost advantage arises from performing particular activities more efficiently than competitors	Porter (1996)
Required Technological Changes in the industry	Has an impact on or causes significant changes in the whole industry	Song & Montoya-Weiss (1998)
	The innovation supplants existing technology (e.g. DVDs vs. video)	Salomo (2003)
	A paradigm shift in the science and technology of an industry	Garcia & Calantone (2002)

Own Compilation

Indicators of Exogenous Technological Newness

Following from the above review of extant definitions and measures, the exogenous technological newness dimension is a composite of four indicators, as shown in Figure 10 and discussed beneath.

Figure 10. Indicators of Exogenous Technological Newness



Own Development

1. New Technological Principle. If a really new technology is the first of its kind, is new to the industry, and has an entirely new set of performance features this implies strong exogenous technological newness. It may be an idea that surprises the industry when it first appears (e.g. the Apple Newton). Alternatively, it could be a 'holy grail' that the industry knows would make a huge difference if it were developed, but no one has yet found a way to create it, e.g. elevators represent a technological bottleneck in making mile-high buildings possible and is, therefore, a holy grail for the skyscraper building industry (Rice et al. 1998, p. 4).

2. Technological Performance Leap. It is not always necessary to rethink the basic technological idea or architecture to introduce discontinuity. A quantum leap can sometimes also be achieved within the existing technological paradigm.

3. Cost Reduction. Typically, cost reduction is a major issue in 'reinnovations' (Rothwell & Gardiner 1988),[18] which follow in the footsteps of new technological paradigms. But the ability to introduce a major cost reduction may also constitute a radical innovation. For example, minimills created disruptive change the steel production industry.

4. Required Technological Changes in the Industry. New technological principles with compelling advantages may well introduce a product generation change in the industry. It is worthwhile noting, however, that there is no *ex ante* assurance that this will take place. What is more, a product may have a great impact on the industry without being technologically outstanding. For instance, through bundling and standards-based advantages Microsoft Word and Excel replaced WordPerfect and Lotus 1-2-3 respectively (Shapiro & Varian 1999, p. 8). The benefits of introducing a new standard can be sizeable and may accrue to the pioneer that is first on the scene with a superior technological solution. But other factors, than being the first-mover, play decisive roles in standard wars. Indeed, being the first is only one of the seven critical assets that primarily determine the ability to introduce a new standard in the industry: 1) Control of an installed base; 2) intellectual property rights; 3) the ability to innovate; 4) first-mover advantages; 5) manufacturing abilities; 6) a presence in complementary products; and 7) brand name and reputation (Shapiro & Varian 1999).

[18] In Garcia & Calantone (2002).

Dimension 2: Exogenous Market Newness

The market passes the ultimate judgment on a new product's innovativeness. In general, therefore, it is not enough for a new product to be a technological feat, but exogenous market newness is an intrinsic aim in innovation as a means to achieve 'commercial success' (Garcia & Calantone 2002).

The product's ability to deliver value in a way that is appreciated by customers can be understood in terms of the trade-off in product attribute benefits and sacrifices (Value Perspective 1), and/or the ability to succor the customer's latent needs and desired consequences and goals (Value Perspective 2).

If the market perceives the product as very new and differentiated, it can be said to have relative advantage (in the terms used by adoption and diffusion literature), and this gives it the potential to shift the sources of competitive advantage and to create a favorable competitive position for the first-mover (Trott 2001, p. 118; Veryzer 1998b, p. 136; Ali 1994; Calantone and di Benedetto 1998; Kleinschmidt & Cooper 1991; Lynn 1998). The sustainability of such competitive advantage is likely to be greater when the learning curve for imitation is higher.

But even if the value proposition is superior (and difficult to imitate), the venture is only a success if customers actually buy the product. In fact, the very newness of the product may deter customers from adopting it. Distribution channels may not want to market the product because they are tied to existing products and the new product would require re-training, redrafting of contracts with existing suppliers, and would undermine supply chain economies and efficiencies.

What is more, customers as a whole may not feel inclined to adopt the new product because of a range of factors, such as product incompatibility and complexity, required change in use behavior, and perceived adoption risks (i.e. the product does not live up to expectations or it has undesirable side-effects and negative consequences).

Hence, exogenous market newness is a somewhat tricky and composite dimension of innovativeness: While, a leap in a product's value proposition, as perceived by customers, is a *favorable* indicator of market newness for the innovating firm, the resistance of customers to adopt the innovation due to product incompatibility and complexity, required changes in established behavior, or adoption risk, is an *unfavorable* indicator of market newness – in the sense that it deters customers from buying the product. On the other hand, for all its complexity and newness, the product may introduce a value proposition that is so compelling that it gives birth to a new market and is widely adopted – despite the need for customers to change their ways and climb the learning curve to start using the product. Such a situation can be quite advantageous, in fact, as witnessed in home computing, internet services, and mobile telephony.

Thus, indicators of exogenous market newness include both the ability of the new product to open up a new market and/or deliver a superior value proposition (i.e. relative advantage), and the new product's intrinsic adoption and diffusion constraints. Both these kinds of indicators, though, imply a higher need for market learning than that of incremental new product improvement which generally results in little or no added product complexity, required change in customer behavior, or adoption risk. Since these indicators of market newness all point towards a need for deeper, more careful, and more experimental market learning

because of greater uncertainty about customer value and potential new product success, they can safely be subsumed under the same exogenous market newness dimension. In other words, given the purpose of the typology there is no reason to separate these two kinds of indicators into distinct dimensions. Other studies that have clustered some or all of these different elements of innovativeness under the market newness dimension include Danneels & Kleinschmidt (2001) and Salomo (2003).

Extant Definitions and Measures of Exogenous Market Newness

A product with high exogenous market newness is likely to go through a non-linear process, rely on unconventional market learning, and is potentially able to have a great market impact. This is brought out by research on radical innovation (e.g. Veryzer 1998a; Veryzer 1998b; Leifer et al. 2000) and by research that uses innovativeness as a moderating variable for the study of innovation management and market learning (e.g. Cooper 1979; Montoya-Weiss & Calantone 1994; Garcia & Calantone 2002; Salomo 2003; More 1982[19]).

One distinctive feature of market newness is a product's ability to introduce a new or enhanced value proposition into the market (or into a new market). The value delivered by the product can be understood via the customer value branch of literature (e.g. Ulaga & Chacour 2001; Woodruff & Gardial 1996). An additional strand of literature for the study of market newness is that of adoption and diffusion, which not only emphasizes that adoption is a question of the product's relative advantage (similar to a product with a superior value proposition), but also highlights the constraints to adoption and diffusion (e.g. Gatignon & Robertson 1991[20]; Rogers 1995). A review of these two strands of literature have led to considering four kinds of market newness (i.e. four indicators):

1. New Market or Product Category. A clear indicator of market newness is when a product introduces a new category and when it opens up a new market or market segment. This is exemplified by Veryzer (1998b, p. 138): "in the case of the first PCs which were based on a new technology and aimed at a market that was completely unfamiliar with the product class, these discontinuous products actually defined a new industry." This ability to introduce a new product type, is one of the three factors of innovativeness that emerged in the NewProd survey (Cooper 1979, p. 98) of critical success factors in product development: "Product Uniqueness: A product which is truly unique; firm is the first into the market with the type of product."

2. Leap in Value Proposition. A second factor in the New Prod survey concerned the introduction of improvements that make the product unique and superior: "Product Uniqueness/Superiority: A product which has significant improvements over previous products making it unique and superior" (Cooper 1979, p. 98).[21]

This corresponds with one of the dimensions of product innovativeness used in an eight-case study of market learning for radical innovation projects, carried out by Veryzer (1998b, p. 138): "The *product benefit* dimension refers to the new capabilities of the product in terms of the needs it satisfies as perceived and experienced by customer or user."

[19] In Danneels & Kleinschmidt (2001).
[20] In Danneels & Kleinschmidt (2001).
[21] The third factor in the NewProd study was related to endogenous newness: "Newness to the Firm: A project which takes the firm into new markets, new technologies, etc." (see dimensions 3 and 4 below).

A superior value proposition may at first glance seem indistinguishable from 'technological performance leap' (Newness Dimension 1). Yet, the subtle difference is that value here is measured through the customer's eyes. To illustrate, it took years of R&D to produce the technological breakthroughs required for producing television sets with solid state technology instead of vacuum tubes. But even if it was considered a scientific advance, the product did not excite the market (Veryzer 1998a). In this sense, there is a conceptual difference between a leap in technological performance and in customer value. It is, therefore, useful to review the two perspectives on a product's customer value:

From Value Perspective 1, a new or enhanced value proposition denotes the ability of a product to introduce superior customer-perceived value in terms of "the trade-off between the multiple benefits and sacrifices perceived in the attributes of the supplier's offering" (Ulaga & Chacour 2001, p. 530).

From Value Perspective 2, on the other hand, a superior value proposition is evaluated by "the customers' perception of what they want to have happen (i.e. the consequences) in a specific use situation, with the help of a product or service offering, in order to accomplish a desired purpose or goal" (Woodruff & Gardial 1996, 54).

In a meta-analysis of new product performance, product advantage was conceptualized as "the customer's perception of product superiority with respect to quality, cost-benefit ratio, or function relative to competitors" (Montoya-Weiss & Calantone 1994, p. 415). In fact, product advantage emerged as one of the strongest correlates of new product success (Montoya-Weiss & Calantone 1994, pp. 408-410). What is more, product advantage – together with the ability to execute the development process – were found to be more critical as determinants of product performance than market competitiveness (Montoya-Weiss & Calantone 1994, p. 411).

The basic idea of introducing superior value through a differentiated product is a principle anyone can relate to. It is described by Porter (1980) as: "something that is perceived industrywide as being unique in a way that is valued by buyers."

Indeed, the *relative advantage* of a new product is a key feature of the classical adoption and diffusion literature and one of the five innovation attributes proposed by Rogers (1995, p. 15): "Relative advantage is the degree to which an innovation is perceived as better than the idea it supersedes."

While the relative advantage of a product is likely to have a positive impact on adoption and diffusion, the remaining four innovation attributes (Rogers 1995) actually constrain customer propensity to adopt a new product.

3. Major Price Reduction. A part of the value proposition of a new product is its price, which is typically considered the most important 'sacrifice' in the perceived trade-off between benefits and sacrifices.

Hence, it is relevant to reiterate the definition of customer value by Ulaga & Chacour (2001, p. 530) as "the trade-off between the multiple benefits and sacrifices perceived in the attributes of the supplier's offering."

Similarly, in the above-mentioned meta-analysis, product advantage was conceptualized as "the customer's perception of product superiority with respect to quality, cost-benefit ratio, or function relative to competitors" (Montoya-Weiss & Calantone 1994, p. 415).

Finally, the *relative advantage* of a new product must include a view to the product's price – even if it is not explicitly stated in Rogers' (1995, p. 15) definition: "Relative advantage is the degree to which an innovation is perceived as better than the idea it supersedes."

Clearly, this factor is related to the ability to achieve cost reduction as mentioned under technological newness. The ability to translate such cost advantages into a price reduction that is perceived as new and interesting by the market, is what makes it a competitive advantage. This is also inherent in the original idea of a cost leadership strategy (Porter 1980).

4. Adoption and Diffusion Constraints. Even if a new product introduces a unique and superior value proposition, its adoption may be impeded if *distribution channels* are wedded to another product and switching costs prohibit these channels from changing to, or supplementing the product portfolio with, the new product. Such distribution constraints may be caused by current contracts with suppliers, the need to re-train sales staff, the incompatibility of the new product with the firm's image, or the existing optimization of supply chain locations, inventories, and transportation routes. Hence, it is explained by Garcia & Calantone (2002, p. 121) that radical innovations lead to new distribution channels (as well as new competitors, new firms, and new marketing activities). In a study by More (1982, p. 12)[22] of accepted and rejected new product projects, 'distribution difficulty' was modeled as: "Buyer industry diversity," "Number of distributor levels," "Importance of distributor support," "Expected distributor support," and "Extent of distributor power."

But other constraints to adoption exist for both business customers and end-users. In fact, a customer may be enthused by an innovation that introduces a leap in customer value, but for several reasons may not adopt it. The point is that even if a product has relative advantage, four additional innovation attributes constrain the customer from adopting the product. Two of these four adoption constraints, enumerated by Rogers (1995, pp. 15-16), are intrinsic to the product itself:

1. *Compatibility* (of the product) is "the degree to which an innovation is perceived as being consistent with the existing values, past experiences, and needs."
2. *Complexity* (of the product) is " the degree to which an innovation is perceived as difficult to understand and use."

The other two attributes identified by Rogers (1995, p. 16) are related to the ease with which the product can be marketed, in the sense that the innovation is easy to discover and try out without too much hassle:

3. *Observability* is "the degree to which the results of an innovation are visible to others."
4. *Trialability* is "the degree to which an innovation may be experimented with on a limited basis."

[22] In Danneels & Kleinschmidt (2001).

In a similar vein, it has been stressed that the degree of *change in established behavior* required from customers, who would like to buy and use a new product, constrains its adoption by those same customers. Based on this variable, Gatignon & Robertson (1991)[23] propose three types of innovation: 'continuous innovations' that have minimal effect on behavior patterns; 'dynamically continuous innovations' that have a moderate effect on behavior patterns; and 'discontinuous innovations' that create new behavior patterns.

Finally, the decision on whether or not to adopt an innovation, as well as the timing of such adoption, is a question of *adoption risk.* More specifically, Gatignon & Robertson (1991)[24] explain that a new product may embody four kinds of perceived risk, potentially impeding its adoption: *uncertainty risk* (created by a lack of standards to evaluate the innovation); *performance risk* (whether the innovation will perform as expected); *social risk* (associated with the loss of social status by making an adoption mistake); and *physical risk* (risk of physical harm to the user).

1. New Market, 2. Leap in Value Proposition, and 3. Adoption and Diffusion. All three of these elements are present in Salomo's (2003, p. 12) measures of the 'macro-market dimension', which has two distinct sections. The first of these is related to creating a *new market* and delivering a *superior value proposition:*

- The innovation addresses a totally new customer need.
- The innovation offers the customer unique advantages over competitor products.

The second part of the 'macro-market dimension' relates to *adoption and diffusion constraints* (Salomo 2003, p. 13):

- The customer is able to quickly, easily and reliably establish whether the innovation meets his or her demands.
- The innovation demands a high learning effort from the customer.

[23] In Danneels & Kleinschmidt (2001).
[24] In Danneels & Kleinschmidt (2001).

Table 4.3. Indicators of Exogenous Market Newness

Indicators of Exogenous Market Newness	*Definitions and Measures Adapted From Literature*	*Authors*
New Market or Product Category	A market that is completely unfamiliar with the product class.	Veryzer (1998b)
	Discontinuous products that actually define a new industry.	Veryzer (1998b)
	Product Uniqueness: A product which is truly unique; firm is the first into the market with the type of product.	Cooper (1979)
	The innovation addresses a totally new customer need.	Salomo (2003)
A Leap in Value Proposition	Product Uniqueness/Superiority: A product which has significant improvements over previous products making it unique and superior.	Cooper (1979)
	New capabilities of the product in terms of the needs it satisfies as perceived and experienced by customer or user.	Veryzer (1998b)
	The trade-off between the multiple benefits and sacrifices perceived in the attributes of the supplier's offering.	Ulaga & Chacour (2001)
	The customers' perception of what they want to have happen (i.e. the consequences) in a specific use situation, with the help of a product or service offering, in order to accomplish a desired purpose or goal.	Woodruff & Gardial (1996)
	Product Advantage: The customer's perception of product superiority with respect to quality, cost-benefit ratio, or function relative to competitors.	Montoya-Weiss & Calantone (1994)
	Something that is perceived industrywide as being unique in a way that is valued by buyers.	Porter (1980)
	Relative advantage is the degree to which an innovation is perceived as better than the idea it supersedes.	Rogers (1995)
	The innovation offers the customer unique advantages over competitor products.	Salomo (2003)
Major Price Reduction	The trade-off between the multiple benefits and sacrifices perceived in the attributes of the supplier's offering.	Ulaga & Chacour (2001)
	Product Advantage: The customer's perception of product superiority with respect to quality, cost-benefit ratio, or function relative to competitors.	Montoya-Weiss & Calantone (1994)
	Relative advantage is the degree to which an innovation is perceived as better than the idea it supersedes.	Rogers (1995)
Adoption and Diffusion Constraints	New distribution channels for radical new products.	Garcia & Calantone (2002)
	Distribution difficulty: Buyer industry diversity, number of distributor levels, importance of distributor support, expected distributor support, extent of distributor power.	More (1982)*
	Compatibility: consistent with the existing values,	Rogers (1995)

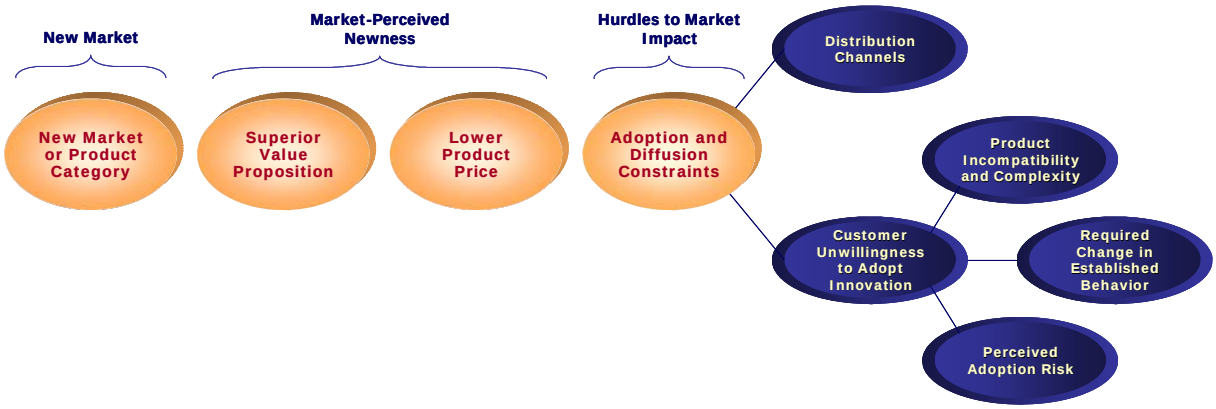
	past experiences, and needs. [this and the measures below are on an inverted scale in the sense that they are the opposite of 'constraints']	
	Complexity: difficult to understand and use.	Rogers (1995)
	Observability: results of an innovation are visible to others.	Rogers (1995)
	Trialability: innovation may be experimented with on a limited basis.	Rogers (1995)
	Required change in established behavior.	Gatignon & Robertson (1991)*
	Adoption risk: uncertainty risk (lack of standards to evaluate the innovation); performance risk (whether innovation will perform as expected); social risk (loss of social status by making an adoption mistake); physical risk (physical harm to the user).	Gatignon & Robertson (1991)*
	The customer is able to quickly, easily and reliably establish whether the innovation meets his or her demands.	Salomo (2003)
	The innovation demands a high learning effort from the customer.	Salomo (2003)

Own Compilation
** in Danneels & Kleinschmidt*

Indicators of Exogenous Market Newness

Based on the above, four core indicators of exogenous market newness have been compiled, as shown in Figure 11.

Figure 11. Indicators of Exogenous Market Newness



Own Development

1. New Market or Product Category. A new product may open up a new industry or market, or it may 'merely' create a new segment that did not previously exist. The first Apple computer created a market for home computers (leading to new use, new customers, and new distribution channels), and the first Sony Walkman opened up a market for mobile

entertainment and miniaturized electronics (Garcia & Calantone 2002, p. 118). Such new products naturally rate high on the market newness dimension.

2. Superior Value Proposition. When customers perceive the trade-off in benefits and sacrifices of a new product's configuration of attributes to be superior to that of other available products, or when its ability to support desired outcomes and goals is greater, this is an indication of high exogenous market newness. For example, DVDs are gradually replacing videos in film distribution. Similarly, the compact disk provided a superior value proposition to vinyl albums and gradually replaced most of them in the market – despite the adoption and diffusion constraints implied by the sunk investments of users in terms of record collections and hi-fi equipment dedicated to the vinyl standard.

3. Major Price Reduction. Price is basically always an issue when comparing products, although its influence varies across products, usage situations, and market segments. Price is, in a sense, a part of the new product's value proposition. But given the significance of price in extant customer value definitions and in strategic management literature (Porter 1980, 1996), it is relevant to separate it out here.

4. Adoption and Diffusion Constraints. If the new product is not easy or attractive to adopt in the eyes of *distribution channels* (e.g. due to switching costs from existing products and suppliers, lack of knowledge about technical or sales issues concerning the new product, or a misfit with the distributor's current image and marketing approach), the product's adoption potential is diminished. As such, the product can be said to have a higher market newness, which in this case translates into an unfavorable situation for the innovating firm (i.e. that distribution channels decide not to adopt it). On the other hand, if the value proposition merits it, the result may be the birth of new distribution channels or the upheaval of old structures. Such a new downstream ecosystem may increase first-mover advantages for the pioneer, if distribution structures, processes and contracts are built around the pioneering product and these are not easily adapted or changed to accommodate imitations.

Customers as a whole may, in fact, have a mixture of reasons not to adopt a new product. These include the *incompatibility* and *complexity* of the new product, which result in hurdles for the customer in buying and using the product. Similarly, the product may require too much *change in established behavior* to be adopted, as e-tailers such as boo.com (sporting equipment) and Webvan (groceries) discovered to their chagrin at the turn of the century. Also various *adoption risks* may deter the customer from acquiring the new product, e.g. uncertainty about new product benefits and performance capabilities or even potential physical harm to the user or a loss of social status (e.g. if others do not think the product is so 'cool').

For example, for 3G cellular phones to be adopted in the European marketplace requires first of all that *distribution channels* embrace them. This does not, however, appear to be a big obstacle, since these are the very telephone operators who invested collectively over €100 billion in licenses a few years ago (The Economist, 18 September 2003).

But some of the concerns of end-users could, conceivably, be that the phones are *incompatible* with current experiences, representing too big a leap for consumers to make, and that they are too *complex* to be readily understood and used. Further, they may require too big a *change in established behavior*, to the extent that users are expected to communicate

visually as well as by voice. What is more, there are a number of *adoption risks*, such as the uncertainty about whether the benefits are worth it and whether the handsets actually work *(performance risk).* Finally, users may be concerned about the potential *physical harm* on the brain caused by a stronger signal, and they may feel that buying 3G could harm, rather than benefit, their *social image* and status, since adopting the standard would be a mistake if it never takes off (and judging from the publicized difficulties this might seem a possible scenario to the consumer), and since the handsets may look somewhat big and clunky.

In fact, technological improvements *are* necessary in order to reduce *performance risk* in terms of difficulties in making handsets work. The *technological performance* of these handsets has to be improved, as explained by The Economist: "…today's 3G handsets are far bulkier and heavier than 2G ones. Operators are banking on smaller, lighter models emerging in 2004."

But, at the end of the day, adoption and diffusion of 3G cellular phones is not so much a question of technological prowess, but of the ability of 3G telephony to open up the mobile multimedia market segment with a *compelling value proposition,* as explained by The Economist (18 September 2003):

> 3G will be introduced by stealth. "It has gotten such a bad name that they are not going to call it 3G," says Mr Modoff… People do not care what kind of technology they are using when they are making a phone call or downloading a ringtone, says Julian Horn-Smith, Vodafone's chief operating officer. 3G, he says, is an enabling technology, not a service, "so we won't market 3G per se.".
>
> …many people do want to use their phones for more than just voice calls and text messaging—though whether the huge outlay in 3G licenses will be justified is still uncertain… Europe's operators… are hoping for a smooth, seamless transition. Indeed, the irony is that if everything goes according to plan, consumers should be unaware that anything has changed. After all the 3G hype, the mark of 3G's success may be that its adoption goes completely unnoticed.

Dimension 3: Endogenous Technological Newness

Whether or not a new product is innovative in the eyes of the industry or the market, it may yet bring the innovating firm into new and unchartered territories. From its initial endeavors to get a foothold on technological solutions within an industry over subsequent generations of product introductions, where new product platforms serve as building blocks for further sustaining technology developments, the individual firm is likely to have its own *internal* technology S-curve, much as that of Foster's macro-level S-Curve (1986), explain Garcia & Calantone (2002, p. 122).

From the endogenous perspective, a new product project's newness is determined by the extent to which it takes the firm into new technological domains (Newness Dimension 3) or new markets or value propositions (Newness Dimension 4). Indeed, the last of the three innovativeness factors, found in the NewProd study by Cooper (1979, p. 98), is that of endogenous newness: "Newness to the Firm: A project which takes the firm into new markets, new technologies, etc."

Extant Definitions and Measures of Endogenous Technological Newness

From the perspective of the innovating firm, initiating development in a new technological *domain* brings the firm into areas with which it is *unfamiliar* (Danneels & Kleinschmidt 2001). Such ventures into unfamiliar territories are likely to also require bridging a *learning gap* and *building competences*. But, whereas two hypothetical new product projects can appear to be equally new in terms of the domains into which they bring the firm, one of these projects may be able to leverage the firm's current resources better than the other. Interestingly, it would appear that project *fit* with the firm's resources is more important for the final success of the new product than its degree of *familiarity* with the technology domain (Danneels & Kleinschmidt 2001, pp. 369-370).

Additionally, the degree to which a new product project represents a *new technological principle* for the firm, or whether it is a *new product platform* that introduces a *leap in product performance* can also be considered indicators of endogenous technological newness.

Finally, a new product project may require, or evoke, *changes in the technical organization.* This is particularly likely for projects that depart from existing product lines and modes of operation. Hence, new product projects that are very new for the firm in question may result in changes to technology strategy, or indeed business strategy, and they may lead to changes in organizational structure, processes and culture (Salomo 2003). What is more, projects that are radical for the individual firm typically involve external development partners (Leifer et al. 2000).

1. New and Unfamiliar Technological Domain. The firm's current domain "identifies the points at which the organization is dependent on inputs from the environment" (Thompson 1967, p. 27).[25] Within its current domain, the firm is likely to be familiar with existing technologies and effective in capturing and interpreting trends and other signals from the environment. In the secondary domain, however, the firm's unfamiliarity with technologies puts it at a disadvantage in pursuing them. This basic issue is exposed by the strand of organizational theory that focuses on the relationship between the organization and its environment (Danneels & Kleinschmidt 2001, p. 360).

New product projects, therefore, can be said to have high endogenous technological newness when they require the firm to venture into new domains. In a study of innovativeness in product development, Normann (1971, p. 206) brings out the implications of embarking on ventures into the secondary domain:

> It is useful… to distinguish between the domain, which is that part of the environment – the technological environment, the market environment, and so on – with which the organization is in more or less constant interaction, and the secondary environment. Because of the constant interaction with the domain, the people in the organization perceive and interpret events in the domain more easily than events outside it. For events outside the domain, there are no appropriate rules for attention and decoding; they do not fit into the cognitive structure of the organization.

When a firm is familiar with a domain it is able to develop products more speedily and with a higher probability of success. In contrast, *technological unfamiliarity* can be considered an indicator of technological newness for the firm, for which three measures are used in the questionnaire by Danneels & Kleinschmidt (2001, p. 366):

[25] In Danneels & Kleinschmidt (2001).

- To what extent did the technology involved in the development of this product represent new or different technology for your firm?
- To what extent did the engineering and design work involved in this new product project represent new or different work for your firm – a type of engineering or design work you had not done before?
- To what extent did the production technology and production process represent a new and different one for your firm – a type of production you had not done before?

2. Technological Learning Gap and Competence Building. A new product project that requires the firm to employ new technical staff, learn new technological skills, and build technology resources and competences has a high level of technological newness for the firm.

Such learning is also required in the unfamiliar domains described above, but there is a subtle, but important, difference between the two aspects. Specifically, it can be said that even if a technology is unfamiliar, it may represent only a modest learning curve for the firm, as long as the technological challenges *fit* the skills of existing staff and there is synergy with the firm's existing knowledge bases.

This is illustrated by Prahalad & Hamel (1990) in their seminal article "The Core Competence of the Corporation." The article explains how Sony's miniaturization skills and Canon's core competences in precision mechanics, fine optics and microelectronics allowed the firms to enter a great diversity of seemingly unrelated markets and industries. The authors define core competencies as the collective learning in the organization, especially how to coordinate diverse production skills and integrate multiple streams of technologies. By integrating different technologies, Sony and Canon are able to venture into unfamiliar domains, nevertheless achieving synergy at the level of technical resources that serve as a common base for a diverse set of a products.

Hence, for the purpose of assessing newness in terms of the technology's fit with current competences, the relevant area of research is the resource-based view of the firm (Danneels & Kleinschmidt 2001, p. 360). This theory of the firm focuses on the firm's resources as the basis for the firm's strategic options and further highlights that "strategy for a bigger firm involves striking a balance between the exploitation of existing resources and the development of new ones" (Wernerfelt 1984, p. 172).

Therefore, Garcia & Calantone (2002, p. 119) state that from the microperspective "a product's innovativeness is contingent upon the firm's capabilities and competencies."

Kusonoki (1997, p. 369)[26] also muses over the organizational learning involved in introducing radical product change, which…

> … requires a new set of organizational capabilities embedded in structures, communication channels, and information processing procedures of organizations, and it is usually quite difficult for established firms to adjust their organizational capabilities for developing innovative products.

[26] In Garcia & Calantone (2002).

For measuring *technological fit*, three items are used in Danneels & Kleinschmidt's (2001, p. 366) questionnaire:

- To what extent were your firm's R&D or product development resources, people, and skills more than adequate to handle the development of this product?
- To what extent were your firm's Engineering resources, people, and skills more than adequate for the engineering and design work involved in this product?
- To what extent were your firm's Production or Operation resources, facilities, and people more than adequate for the production of this product?

Gatignon et al. (2002, p. 1113) propose two dimensions of competences needed for new product projects: the first dimension is the degree to which the innovation builds on existing competences or makes them obsolete, i.e. *enhancing or destroying competences;* the second dimension is the extent to which the innovation requires the firm to reach beyond its existing experience to *acquire new resources.* These two dimensions are translated into the following measures:

- *The need for enhancing or destroying competences*
  - Business unit introduced innovation by making simple adjustments to existing technology
  - Innovation built a great deal on business unit's prior technological skills
  - Innovation built heavily on business unit's existing experience base
  - Innovation rendered business unit's experience base obsolete (reversed)
  - Innovation built heavily on business unit's existing technological knowledge
  - Innovation built on technical know-how that existed widely among firms competing in this product category
  - Innovation rendered obsolete the expertise that was required to master the older technology (reversed)
  - Mastery of the old technology did not help business unit master innovation (reversed)
- *The need for new competence acquisition*
  - Innovation involved fundamentally new concepts or principles for business unit
  - Innovation required new skills which business unit did not possess
  - Innovation required business unit to develop many new skills
  - Innovation required business unit to learn from completely new or different knowledge bases
  - Innovation required business unit to adopt different methods and procedures
  - Innovation required business unit to carry out a great deal of retraining

1. Unfamiliar Domain and 2. Learning Gap. Green et al. (1995)[27] propose the following three measures pertaining to familiarity with the domain and to fit with existing technology resources:

- Familiarity with science and technology base within firm's R&D
- R&D actual experience with science and technology knowledge base within firm's R&D
- R&D existing science and technology knowledge within firm's R&D

3. New Technological Principle or Leap in Product Performance. A breakthrough project for the firm may or may not be viewed as such by the market. But it is, nevertheless, a breakthrough from the endogenous perspective and may become the basis for the firm's subsequent market share growth. For example, for AMD it was a breakthrough to launch a microprocessor of over 100 MHz in 1997, but this was merely comparable to the processor introduced by Intel in 1995. With time, though, AMD has managed to collapse the imitation gap – sometimes with sustaining developments and sometimes with a new product platform.

This gives rise to thinking in terms of three types of projects for the individual firm: *breakthrough* projects, *platform* projects, and *derivative* projects. This framework is proposed by Wheelwright & Clark (1992) who primarily discuss newness in terms of the individual firm, but actually considers breakthrough projects from the exogenous perspective. Nevertheless, Wheelwright & Clark's (1992, p. 5) exposition of these three project types is instructive for a product-based understanding of endogenous technological newness:

> *Derivative projects* range from cost-reduced versions of existing products to add-ons or enhancements for an existing production process. For example, Kodak's wide-angle, single-use 35 mm camera, the Stretch, was derived from the no-frills Fun Saver introduced in 1990. Designing the Stretch was primarily a matter of changing the lens…
>
> *Breakthrough projects.…* establish core products and processes that differ fundamentally from previous generations. Like compact disks and fiber-optics cable, they create a whole new product category that can define a new market. Because breakthrough products often incorporate revolutionary new technologies or materials, they usually require revolutionary manufacturing processes….
>
> *Platform projects* are in the middle of the development spectrum and are thus harder to define. They entail more product and/or process changes than derivatives do, but they don't introduce the untried new technologies or materials that breakthrough products do. Honda's 1990 Accord Line is an example of a new platform in the auto industry: Honda introduced a number of manufacturing process and product changes but no fundamentally new technologies. … platform products typically offer fundamental improvements in cost, quality, and performance over preceding generations. They introduce improvements across a range of performance dimensions – speed, functionality, size, weight. (Derivatives, on the other hand, usually introduce changes along only one or two dimensions.) Platforms also represent a significantly better system solution for the customer.

In other words, a product-based examination of endogenous technological newness gives rise to considering the extent to which the project represents a totally new technological principle for the firm (and, as such, is a breakthrough for the focal firm) or a leap in technology performance (in the form of a new platform for future growth and incremental – or derivative – product development).

[27] In Salomo (2003).

4. Required Change in the Technical Organization. A technology that leads the firm into new territory can have an important impact on the technology strategy and, indeed, the corporate strategy of the firm. Further, if the technology is very new to the firm, or represents a radical departure from past development initiatives, it may not be supported by current processes for product development and manufacturing. This implies a need to adapt these processes to accommodate the requirements of the project. It may be a conscious design effort, or it may happen inadvertently in the wake of a very new, and strategically important project. The same is true of changes to the organizational structure and culture. Typically, a very new product project also involves more active collaboration, and possibly co-funding, with external development partners (Leifer et al. 2000).

Hence, Garcia & Calantone's (2002, p. 113) definition of the microperspective[28] alludes to the impact on the organization:

> From a micro perspective, 'innovativeness' is the capacity of a new innovation to influence the firm's existing marketing resources, technological resources, skills, knowledge, capabilities, or strategy.

While the following measures are intended by Salomo (2003) as a category separate from those of technological and marketing newness, they are nevertheless useful to consider in exploring possible changes to the technical organization required for – or resulting from – the new product project:

- The whole undertaking required a new direction in business strategy
- The whole undertaking required a totally new organizational structure
- The employees involved in the undertaking needed to build new qualifications from scratch
- Undertaking the innovation required fundamental changes to business processes
- We had very little experience in the appropriate production procedures/equipment
- The whole undertaking significantly changed company culture
- The whole undertaking demanded a clearly more intensive cooperation with external partners
- The financial requirements for the undertaking far exceeded the customary limits for new product development

[28] As mentioned, Garcia & Calantone (2002) also include the firm's customer in the micro perspective. In this discussion, however, the customer is relegated to the exogenous perspective, and is considered part of the market as a whole.

Table 4.4. Indicators of Endogenous Technological Newness

Indicators of Endogenous Technological Newness	*Definitions and Measures Adapted From Literature*	*Authors*
New and Unfamiliar Technological Domain	*Technology familiarity:*	Danneels & Kleinschmidt (2001)
	To what extent did the technology involved in the development of this product represent new or different technology for your firm?	Danneels & Kleinschmidt (2001)
	To what extent did the engineering and design work involved in this new product project represent new or different work for your firm – a type of engineering or design work you had not done before?	Danneels & Kleinschmidt (2001)
	To what extent did the production technology and production process represent a new and different one for your firm – a type of production you had not done before?	Danneels & Kleinschmidt (2001)
	The current domain identifies the points at which the organization is dependent on inputs from the environment.	Thompson (1967)*
	In the technological environment with which people are in constant interaction, events are perceived and interpreted more easily than events outside the domain where there are no appropriate rules for attention and decoding; they do not fit into the cognitive structure of the organization.	Normann (1971)
	Familiarity with science and technology base within firm's R&D.	Green et al. (1995)**
Technological Learning Gap and Competence Building	The collective learning in the organization, especially how to coordinate diverse production skills and integrate multiple streams of technologies	Prahalad & Hamel (1990)
	From the microperspective a product's innovativeness is contingent upon the firm's capabilities and competencies.	Garcia & Calantone (2002)
	Technological Fit:	Danneels & Kleinschmidt (2001)
	To what extent were your firm's R&D or product development resources, people, and skills more than adequate to handle the development or this product?	Danneels & Kleinschmidt (2001)
	To what extent were your firm's Engineering resources, people, and skills more than adequate for the engineering and design work involved in this product?	Danneels & Kleinschmidt (2001)
	To what extent were your firm's Production or Operation resources, facilities, and people more than adequate for the production of this product?	Danneels & Kleinschmidt (2001)
	Need for competence-enhancing or destroying:	Gatignon et al. (2002)
	Business unit introduced innovation by making simple adjustments to existing technology.	Gatignon et al. (2002)

	Innovation built a great deal on business unit's prior technological skills.	Gatignon et al. (2002)
	Innovation built heavily on business unit's existing experience base.	Gatignon et al. (2002)
	Innovation rendered business unit's experience base obsolete (reversed).	Gatignon et al. (2002)
	Innovation built heavily on business unit's existing technological knowledge.	Gatignon et al. (2002)
	Innovation built on technical know-how that existed widely among firms competing in this product category.	Gatignon et al. (2002)
	Innovation rendered obsolete the expertise that was required to master the older technology (reversed).	Gatignon et al. (2002)
	Mastery of the old technology did not help business unit master innovation (reversed).	Gatignon et al. (2002)
	The need for new competence acquisition:	Gatignon et al. (2002)
	Innovation involved fundamentally new concepts or principles for business unit.	Gatignon et al. (2002)
	Innovation required new skills which business unit did not possess.	Gatignon et al. (2002)
	Innovation required business unit to develop many new skills.	Gatignon et al. (2002)
	Innovation required business unit to learn from completely new or different knowledge bases.	Gatignon et al. (2002)
	Innovation required business unit to adopt different methods and procedures.	Gatignon et al. (2002)
	Innovation required business unit to carry out a great deal of retraining.	Gatignon et al. (2002)
	R&D actual experience with science and technology knowledge base within firm's R&D.	Green et al. (1995)**
	R&D existing science and technology knowledge within firm's R&D.	Green et al. (1995)**
New Technological Principle or Leap in Product Performance	Breakthrough projects establish core products and processes that differ fundamentally from previous generations and incorporate revolutionary new technologies or materials (and require revolutionary manufacturing processes).	Wheelwright & Clark (1992)
	Platform projects entail more product and/or process changes than derivatives do, but don't introduce the untried new technologies or materials that breakthrough products do. Platform products typically offer fundamental improvements in cost, quality, and performance over preceding generations. They introduce improvements across a range of performance dimensions – speed, functionality, size, weight. (Derivatives, on the other hand, usually introduce changes along only one or two dimensions.).	Wheelwright & Clark (1992)
Required Change in Technical Organization	From a micro perspective, 'innovativeness' is the capacity of a new innovation to influence the firm's existing marketing resources, technological resources, skills, knowledge, capabilities, or	Garcia & Calantone (2002)

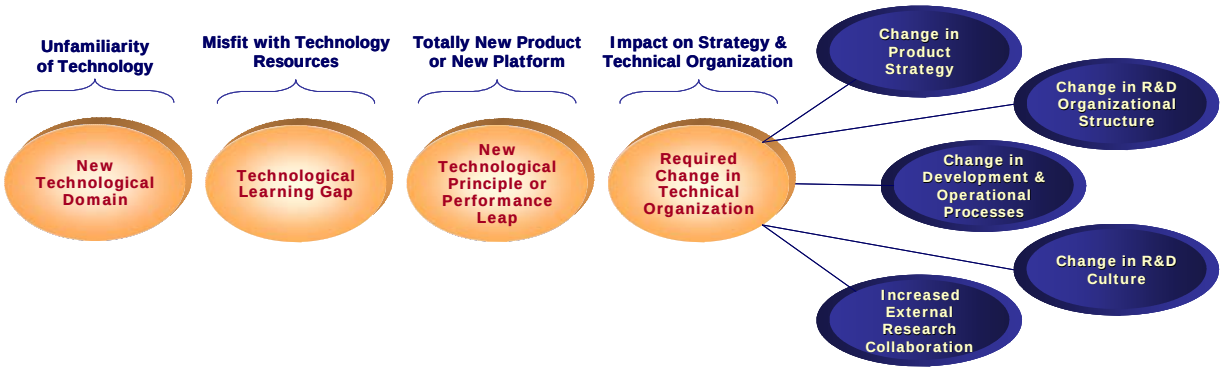
	strategy.	
	The whole undertaking required a new direction in business strategy.	Salomo (2003)
	The whole undertaking required a totally new organizational structure.	Salomo (2003)
	The employees involved in the undertaking needed to build new qualifications from scratch.	Salomo (2003)
	Undertaking the innovation required fundamental changes to business processes.	Salomo (2003)
	We had very little experience in the appropriate production procedures/equipment.	Salomo (2003)
	The whole undertaking significantly changed company culture.	Salomo (2003)
	The whole undertaking demanded a clearly more intensive cooperation with external partners.	Salomo (2003)
	The financial requirements for the undertaking far exceeded the customary limits for new product development.	Salomo (2003)

Own Compilation.
** in Danneels & Kleinschmidt (2001); ** in Salomo (2003).*

Indicators of Endogenous Technological Newness

Extant definitions and measures related to endogenous technological newness, lead to the proposition of the indicators in Figure 12.

Figure 12. Indicators of Endogenous Technological Newness



Own Development

1. New and Unfamiliar Technological Domain. A new product project may lead the firm into a new domain in which it is unfamiliar with the technology and, therefore, with the requisite engineering, design and production work. In other words, venturing into a new technology domain with which the firm is unfamiliar implies high endogenous technological newness. As an extreme example, Nokia's move from the rubber industry into telecommunications took the firm into a new technological domain.

2. Technological Learning Gap and Competence Building. For Nokia, entering a new domain translated into a great need for learning to become on a par with the rest of that industry. By

venturing into the telecommunications domain, Nokia clearly faced a learning gap that the firm had to bridge and an obvious need to build new competences within the organization. This shows that there is a correlation between the unfamiliarity of the domain for the new product and the potential learning gap or the need to build new competences. On the other hand, Sony's and Canon's expansions into new arenas, including still cameras, video cameras, mobile music entertainment as well as laser printers and copiers has not been as dramatic as that of Nokia's shift from rubber to telecommunications. This is because Sony and Canon were able to build on their technological skills in a more evolutionary way and enhance their competences in ways that did not upset the firms or introduce revolutionary change (Prahalad & Hamel 1990).

Therefore, it may be said that a resource based view (Wernerfelt 1984) more accurately and actionably highlights the managerial implications of technological newness than an effort to establish how new a new technological 'domain' actually is. Indeed, it was witnessed in a survey of 262 new product development projects in 125 industrial firms (of which 123 projects were considered successes, 79 failures, and 60 were killed) by Danneels & Kleinschmidt (2001, pp. 369-370) that it is more risky to depart from current resources than it is to venture into unfamiliar industries and markets:

> One of the most striking findings was that financial performance of a product does not so much depend on whether the product stays close to home in terms of the markets it is targeted at or the technologies it uses (i.e., familiarity), but whether it fits with the firm's existing marketing and technological competences. It is thus not whether the firm aims at new customers that determines performance, but rather whether it can use its marketing skills and resources to address those customers. Similarly, it is not whether the product requires a new technology that determines financial performance, but rather whether the firm can use its technological skills and resources to acquire that new technology…
>
> The managerial relevance of this finding is great. Since familiarity has no association with performance and fit does, it is important to distinguish the two forms of innovativeness. It suggests that managers should evaluate new products on their degree of fit with their firm's technological and marketing competences. Managers evaluating new product proposals should not be discouraged by products that go after markets with which they have no experience or require technology new to the firm, but should ask whether development of the new product can draw on existing marketing and technological competences.

Taking a resource based view of newness as *fit*, or synergy, with current competences, two types of technological learning can be discerned: 1) competence-enhancing or destroying, and 2) new competence acquisition. Interestingly, in a survey of 143 products in which an innovation was introduced, using a sample of 141 R&D directors from various countries, the most successful products were found to be those where current competences were enhanced and new ones acquired, it is reported by Gatignon et al. (2002, p. 1119):

> … building on and acquiring new competencies have distinct impacts on innovation outcomes. While competence-enhancing innovations are significantly associated with perceived commercial success, those most successful innovations are those that both build on extant competencies as well as involve the acquisition of new competencies. It may be that those most successful innovations involve both exploitation of existing capabilities as well as exploring new capabilities from outside the firm (Cohen and Levinthal 1990, Rothaermel 2001).

This was found to be particularly true of innovations that resulted in changes to the product's core subsystems – i.e. new subsystems or new linkages/integration of subsystems (Gatignon et al. 2002, p. 118).

3. New Technological Principle or Leap in Product Performance. Products that involve the highest degree of endogenous technological newness are those that require the innovating firm to create or adopt a totally new technological principle. A high degree of newness, although a slightly lesser one, is implied by creating a new product platform with new subsystems and the integration of subsystems into a new and coherent whole. Hence, it would constitute a totally new technological principle for IBM to make an electrical car (but this would not be the case for GM), as explained by Garcia & Calantone (2002, p. 119). Since Honda had already been in the car industry for years in 1990, the Accord line was not a radical departure from existing operations, but it was, nevertheless, a new platform that became the basis for later derivative (i.e. evolutionary) new product developments. Similarly, "in the computer market, IBM's PS/2 is a personal computer platform; in consumer products, Proctor & Gamble's Liquid Tide is the platform for a whole line of Tide brand products…" (Wheelwright & Clark 1992, p. 5).

As another case in point, Intel's 80486 microprocessor was the fourth in a series and introduced a number of performance improvements targeted at the firm's current markets. Over the life of the 486 platform Intel has introduced derivative products and modifications offering some variation in speed, cost, and performance, leveraging the innovations of the core platform (Wheelwright & Clark 1992, pp. 5-6). Gradually, this S-curve was taken over by its Pentium processor – and so on. Therefore, new product platforms are vital sources of medium- or long-term growth and renewal for the firm.

4. Required Change in Product Strategy and Technical Organization. A product that is very new for the firm may lead it to reassess its core business and long-term growth prospects. What is more, a product that is new or revolutionary for the firm is likely to require changes and process adaptations in research & development as well as in manufacturing, and may leave in its wake a new kind of technical organization in terms of structure, processes and culture. Therefore, an indicator of endogenous technological newness is the need of the new product project for organizational adaptation – or its ability to engender change – in the technical organization (development and production). More specifically, these changes include: a new direction in product or business strategy; new structure, processes or culture of the technical organization; and new or enhanced external linkages to development partners.

Dimension 4: Endogenous Market Newness

As explained by Garcia & Calantone (2002, p. 122), the firm's internal S-curve is also applicable to the marketing dimension, in the sense that new markets need to be understood, knowledge bases must gradually be built, and customer value must be understood. In this way, the firm is able to progress along the S-curve and make a leap in learning, in order to deliver a compelling, or at least competitively comparable, value proposition to customers.

This dimension also appears as the third of the three innovativeness factors found in the NewProd study by Cooper (1979, p. 98): "Newness to the Firm: A project which takes the firm into *new markets,* new technologies, etc." (emphasis added).

Extant Definitions and Measures of Endogenous Market Newness

New product projects that take the firm into new markets put the firm in contact with new types of customers who have different kinds of needs and preferences than those of current customers, and pits the firm against a new set of competitors. Such unfamiliarity with the market implies that the new product project has endogenous market newness. This is also true of the (correlated) indicator of the need to bridge a learning gap in marketing, and to build new market competences. For example, marketers need to learn new promotion and advertising practices, the sales people need to learn new tricks, and the service people have to learn about repair and maintenance issues and terms of ownership and buyer-seller relationships implied by the new product's aftermarket. Another indicator of endogenous market newness is if the firm has created a new or enhanced value proposition compared to its existing product portfolio (in the eyes of the customer). Finally, required changes to, or impact on, the marketing strategy, organization and downstream relationships also indicate high endogenous market newness.

1. New and Unfamiliar Market or Product Category. By venturing into an unfamiliar market, the firm comes into contact with new customers, whose needs and preferences it is not used to fulfilling. This is a challenge to the firm in its quest to deliver superior customer value – both in terms of finding ways to configure product attributes to achieve differentiation and in seeking to understand and meet latent customer needs and customer desired outcomes. The characteristics and response patterns of different market segments, and the most promising product adaptations to the needs of each, can be a puzzle to the newcomer in the market. What is more, the appropriate methods and channels for marketing, sales and distribution may be alien to the firm. Finally, the firm does not know the competitive game in the marketplace and the likely territorial responses of key players.

These characteristics of endogenous market newness have implications for new product development and for the type and manner of market learning required.

Similar to Newness Dimension 3, the characteristics and consequences of venturing into unfamiliar markets are highlighted by organizational theory that looks at the relationship between the firm and its environment. For the purposes of measuring the degree to which the market is unfamiliar to the firm, Danneels & Kleinschmidt (2001, p. 366) use the following questions:

- To what extent was this product aimed at new customers to your firm – customers that you had not sold to before?
- To what extent did this product take you up against new competitors – competitor firms that you had never faced before?
- To what extent did this product cater to new customer needs – customer needs that you had not served before?
- To what extent was the market for this product new or different for your firm – new or different from the markets you normally sell into?
- (To what extent did this product represent a new product category – a type of product that your firm had not made and/or sold before? – *Item was dropped)*

2. Marketing Learning Gap and Competence Building. A market may be unfamiliar to the firm, but may, nevertheless, *fit* the company's resource endowments in the sense that marketing, sales and service do not need to make a leap in learning to understand the new market, but rather, customer-facing skills enable the firm to appreciate customer motives and behavior in a way that is conducive to effectively addressing potential customers in the new market.

The extent of fit, or synergy, with the firm's current resources and competences is measured by Danneels & Kleinschmidt (2001, p. 366) with the following questions:

- To what extent was your existing company's salesforce (or your distributors' sales forces) more than adequate to handle the selling of this product?
- To what extent were your firm's advertising and promotion people, skills, and resources more than adequate for the advertising and promotion of this product?
- To what extent were your firm's marketing research people, skills, and resources more than adequate for the gathering of market information needed for this product?
- To what extent was your firm's customer service group – people, skills, resources – more than adequate to handle the customer service needed for this product?

Hence, there is a good fit if the firm's marketing, sales and service people possess the attitudes, skills and methods needed in the new market; if the firm's existing methods of generating market intelligence are also effective in the new market; if the firm is able to use its image and advertising skills for promoting products in the new market; if the firm is a multiproduct, multimarket firm that is used to entering and adapting to new arenas; and if the firm's existing distribution channels are suited to addressing the new markets and if they can do this without excessive re-training of distributor staff.

3. New or enhanced value proposition. This indicator of endogenous market newness is similar to the one under Newness Dimension 2, in the sense that the value of the firm's products is measured in the customer's eyes, but the indicator is different from the point of view that it is not evaluated relative to other offerings in the marketplace, but rather, in terms of the firm's ability to deliver customer value in a way that is new to the firm. In other words, a value proposition that is new or better as perceived by customers if they were asked to compare it with the firm's existing products.

This may, therefore, imply a product that is unique and superior to the value proposition of other products in the firm's product portfolio; that is able to satisfy customer needs in a new or better way as perceived and experienced by the customer or user (adapted from Veryzer 1998b, p. 138); that represents a different trade-off between product benefits and attributes than previous product types made by the firm (Value Perspective 1); that brings to bear new or better ways of fulfilling latent needs or desired customer outcomes than prior offerings made by the firm (Value Perspective 2); and that creates a new or better quality, cost-benefit ratio or function relative to existing products in the portfolio (adapted from Montoya-Weiss & Calantone 1994, p. 415).

1. A New Market or Product Category and 3. a New or Enhanced Value Proposition. The measures of micro-market newness proposed by Salomo (2003) capture both the ability of the

new product to take the firm into a new market and the extent to which it represents a new or enhanced value proposition:

- The innovation project will enable the firm to win many new customers
- The innovation project is likely to fundamentally improve the firm's market position
- The means of value generation becomes redundant or changes fundamentally through the innovation (e.g. B2B marketplaces vs. classical marketing channels)

4. Impact on the Marketing Organization. Entering a new market can lead the firm to reassess its core business and its answer to the question of how and where it intends to ensure its long-term survival. Therefore, new product projects that have high endogenous market newness can impact the organization as a whole and, in particular, the marketing strategy and organization. As a result of such new market ventures the customer-facing organization may need a new structure, new processes and changes to its culture. What is more, a new market may well require new distribution methods and relationships, which may or may not result in a shift from, or decreased utilization of, existing distribution channels.

The measures of internal resource fit proposed by Salomo (2003) can also be adapted to the needs of analyzing new market-induced changes and, in particular, changes to the customer-facing organization. Such an *adaptation* of these measures (listed above) could read as follows: new direction in marketing strategy; new customer-facing organization structure; new qualifications needed by marketing people involved in development; new culture in the customer-facing organization; and new cooperation with distribution channels.

Table 4.5. Indicators of Endogenous Market Newness

Indicators of Endogenous Market Newness	*Definitions and Measures Adapted From Literature*	*Authors*
New and Unfamiliar Market or Product Category	*Market Familiarity:*	Danneels & Kleinschmidt (2001)
	To what extent was this product aimed at new customers to your firm – customers that you had not sold to before?	Danneels & Kleinschmidt (2001)
	To what extent did this product take you up against new competitors – competitor firms that you had never faced before?	Danneels & Kleinschmidt (2001)
	To what extent did this product cater to new customer needs – customer needs that you had not served before?	Danneels & Kleinschmidt (2001)
	To what extent was the market for this product new or different for your firm – new or different from the markets you normally sell into?	Danneels & Kleinschmidt (2001)
	(To what extent did this product represent a new product category – a type of product that your firm had not made and/or sold before? – *Item was dropped*.)	Danneels & Kleinschmidt (2001)
	The innovation project will enable the firm to win many new customers	Salomo (2003)
Marketing Learning Gap and Competence Building	*Marketing Fit:*	Danneels & Kleinschmidt (2001)
	To what extent was your existing company's salesforce (or your distributors' sales forces) more than adequate to handle the selling of this product?	Danneels & Kleinschmidt (2001)
	To what extent were your firm's advertising and promotion people, skills, and resources more than adequate for the advertising and promotion of this product?	Danneels & Kleinschmidt (2001)
	To what extent were your firm's marketing research people, skills, and resources more than adequate for the gathering of market information needed for this product?	Danneels & Kleinschmidt (2001)
	To what extent was your firm's customer service group – people, skills, resources – more than adequate to handle the customer service needed for this product?	Danneels & Kleinschmidt (2001)
	Satisfy customer needs in a new or better way than other products in the firm's portfolio as perceived and experienced by the customer or user .	Adapted from Veryzer (1998b)
New or Enhanced Value Proposition	A different trade-off between product benefits and attributes than previous product types made by the firm.	Adapted from Ulaga & Chacour (2001)
	New or better ways of fulfilling latent needs or desired customer outcomes than previously done by the firm.	Adapted from Woodruff & Gardial (1996) and inspired by Slater & Narver (1998, 1999)
	new or better quality, cost-benefit ratio or function	Adapted from Montoya-

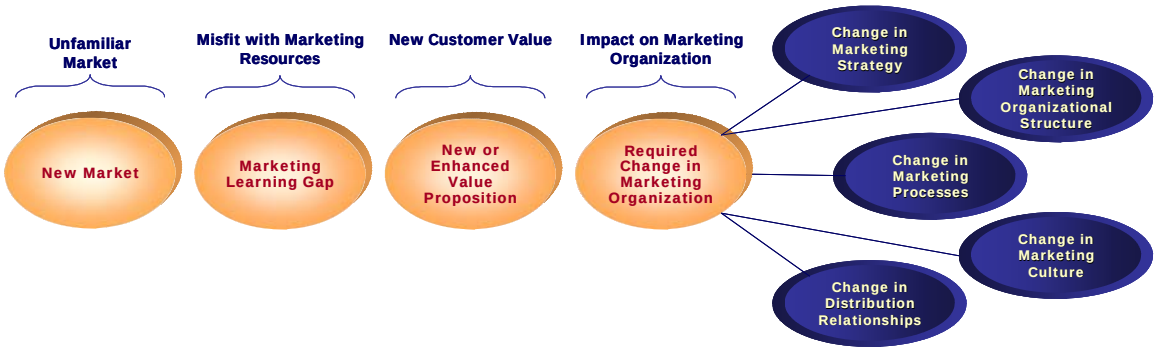
	relative to existing products in the portfolio.	Weiss & Calantone (1994)
	The innovation project is likely to fundamentally improve the firm's market position.	Salomo (2003)
	The means of value generation becomes redundant or changes fundamentally through the innovation (e.g. B2B marketplaces vs. classical marketing channels).	Salomo (2003)
Required Change in Marketing Organization	From a micro perspective, 'innovativeness' is the capacity of a new innovation to influence the firm's existing marketing resources, technological resources, skills, knowledge, capabilities, or strategy.	Garcia & Calantone (2002)
	See above	Salomo (2003)

Own Development

Indicators of Endogenous Market Newness

Based on the above, the indicators presented in Figure 13 have been found to be useful in examining endogenous market newness.

Figure 13. Endogenous Market Newness



Own Development

1. New and Unfamiliar Market or Product Category. When the firm develops a product that takes it into a new market, it comes into contact with new customers and in rivalry with a new set of competitors. The firm may also need new distribution channels or new contract terms with its existing distributors. These factors imply that the new products in question have high endogenous market newness. For example, Dell's current ventures into the computer peripherals market for laser printers, ink-jets, scanners and other such products, takes the firm into an unfamiliar domain. Some customers will be new and Dell will obtain a larger share of its business. The move also takes Dell into a different competitive battleground, where it comes face-to-face with Hewlett-Packard and other large scale peripherals manufacturers. Dell can choose to sell peripherals through existing channels and train sales people to handle these products. Alternatively, Dell can decide that such a new line of product requires the firm to rethink its core tenet of direct sales and to make structural changes in some of its downstream processes and systems.

2. Marketing Learning Gap and Competence Building. A new market may or may not be readily addressed with existing customer-facing resources. If new marketing people and methods are needed, new (firm or distributor) sales staff and techniques required, or new service representatives and procedures necessary, this implies a misfit with current resources and the need to build competences to compete in the market. Upon entering peripherals, Dell may decide that its development staff is well-equipped to make peripherals, or the company may find that the more mechanical product concept and the large scale production-type business may warrant new staff and, certainly, new competences for Dell. Still, it is not as big a market learning gap as it would have been to enter, say, household appliances.

3. New or Enhanced Value Proposition. In its efforts to enter new markets and market segments, or in the effort to grow the market share of existing markets, the firm must make new products that depart from its current products – in the eyes of the customer – by introducing a totally new value proposition or by enhancing the value proposition of existing product concepts. For example, in the desire to increase its presence in computer peripherals, Dell's new printers, scanners and other such products inevitably represent new value propositions in comparison to Dell's existing line of products, as judged by the market. If Dell is also able to make printers and other peripherals that deliver superior customer value compared to Hewlett-Packard and other competitors this would be good news for Dell, and would give these products a higher rating on Newness Dimension 2 (exogenous market newness) as well.

4. Required Change in Marketing Organization. If new product projects are very new for the firm, this is likely to imply changes in strategy, organization and external relationships. For example, Dell's move into peripherals represents a strategic change and a new marketing strategy, it may require a structural initiative to give marketers of peripherals room to expand the business with other promotion and distribution methods from the core computer business, the marketing culture may be different, and downstream relationships will also need adaptation. This potential impact, or requisite change, to the marketing organization means that the strategic initiative implies endogenous market newness for Dell (but again not an excessively high degree of newness).

From Newness Dimensions to an Innovativeness Typology

Each of the four dimensions consists of four key indicators. By assessing these indicators it is possible to determine the nature of newness on the dimension in question, which in combination may help the researcher or practitioner in understanding the nature of the new product project.

The indicators also serve to determine whether a dimension ranks 'high' or 'low' for a particular new product project, which is necessary for classification purposes.

Towards a Four-Dimensional Typology of Product Innovativeness

Innovativeness is an important moderating variable to the study of innovation management (see above). One way this becomes clear is by observing the differences in market learning for incremental and discontinuous new product projects. Upon closer inspection, though, it also becomes clear that a dichotomous view of new product types as either incremental or

discontinuous masks the nuances of different types of projects that result from the multidimensional nature of product innovativeness.

Therefore, an effort is made here to provide the background for a contingency-based discussion of innovation management by establishing different types of new product projects in terms of their innovativeness. A new product project's innovativeness profile is a composite of two perspectives that are integral to the innovativeness construct: firstly, a product's degree of newness is 'in the eyes of the beholder' (the outside industry and market or the innovating firm itself) and secondly, there are different ways in which a product can be new (it can be technologically new or, alternatively, it can address a new market and/or be perceived as new by the market).

These two perspectives on innovativeness *(new to whom* and *new in what way?)* lead to four dimensions of newness, as discussed above:

A. *Exogenous technological newness:* The extent to which the new product employs technology that is new to the industry.
B. *Exogenous market newness:* The extent to which the new product opens up a new market or is perceived as new by the market.
C. *Endogenous technological newness:* The extent to which the product employs technology that is new to the innovating (focal) firm.
D. *Endogenous market newness:* The extent to which the product addresses a market new to the focal firm, or is new compared to the firm's existing products (in the eyes of the customer).

Each of these dimensions impacts the way market learning is done in a new product project. For example, if a new product introduces a whole new technology to an existing market (such as the original CT Scanner that was a substitute for, and an improvement over, some of the applications of standard radiology at the time), it may be assumed that the focus in the front-end of development will be on technology and that it would be useful to probe the market with prototypes as soon as possible, in order to learn about market reactions and to identify the most promising applications of the technology to the market (Lynn et al. 1996). In contrast, applying an existing technology to a new market (e.g. new applications for existing microprocessor or semiconductor technologies), means that market learning is focused on ascertaining customer needs and customizing the technology to the needs of the new domain. With regard to the exogenous-endogenous perspective, it is clear that the pioneer who introduces a breakthrough product that is new to the industry and to the market starts from a clean slate and must take a very experimental approach to market learning. Subsequent to such product introductions follower firms enter the scene. These firms also need to do market learning, but they can benefit from observations about market reactions to existing products (e.g. 3Com's PalmPilot that incorporated learnings from Apple Newton's market failure), and can reverse-engineer existing products and make improvements to the technology based on that.

To sum up, four dimensions of newness have been defined, and the promise of a four-dimensional innovativeness typology for the study of innovation management has been recognized. This has led to the development of a four-dimensional innovativeness typology,

as presented below, but first the typology proposed by Garcia & Calantone (2002) will be reviewed, since this typology builds on quite similar dimensions (the macro-micro perspective as well as the technological-marketing view of innovativeness) to those employed here.

Extant Multidimensional Innovativeness Typology

"…it is important to consider both a marketing and technological perspective as well as a macrolevel and microlevel perspective when identifying innovations," explain Garcia & Calantone (2002, p. 110).

Based on this multidimensional view of innovativeness, the authors propose a classification of product innovations into three types: radical, really new and incremental innovations. These types are summed up as follows by Garcia & Calantone (2002, p. 120):

> Radical innovations are innovations that cause marketing *and* technological discontinuities on *both* a macro *and* microlevel. Incremental innovations occur only at a microlevel and cause either a marketing *or* technological discontinuity but *not* both. Really new innovations cover the combinations in between these two extremes.

More specifically, Garcia & Calantone (2002, pp. 120-123) explain the nature of each of the three types as follows:

- *Radical innovations* embody a new *technology* that results in a new *market* infrastructure and causes discontinuity on a world, industry or market level. Hence, it automatically causes discontinuities on the firm and customer level as well. For example, if a new industry results from a radical innovation (e.g., the World Wide Web), new firms and new customers also emerge for that innovation. Radical innovations create a demand previously unrecognized by the consumer (i.e. latent needs as discussed under Value Perspective 2), which then cultivates new industries with new competitors, firms, distribution channels, and new marketing activities, such as the home computer industry and market (Garcia & Calantone 2002, pp. 120-121).
- *Really new innovations* comprise the majority of innovations, but has received little attention in the literature in the last twenty years, according to Garcia & Calantone (2002, p. 122). For really new innovations, a discontinuity occurs on either a marketing or technological macro basis in combination with a microlevel discontinuity. This may take the shape of new product lines (e.g., Sony Walkman), product line extensions with new technology (e.g., Canon Laserjet), or new markets with existing technology (e.g., early fax machines), explain Garcia & Calantone (2002, p. 122).
- *Incremental innovations* provide new features, benefits, or improvements to the *existing* technology in the *existing* market. It occurs only on a microperspective affecting either the marketing and/or technology S-curve(s). Incremental innovations evolve from the iterative nature of the process of innovation (Garcia & Calantone 2002, p. 123).

One of the benefits of distinguishing these three types is that it introduces an intermediate category to soften the contrasts in the classical dichotomous view of new product projects as either incremental or radical. This is useful for an overall classification of products and may serve broad high-level purposes in the innovation literature. Yet, the distinction lumps together products that have quite different innovativeness profiles in terms of their newness

on the four enumerated dimensions. The merits and shortcomings of the typology will be elaborated upon below.

The Merits of the Typology by Garcia & Calantone (2002)

The typology by Garcia & Calantone (2002) has the benefits of explicitly addressing not only the technology-marketing perspective, but also the macro-micro perspective. By observing that macrolevel newness by definition implies microlevel newness, the authors are able to reduce the number of potential new product types. By further bundling some of the potential combinations together, they end up with a classification that exposes three types of new products.

The typology builds on a literature review that exposed two perspectives of innovativeness, the first of which deals with the question "new to whom?", as explained by Garcia & Calantone (2002, p. 118):

> The measurements utilized in the empirical analyses reviewed can be broken into two frameworks; (a) a macrolevel where the concern is measuring how the characteristics of product innovation is new to the world, the market, or an industry…, and (b) a microlevel where product innovativeness is identified as new to the firm or the customer…

The second perspective deals with the issue "new in what way?", for which Garcia & Calantone (2002, p. 119) made the following observations in their literature review:

> Technological innovations have two 'forces' from which discontinuities may originate –from a marketing direction or from a technological direction. Product innovation may require new marketplaces to evolve, and/or new marketing skills for the firm. Similarly, product innovations may require a paradigm shift in the state of science or technology embedded in a product, new R&D resources, and/or new production processes for a firm. Some products, of course, may require discontinuities in both marketplace and technological factors. Studies reviewed cover all three of these scenarios; marketplace discontinuity…, technological discontinuity…, and both types of discontinuities...

By combining these perspectives, a product's newness can be defined in several ways, leading to a range of possible innovation types. Yet, a more manageable number is derived from the observation that: "It is impossible to have an innovation that is discontinuous on a macro level and not on a microlevel, thus, several combinations are eliminated" (Garcia & Calantone 2002, p. 120). The classification scheme is further simplified by subsuming some of the remaining combinations under three comprehensive categories as detailed above.

A central benefit of this typology is that it interposes the really new product type between the incremental and the radical types. The need for this is clear in considering that radical innovations are quite are rare in occurrence, as explained by Garcia & Calantone (2002, p. 120): "It has been suggested that only 10% of all new innovations fall into the category of radical innovations…" Classifying all the remaining non-radical products as incremental is likely, therefore, to be derogatory of some of these products.

From this point of view, it can be considered appropriate that Maidique and Zirger (1984),[29] categorized 16.7% of all innovations as 'radical breakthrough' products, 58.3% as products

[29] In Garcia & Calantone (2002).

bringing about 'significant technical change' and 25% as products bringing about 'incremental change'. Similarly, Kleinschmidt & Cooper (1991) [30] provided a breakdown of 30% 'highly innovative' products, 47% 'moderately innovative' products and 23% 'low innovativeness' products. Similarly, Griffin (1997) [31] found a distribution of 10%, 42% and 48%. Garcia & Calantone (2002, p. 120) conclude that "in a random sample, radical innovations are rare and should not account for more than 20% of the sample, likewise, incremental innovations should account for no less than 20% of the sample."

It is, therefore, a plus that the typology includes more than two classes of products. But the typology also has shortcomings that make it less than ideal for the purposes of studying contingencies in innovation management.

Shortcomings of the Existing Multidimensional Innovativeness Typology for Innovation Management

Garcia & Calantone's (2002) innovativeness typology is intended as a general framework for the classification of innovations to advance the understanding of new product development processes of different types of innovations (Garcia & Calantone 2002, p. 111).

Yet, upon closer inspection the typology would appear to be sub-optimal for the study of innovation management: Firstly, a variety of potential combinations have been bundled under two of the three headings, those of 'really new' and 'incremental' product innovations, which is problematic from a contingency point of view, since the different product types within each category have distinct requirements in terms of innovation process and market learning. Secondly, the microperspective described by Garcia & Calantone (2002) comprises both the firm and the customer, which creates some confusion in the use of the framework since the customer is, in essence, a part of the marketplace, which, in their terminology, belongs under the macroperspective.

The need for a differentiated typology for the study of innovation management. Garcia & Calantone (2002) make a noteworthy contribution to the study of innovativeness by highlighting the need to look at both the macro-micro perspective and the technology-marketing perspective. They then proceed to lump several of the possible combinations under only three labels, essentially removing the variety they themselves put emphasis on for the study of innovativeness. It may be that for some users of an innovativeness typology three categories suffice – e.g. for the study of innovativeness within and across business sectors – but for the purpose of studying how the individual firm learns about the market for different project types, the value of splitting up the innovativeness construct into multiple dimensions is somewhat lost when only three composite labels are retained. For example, a 'really new' product is new in both technological terms and in marketing terms.

The need to look explicitly at the external (exogenous) and internal (endogenous) aspects of innovativeness for the study of innovation management. Garcia & Calantone (2002, p. 119) elucidate that:

> a product's innovativeness is contingent upon the firm's capabilities and competencies. For an electronics manufacturer such as IBM to begin to manufacture and market electric automobiles

[30] In Garcia & Calantone (2002).
[31] In Garcia & Calantone (2002).

> would be a disruptive and discontinuance endeavor. Yet, for General Motors to design and market the same electric vehicle would not be considered discontinuous.

As such, Garcia & Calantone put the spotlight on the need for management studies to assess newness not only in industry and market terms, but also in firm-specific terms. The point is that for a newcomer to an industry, developing products that are on a par with those of other players in the industry, and incremental in the eyes of the market, may well require development processes and market learning practices that resemble those of discontinuous innovations. Surprisingly, though, Garcia & Calantone (2002, p. 119) also include the customer in the micro perspective: "The microperspective views product innovativeness as new to the firm or new to the firm's customer…" and they further explain that from the microperspective: "the same product may be defined with varying degrees of innovativeness by a firm's customers." The problem with this is that customers are essentially a part of the marketplace, which belongs to the macro perspective. In that sense, there is some intrinsic confusion in the classification scheme.

Thus, Garcia & Calantone's (2002) contribution has been a valuable source of inspiration for this study, but for the purpose of making contingency-based observations about innovation management, their framework is limited: 1) only three innovation categories are included to encompass the multiple dimensions of the innovativeness construct; and 2) 'the customer' is included under the micro perspective, whereas 'the marketplace' belongs under the macro perspective.

In contrast, this paper: 1) seeks to delve into more of the variety entailed by the two perspectives brought out by Garcia & Calantone (2002), by proposing a typology that includes more of the potential combinations of the four newness dimensions; and 2) is more explicit about firm-specific newness, as opposed to newness in the eyes of outsiders to the firm, as inherent in the 'endogenous' perspective discussed in this study (as opposed to including the customer under the micro perspective as done by Garcia & Calantone 2002).

A typology that builds on Garcia & Calantone's (2002) contribution, but departs from it in these two ways, should facilitate a more comprehensive and differentiated study of innovation management for new products with different innovativeness profiles.

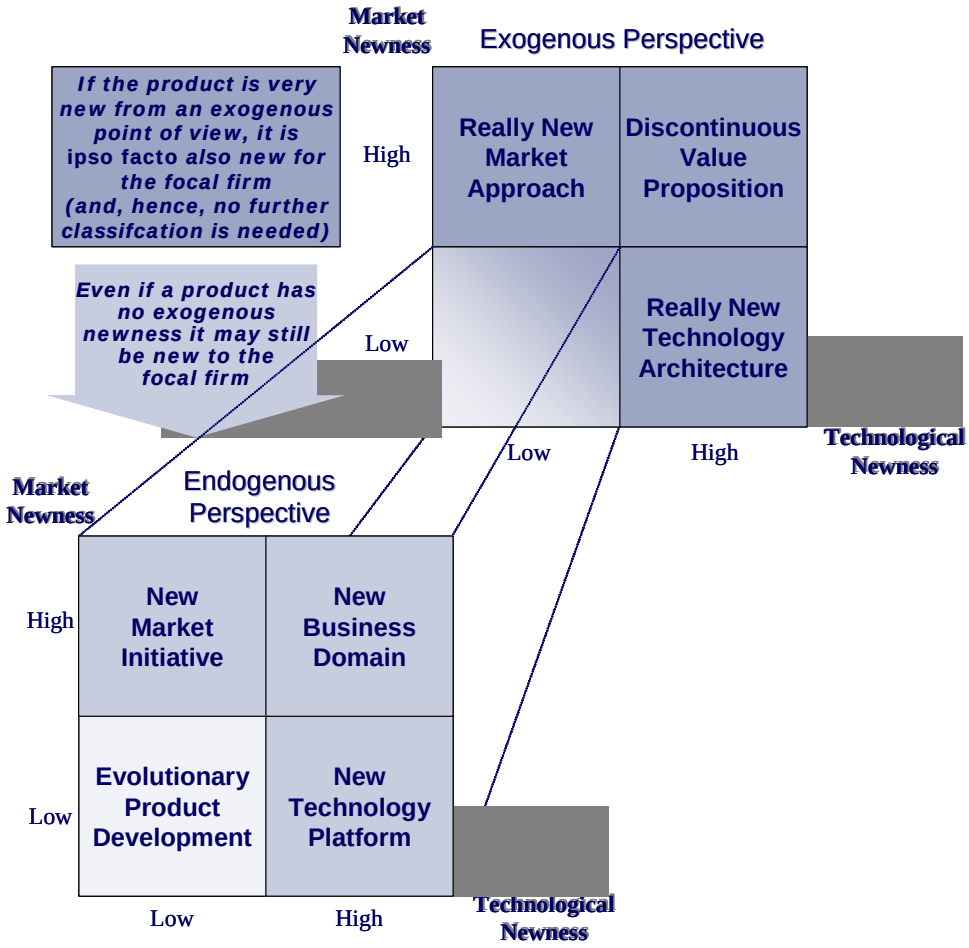
The Four-Dimensional, Composite Innovativeness Typology

A four-dimensional typology with two values for each dimension (high or low) would, from a mathematical point of view, be expected to have 16 categories. Fortunately, though, it has been possible to reduce the number of combinations proposed in the typology below, since any innovation that is really new or radical from an exogenous point of view, is *ipso facto* also highly new for the individual firm (Garcia & Calantone 2002, p. 120).

One approach to categorization of products, therefore, is to start by looking for newness in the eyes of the industry or the market. If the product has a high degree of either technological or market newness (or both) from an outside (exogenous) perspective, there is no need to explore whether or not it is also new for the innovating firm. If, however, the new product concept is not really new to the industry and market, it may yet be a very innovative feat for the individual firm with little experience in the technology or market. Therefore, a product with low newness from the exogenous perspective is further classified to determine the

technological and market newness for the focal firm (endogenous newness), as shown in Figure 14.

Figure 14. Twin Matrices of Exogenous and Endogenous Newness

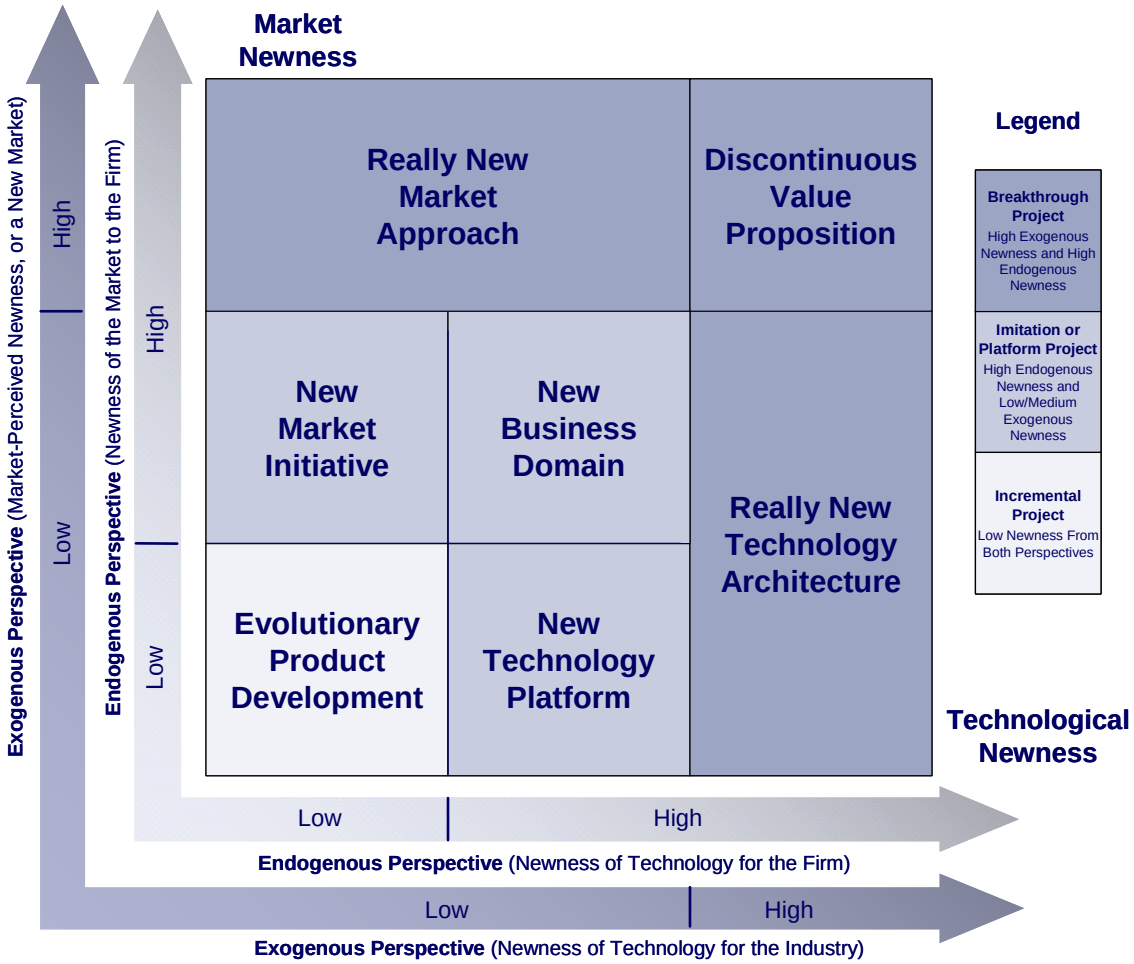


Own Development

By collapsing these two matrices, the result is Figure 15, wherein the technological and market newness dimensions are represented as the horizontal and vertical dimensions respectively. The highest end of each dimension is where there is both exogenous and endogenous newness (darkest shade), whereas the medium stage in the model represents products that are new from the endogenous perspective (a medium shade) – and have a low degree of exogenous newness – and the lower left hand box is characterized by low newness from both an exogenous and endogenous point of view (lightest shade).[32]

[32] In an earlier version of the figure, the middle column and row with high endogenous newness was given the label 'low/medium' exogenous newness, which was changed to 'low' in order to achieve parsimony and communicability. The intention was to indicate that some of the 'reinnovations' that proceed discontinuous or really new product introductions often have at least some newness to the industry and market. For example, when Intel introduces new generation product platforms, such as its introduction of the Pentium chip some years ago, this does not represent a discontinuous or really new product innovation, but does, nevertheless, have a medium degree of newness in the eyes of the industry and market.

Figure 15. The Composite Four-Dimensional Innovativeness Typology



Own Development

The typology provides more detail and diversity to the classification of innovations than that introduced by Garcia & Calantone (2002). It is also conceptually easy to compare the two classifications, notwithstanding the slight conceptual difference between the 'micro' perspective introduced by Garcia & Calantone and the 'endogenous' perspective used here:

- Radical Innovations (Garcia & Calantone 2002)
    - Discontinuous Value Proposition
- Really New Innovations (Garcia & Calantone 2002)
    - Really New Technology Architecture
    - Really New Market Approach
- Incremental Innovations (Garcia & Calantone 2002)
    - New Business Domain
    - New Technology Platform
    - New Market Initiative
    - Evolutionary Product Development

The composite typology introduced here has four dimensions:

1) From the exogenous perspective, technological newness is concerned with the ability of the technology to introduce a new technological principle, a leap in technological performance, a major reduction in costs, and/or exercise a technological impact on the industry (Newness Dimension 1).

2) Exogenous market newness, on the other hand, is the ability of the product to create a new market or product category, to deliver a superior value proposition, and/or to exercise an impact on the market (Newness Dimension 2).

3) From the endogenous technology perspective, the product may represent a new and unfamiliar technological domain for the focal firm and a technological learning gap. It may also be a new technological principle, or a leap in technology performance, as compared to the firm's existing products. Finally, the new product project may require (or result in) changes to the strategy and technical organization (newness dimension3).

4) Endogenous market newness is the extent to which the new product is in a new market domain for the firm and/or represents a marketing learning gap. It may also be a new or enhanced value proposition over previous firm products. Finally, it may require (or result in) changes to marketing strategy and organization (Newness Dimension 4)

Based on these four dimensions, it is possible to describe any of the seven new product project types in the framework.

The Seven Innovativeness Profiles in the Typology

Each new product project type in the typology can be described (with a greater or lesser degree of accuracy) using new product types from literature. What is more, each of the seven innovativeness profiles has distinct characteristics derived from its rating on the four dimensions of newness. This is discussed below and summed up in Figure 16.

Evolutionary Product Development

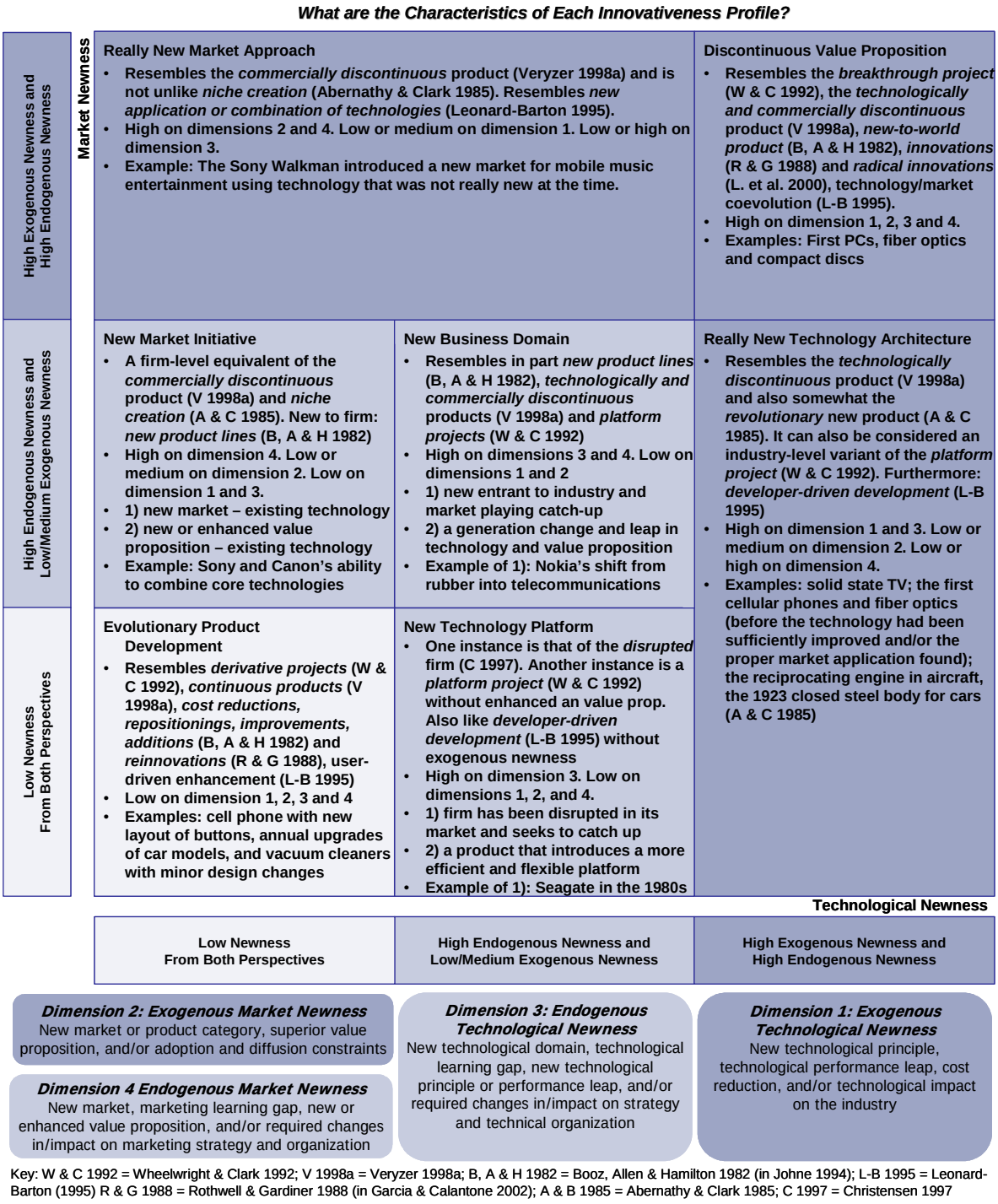
The Evolutionary Product Development profile is incremental in nature and is, as such, a part of most frameworks on innovativeness (as the product type with the lowest level of innovativeness). Different names for this type of new product include: *derivative projects* (Wheelwright & Clark 1992), *continuous* products (Veryzer 1998a), *cost reductions, improvements/revisions to existing products, repositionings, additions to existing product lines* (Booz, Allen & Hamilton 1982)[33] as well as *reinnovations* (Rothwell & Gardiner 1988).[34]

Evolutionary product development introduces little technological or market newness to the industry and the market and it is not an innovative feat for the firm itself. Yet, even if the end result of such small, rapid and continuous product improvement is not all that new in itself, it enables the firm to sustain a technological edge and a perceived element of freshness in the market. For these reasons they are essential to sustaining the firm's competitive advantage and its ability to grow and maintain market share. While Evolutionary Product Development

[33] In Johne (1994).
[34] In Garcia & Calantone (2002).

involves little technology or market exploration into new domains, it exploits current resources well and leverages existing competences that the firm has built within its core domains.

Figure 16. Seven Innovativeness Profiles



Own Development

Extant Literature on Evolutionary Product Development

This new product category is similar in nature to *derivative projects* (Wheelwright & Clark 1992), which introduce incremental product changes along only one or two dimensions, either

speed, functionality, size, weight, or packaging. The example used in the above is that of Kodak's wide-angle, single-use 35 mm camera, the Stretch, which was derived from the no-frills Fun Saver introduced in 1990 by merely changing the lens and making minor adjustments (Wheelwright & Clark 1992, p. 5).

It is also similar to *continuous* products (Veryzer 1998a), which utilize existing technology and provide the same benefits as existing products in a slightly new, but not very innovative, way.

Furthermore, it resembles *user-driven enhancement* (Leonard-Barton 1995), which is the reactive mode of making technological improvements in accordance with known performance parameters for current product paradigms, driven by competition and explicit customer demands.

Evolutionary product development also resembles the product types in the lower left-hand corner of the typology by Booz, Allen & Hamilton (1982),[35] in the sense that these products have relatively low newness in the eyes of both the company and the market: *Cost reductions* provide similar performance to existing products, but at a lower cost; *repositionings* are existing products that target (somewhat) new markets; *improvements/revisions to existing products* are somewhat new to the firm but not to the market; and *additions to existing product lines* are somewhat new to the market and to the firm.

Different variations of Evolutionary Product Development exist. This is clear from Rothwell & Gardiner's (1988)[36] explanation that *reinnovations* either use existing technology to improve upon existing product design (incremental), improved materials to improve existing products (improvements), or new technology to improve subsystems of existing products (minor details). Other reinnovations that do not belong under this heading include: The use of new technology to improve existing products (generational) and the use of existing technology to create new products (new mark products).

Indicators of Evolutionary Product Development

Evolutionary product development entails little technological newness to the industry in terms of performance enhancements and cost reductions and has little impact on industry *modus operandi*. The product is developed within the focal firm's familiar technology domain and leverages its existing resources. Therefore, this type of product has little or no impact on business strategy or on the structure, processes, or culture of the technical organization.

This type of product is not new in market terms either, since it is introduced within an existing category with only slight improvements to the existing value proposition in the eyes of the customer. Therefore, the product is also easy for customers to understand and use, and it requires little or no learning or adaptation either by distribution channels or by consumers. This type of product is developed by the focal firm for familiar markets and employs existing marketing resources. Basic market understanding already exists and market learning zooms in on the potential market interest in, and response to, specific value improvements in the configuration of product attributes. Therefore, the product does not create any real ripple effects on the market strategy or the marketing organization's structure, processes, or culture.

[35] In Johne (1994).
[36] In Garcia & Calantone (2002).

Despite the limited amount of newness and the low potential impact on the market and on the firm's strategy and organization, these products are not without significance. In fact, "for many firms, incremental innovations are the lifeblood of the organization" (Garcia & Calantone 2002, p. 123). These new product introductions exploit the knowledge and technology platform of generational product developments introduced by the firm in the past and they enable the firm to maintain and expand its market presence (in a maturing market). By constantly seeking improvements to existing products, the firm is also alerted to constraints in, and potential benefits of, changes in the technology platform or architecture.

Discontinuous Value Proposition

The Discontinuous Value Proposition is at the other end of the spectrum on all counts. It goes by various names, such as *breakthrough projects* (Wheelwright & Clark 1992), *technologically and commercially discontinuous* products (Veryzer 1998a), *new-to-world products* (Booz, Allen & Hamilton 1982),[37] *innovations* (as opposed to reinnovations – see Rothwell & Gardiner 1988),[38] and *radical innovations* (Leifer et al. 2000).

This innovativeness profile ranks high on exogenous technological and market newness, which implies that it introduces a new technological principle and a new market or product category; it creates a leap in technological performance or a radical reduction in cost and introduces a superior value proposition; the newness of the technology impacts industry paradigms and standards; and the newness of the product's value proposition impacts the market. Adoption and diffusion hinges on changes in distribution channels and customer willingness to learn and adapt.

Further, the product has high endogenous newness, which is evidenced by: the newness of the technology domain and the market for the innovating firm; the technological and marketing learning gap for the firm; the newness for the firm of the product's technological principle and performance features as well as its value proposition; and the impact on the firm's technical and marketing organization.

Extant Literature on the Discontinuous Value Proposition

These are the *breakthrough projects* (Wheelwright & Clark 1992, p. 5) that establish core products and processes which differ fundamentally from previous generations, such as compact discs and fiber-optics cables. They introduce a whole new type of product that may lead to subsequent platform generations and a host of derivative projects.

They are also similar in nature to the *technologically and commercially discontinuous* products (Veryzer 1998a) that deliver new benefits involving the application of a significant new technology, as exemplified by PCs and pagers when they were first introduced. The notion of technological innovativeness combined with a high degree of market newness is, in fact, the epitome of the Discontinuous Value Proposition.

[37] In Johne (1994).
[38] In Garcia & Calantone (2002).

These new products are also the *new-to-world products* (Booz, Allen & Hamilton 1982)[39] that rank high both on newness to the market and newness to the company. This ability to introduce newness from an exogenous and (therefore also) endogenous perspective is a hallmark of the Discontinuous Value Proposition.

The project type is also similar in kind to the *technology/market coevolution* (Leonard-Barton 1995), where technologists run far ahead of customers by developing a new and unheard of application using new technology.

In a more general sense these new products are the *innovations* (Rothwell & Gardiner 1988)[40] that introduce a new technological paradigm and result in subsequent reinnovations. They are also the *radical innovations* (Leifer et al. 2000) with "the potential to produce one or more of the following: an entirely new set of performance features, improvements in known performance features of five times or greater, a significant (30% or greater) reduction in cost" (as long as these technological performance improvements create new markets or are valued highly by customers).

Indicators of the Discontinuous Value Proposition

This innovativeness profile entails the maximum degree of newness on all four dimensions.

From the *exogenous* perspective, these radically new products introduce a new technological principle or, at the least, a leap in technological performance. This may be complemented by a major reduction in cost. Typically, though, a cost reduction in itself is not sufficient grounds for a new product to qualify to be labeled as a Discontinuous Value Proposition. A Discontinuous Value Proposition is likely to introduce a new technological paradigm and set new standards in the industry.

These products are not only technological wonders, though. They also create a new market or product category, or at least introduce a leap in value proposition in the eyes of the customer. As such, the successful Discontinuous Value Proposition greatly impacts the market. But because of its departure from previous product concepts, a range of hurdles exist for its successful adoption and diffusion in the marketplace. One type of constraint is related to the need for new distribution channels or for existing channels to adapt their processes, align their marketing image, and replace or train their personnel. Another type of constraint is related to the possibility that a broad range of customers may be unwilling to adopt the innovation due to the incompatibility and complexity of the product, the changes to established behavior required for the customer to be able to adopt the product, and the perceived risks of adoption (such as performance uncertainty, physical harm, or potential damage to the user's social status).

It goes without saying, therefore, that for the innovating firm (the *endogenous* perspective), the development of a Discontinuous Value Proposition is typically highly exploratory, experimental and even revolutionary in nature. The process typically runs in fits and starts and may well be shelved for some years and then be re-awakened due to changes in technology or to individual initiative and belief in the idea (e.g. by the original champion or someone who picks up the relay).

[39] In Johne (1994).
[40] In Garcia & Calantone (2002).

From the technological point of view, the Discontinuous Value Proposition leads the firm into a new technological domain and/or requires a major learning effort to acquire new competences or greatly enhance existing ones. The product concept is a new principle for the firm or, at least, a leap in technological performance over the firm's existing products. Hence, the Discontinuous Value Proposition is likely to require, or result in, changes to the technical organization. This can imply a change in technology strategy, new organizational structure, processes and culture for R&D, and/or the extension of collaborative relationships with external research partners.

From the market perspective, the Discontinuous Value Proposition leads the firm into unfamiliar markets, demands new marketing learning of the firm, introduces a customer value proposition that is very new compared to previous products made by the firm, and it is likely to impact the firm's marketing strategy, marketing organization (structure, processes, and culture), and is likely to require changes in distribution relationships.

Really New Technology Architecture

This innovativeness profile has high technological newness, but does not create a new market or introduce a new and exciting value proposition to the market. Neither is it, necessarily, a new market domain for the focal firm. The product type is similar to that of the *technologically discontinuous* product (Veryzer 1998a).

The Really New Technology Architecture is a technological achievement (high exogenous and endogenous technological newness), but it is not greeted with the kind of enthusiasm by the market that would earn it a high rating on the exogenous market newness scale (dimension 2). This may, however, change as the technology is further developed to suit the needs of the market, or the technology finds a market that values its potential.

The product may or may not address one of the firm's existing markets, for which reason the endogenous market newness (Newness Dimension 4) can be either high or low.

Extant Literature on the Really New Technology Architecture

These are the *technologically discontinuous* products (Veryzer 1998a) that employ advanced technological capability, without enhancing the product capability. The example mentioned by Veryzer (1998a) is that of solid state technology for television sets, which represented a new technological principle compared to the vacuum tube TVs of the time, but the technology addressed an existing market *and* did not deliver a superior value proposition over existing solutions – in the eyes of the customer.

The Really New Technology Architecture may also be likened to the *revolutionary* new product (Abernathy & Clark 1985) that disrupts or renders obsolete existing technology or production competences while conserving and entrenching existing market and customer linkages. Examples include the 1923 innovations of the Ford V-8 engine and the closed steel body. This comparison implies a slightly higher customer-perceived newness. Indeed, even if the Really New Technology Architecture does not introduce a dramatic leap in customer value, it would not be a reasonable project type without at least some new value to customers.

The Really New Technology Architecture resembles *developer-driven development* (Leonard-Barton 1995), where new technologies are used in familiar markets, by creating new solutions, function, enhanced features, or capabilites a technology may offer. In that sense, developer-driven development introduces new customer value within current markets. If, indeed, it is a leap in customer value (the second indicator of exogenous market newness) it is probably more correct to compare it with the Discontinuous Value Proposition, even if it takes place within current markets (the first indicator of exogenous market newness).

The Really New Technology Architecture product is similar to *platform projects* (Wheelwright & Clark 1992) in the sense that the product introduces a new technological architecture for subsequent product development. Yet, this product type differs from platform projects in the sense that it introduces a technology architecture which is really new to the industry, thereby leading to subsequent adoption and diffusion and technology enhancements by a variety of players. This is not necessarily the idea of platform projects, since these projects are mostly intended to describe platforms that are new to the individual firm, such as the Honda Civic line and the Proctor & Gamble Liquid Tide line of products. Also, the Really New Technology Architecture is strictly technological in its newness (this is in fact also the core nature of platform projects (Wheelwright & Clark 1992) although they are not explicitly defined in this way, rather as product and process change).

Indicators of the Really New Technology Architecture

This innovativeness profile has a high degree of exogenous and endogenous technological newness (dimension 1 and 3). Yet, it entails only low exogenous market newness (dimension 2) and the endogenous market newness may be either low or high (dimension 4).

As such, the Really New Technology Architecture resembles the Discontinuous Value Proposition except for the fact that it addresses an existing market and does not introduce a leap in the value proposition in the eyes of the customer (but it may, nevertheless, introduce some new customer-perceived value). Hence, this product type may well be characterized by a low degree of market uncertainty, even if the technology can require years of research.

Yet, for all the research that has gone into a Really New Technology Architecture, if it does not actually end up creating customer value in reward for the long hours and high cost of research it may initially be considered a failure. In this case, the subsequent aim may well be to leverage the Really New Technology Architecture by focusing attention on introducing real customer value. In other words, non-value-adding case of the Really New Technology Architecture may be only the first effort to find ways to employ technology in ways that will appeal to the market. Such efforts can easily fail at first, but subsequent enhancements of the value proposition, or merely finding another market or market segment to address, may move the next new product into another box: 1) The product may become a ‘Really New Market Approach’ if it achieves a breakthrough in the customer value proposition without additional radical changes to the technology, but merely by adapting the technology to customer needs in a way that leverages the technology architecture that has now become ‘established’; 2) the product may find a different market that greatly values the technology, thereby achieving the requisite newness from the exogenous market perspective, also shifting the product type to a ‘Really New Market Approach’ (if the technology is now considered established); and 3) to the extent that the technology can still be considered new and innovative, the ability to also

introduce a compelling value proposition may warrant the label 'Discontinuous Value Proposition'.

Alternatively, the point in creating a Really New Technology Architecture may be to introduce a more coherent architecture for improving supply chain efficiencies and/or a modularized system that enables flexibility and customization of the product configuration.

An example of a Really New Technology Architecture that addressed a new market, but was not initially attractive in the eyes of potential customers (therefore only qualifying for a low level of exogenous market newness) is that of cellular phones, which were initially beset with problems, such as the bulky and heavy nature of the handsets. Users testing these prototypes did not respond favorably to them. In fact, it is reported (e.g. by Michael Goldman & Associates, L.L.C.) that in the early 1980s AT&T asked McKinsey to estimate how many cellular phones would be in use in the world at the turn of the century. McKinsey noted that the handsets were absurdly heavy, the batteries kept running out, the coverage was spotty, and the cost per minute was exorbitant. The consulting company, therefore, concluded that the total world market for cellular phones in the year 2000 would be 900,000. Already by 1999, however, 900,000 new subscribers were joining mobile phone services every three days.

By tracing out the discoveries made by Motorola in its cellular phone ventures, it becomes clear that initial thoughts about target market segments were quite incorrect, and the great consumer market did not figure in the firm's calculations. This initial ineptness in targeting the right segments was even more true of Corning's fiber optics, which took a long and winding development path to find the right market application; not only did the technology need to be enhanced multifold, it was also necessary to keep experimenting with the market approach to get from the original focus on picture phones to finally getting an order for long-haul phone lines (Lynn et al. 1996). In this sense the concept started out as a Really New Technology Architecture for picture phones, but it only became a successful Discontinuous Value Proposition when the technology was enhanced dramatically and the market for long haul phone lines had been identified in 1978 (and when the market was finally deregulated and MCI placed an order in 1982).

Needless to say, this new product project type has a high level of technology newness for the innovating firm. Even so, the endogenous technological newness (dimension 3) has different shades, e.g. depending on the firm's heritage. For example, an automobile manufacturer that ventures into the emerging fuel-cell technology for cars would have experience in creating wheels, steering, bodies etc. for cars, as well as a range of other relevant resources and tacit knowledge that would put it an advantage compared to other firms outside the automobile industry.

As a note, the focal firm may or may not be creating this new product for one of its existing markets (dimension 4).

Really New Market Approach

The product type is commercially discontinuous (Veryzer 1998a) and is, to some extent, similar to the niche creation product (Abernathy & Clark 1985). The product has a high degree of exogenous and endogenous market newness (dimension 2 and 4). However, different firms will perceive this high degree of newness differently depending on their

heritage and experience within the market. In other words, some variation is inherent in the 'high' level of endogenous market newness. The technology is not new in industry terms (dimension 1), but it may or may not be new for the individual firm (dimension 3). Indeed, the basic feature of the Really New Market Approach is that it has high market newness (dimension 2) without using radically new technology (dimension 1). As such, it is a favorable proposition for the innovating firm, since its commercial value is achieved without the time, costs and uncertainty of technology research intrinsic to the Discontinuous Value Proposition and the Really New Technology Architecture. On the other hand, this may also imply that the imitation gap is shorter and entry barriers to the new market lower.

Extant Literature on the Really New Market Approach

These products are *commercially discontinuous* (Veryzer 1998a) in the sense that they use existing technological capability to introduce enhanced product capability. The example used by Veryzer (1998a) is that of the Sony Walkman, which created a new market with only minor adaptation of existing technology.

The Really New Market Approach may also be likened to *niche creation* (Abernathy & Clark 1985), which conserves and entrenches existing technology and production competences but disrupts, or creates new, market and customer linkages. One example is that of the Ford Model A, which defined an emerging market segment (the moderately priced family car with good performance, modern styling, comfort, and convenience) through incremental technological improvements (Abernathy & Clark 1985, p. 11). It may, on the other hand, be argued that a product such as the Ford Model A only qualified for a medium level exogenous market newness, which would put it in one of the boxes for products that are new mostly from an endogenous perspective.

The Really New Market Approach relies on mature technology for a new customer base and, therefore, is comparable to the *new application or combination of technologies* (Leonard-Barton 1995).

Indicators of the Really New Market Approach

This is the 'alter ego' of the Really New Technology Architecture in the sense that it is new from an exogenous market perspective (dimension 2), but not really from a technology point of view (dimension 1). From the endogenous perspective, it is, inevitably, also new from a market perspective (dimension 4), but not necessarily from a technology perspective (dimension 3).

The Really New Market Approach opens up a new market or market category and/or introduces a superior value proposition to the market. In this way the new product project achieves a high rating on the exogenous market newness dimension. But this also implies that changes in relationships with, or processes for, distribution channels may be needed. What is more, customers may see the product as incompatible and complex, they may feel they have to change their established behavior, or they may perceive adoption to be risky.

The Really New Market Approach is, however, a very favorable new product type, since it can be developed without years of arduous and expensive research and related uncertainties about the final outcome (as implied by the two previous innovativeness profiles).

On the other hand, the fact that technology is not all that new to the industry may speed up the emergence of imitations since the technological learning curve is likely to be low for other firms that have experience in that technology domain and without the introduction of a really new technology it may not be possible to patent the new product idea.

While, the exogenous technological newness (dimension 1) is not high, it is not unlikely that the Really New Market Approach will require at least some technology development, for which reason the category encompasses both a low and a medium level exogenous technological newness.

At the firm level, the Really New Market Approach clearly represents a new or enhanced value proposition compared to existing products in the firm's product portfolio and the new product project may well entail a marketing learning gap and changes to the marketing strategy and organization (dimension 4). Again, though, the implications of such high endogenous market newness may differ from firm to firm. For example, when Sony developed the first Walkman, the overall market for consumer electronics was already well-known to the firm and distribution relationships with hi-fi retailers were established. This meant that only the market and the value proposition for mobile music entertainment were novelties for the firm. For a firm in a very different industry, however, it would have represented a higher degree of market newness to introduce such a product. In other words, the 'high' endogenous market newness rating contains some nuance within it.

At the firm level, the technology may or may not be new (dimension 3).

New Business Domain

None of the typologies in the above fully capture the idea of the New Business Domain, but elements of it are inherent in the following product types: *platform projects* (Wheelwright & Clark 1992), *new product lines* (Booz, Allen & Hamilton 1982),[41] and *technologically and commercially discontinuous products* (Veryzer 1998a).

The New Business Domain exists in different flavors: One instance is when a new product project takes the firm into a new market. A second, more moderate, instance of the New Business Domain is when a firm develops a new product that introduces a leap in technical performance and the customer value proposition over its existing products (but not necessarily over competing products).

The New Business Domain has high endogenous technological and market newness (dimensions 3 and 4), but only low exogenous technological and market newness (dimensions 1 and 2). In other words, this is the follower firm that ventures into unfamiliar technology and market domains, departs from existing technology and marketing resources, or introduces a leap in technical performance and value proposition over previous products. In this sense, the New Business Domain represents diversification or innovation on dual fronts (technological and market newness).

[41] In Johne (1994).

In the cases where the firm is diversifying into new technologies and markets (as exemplified by Nokia's shift from rubber to telecom) a high risk is implied. But it may also turn out to be a very successful strategy, and the risk is alleviated by the existence of second-mover advantages, which accrue to the (fast) follower, who has the possibility to benefit from the hard-learned lessons of the pioneer's technology and market experiments.

Extant Literature on the New Business Domain

One instance of the New Business Domain is a firm that diversifies into new technologies and markets. In this respect, it resembles the *technologically and commercially discontinuous* product (Veryzer 1998a) that has advanced technological capability and enhanced product capability. But even if this comparison captures the dual aspect of technological and market newness that are the intrinsic features of the New Business Domain, it should be said that Veryzer (1998a) primarily refers to *exogenous* newness in his typology. The analogy is useful, though, to the extent that the innovative feat for firms engaged in the dual technology and marketing learning implied by the New Business Domain resembles that of the Discontinuous Value Proposition, where the product is technologically new to the industry as well as new in market terms.

The New Business Domain also resembles *new product lines* (Booz, Allen & Hamilton (1982)[42] to the extent that these have a high degree of newness to the company but not to the outside industry and market.

The other instance of the New Business Domain, where the firm introduces a leap in technical performance and value proposition over its existing products, can best be likened to *platform projects* (Wheelwright & Clark 1992). Still, it has to be a new platform that constitutes a leap in customer value over existing products in the firm's portfolio.

In sum, the three sources of literature used here capture first, the dual aspect of technological and commercial innovativeness, then, the notion of company newness (as opposed to outside market newness), and finally, the idea that firms have major platform projects with high endogenous newness that set the stage for later product introductions.

Indicators of the New Business Domain

The New Business Domain is new for the firm in both technological and market terms (dimensions 3 and 4). It is, however, not really new from the exogenous perspective (dimensions 1 and 2).

One instance of the New Business Domain is a firm playing catch-up in a product technology and market that is new to the firm itself. But even the imitator is likely to look for possibilities to differentiate its product by introducing as much technological and market newness as possible. Therefore, the exogenous technology and market newness (dimensions 1 and 2) can rate medium as well as low. Another instance of the New Business Domain is the firm that introduces a generation change in technological performance and a leap in value proposition over its existing products, but not necessarily over competitor products. Such new products may also qualify for a medium level exogenous newness.

[42] In Johne (1994).

With regard to *the first instance* of the New Business Domain the firm is taken into a new and unfamiliar technology and market domain and/or the firm departs from making products that leverage its existing technology and marketing resources. It is also likely to require, or result in, changes to the firm's strategy and to the structure, processes and culture of the technical and marketing organizations. In addition, it may require creation and extension of external relationships, including technology partners (dimension 3) and distribution channels (dimension 4).

An extreme example of this instance is that of Nokia, which spearheaded into the telecommunications industry and market from its original position in tires, boots and other rubber supplies.

As such, the New Business Domain can be a risky diversification endeavor, since the firm has to learn about new technologies as well as new markets. The fact that the product is new to the individual firm and not to the industry and market connotes a firm playing catch-up with the rest of the industry. The dual technological and market newness is likely to require new product processes and market learning practices that resemble those of the Discontinuous Value Proposition. The difference, however, is that the firm is able to learn from existing players in the field – and it may even be able to introduce improvements over existing products (thereby qualifying for a medium level of exogenous newness).

The fact that technologies and markets already exist help to make the venture much less risky than that of the Discontinuous Value Proposition, where a pioneering firm is engaged in the dual challenges of inventing new technologies and identifying promising market applications for virgin domains. Indeed, the potential to learn about technologies and markets from first-movers can provide the (fast) follower with significant second-mover advantages. Examples from the preceding discussion include: Microsoft's ability to ape MacOS and make Windows the standard in computer operating systems; 3Com's introduction of a handheld computer several years after Apple's failed attempt to launch its handheld Newton device; and GE's ability to take over market leadership in CT Scanners from the pioneer EMI.

This idea of reverse engineering existing products, and then making even better models, became well-known, both inside and outside business circles, during the 1970s when Japanese automobile manufacturers played the game to the hilt.

The *second instance* of the New Business Domain relates to the introduction of a new technological principle or a performance leap over existing products, as well as a new or enhanced value proposition over existing products (dimensions 3 and 4).

Such generational product changes can serve as a foundation for a succession of new product development activities by the firm.

New Technology Platform

The same ideas are inherent in the New Technology Platform as in the New Business Domain, but in this case, the product is not introduced to a new market and the product does not create a very new customer value proposition over the firm's existing products.

One instance of the New Technology Platform is highlighted by the notion of the *disrupted* firm (Christensen 1997). Another instance is that of a *platform project* (Wheelwright & Clark 1992), albeit one that does not, actually, create new or enhanced customer value.

The high technological newness for the firm (dimension 3), coupled with low market newness for the firm (dimension 4), may stem from the fact that the firm has been overtaken in its current markets by disruptive technology. It may also imply that the firm is building a New Technology Platform that improves its internal purchasing or production efficiencies and lends itself to building customer value in future versions or to leverage modularization to adapt the product to targeted customer segments.

Extant Literature on the New Technology Platform

One instance of the New Technology Platform is a firm that has fallen behind in a new technology for its own market, and is seeking to develop a technology platform that is on a par with what has now emerged in the industry. This is a similar idea to that of the *disrupted* firm (Christensen 1997), as exemplified by Seagate and other disk drive manufacturers, who were sidetracked by new generations of disruptive technologies (e.g. the shift from 5.25 inch to 3.5 inch drives) and, therefore, had to exert themselves to try to catch up with upstart manufacturers of the disruptive technology.

Another instance of this innovativeness profile is a firm that introduces a new product generation that is not perceived as discontinuous to the industry, but is important as a next generation technology platform to set the stage for the introduction of a sequence of product improvements by the firm. It may be, for example, that the firm needs to clean up its technology platform and reengineer its production processes. This does not necessarily translate directly into customer value. In this sense, it can be considered a variant of the *platform project* (Wheelwright & Clark 1992), one that does not create real value in the market, but serves as a new generation and a foundation for future product enhancements.

Since the technology is new to the firm and the product is aligned with the current customer base, it can be compared to *developer-driven development* (Leonard-Barton 1995) with the caveat that it is not necessarily so new to the market. But Leonard-Barton (1995) does not distinguish clearly between exogenous and endogenous newness (in fact, the scale “alignment of product line with current customer base” indicates endogenous newness, whereas the discussion in the adjoining text implies exogenous newness).

This innovativeness profile can be said to be a firm-level equivalent to the *technologically discontinuous product* (Veryzer 1998a) and the *revolutionary new product* (Abernathy & Clark 1985).

Indicators of the New Technology Platform

This innovativeness profile exhibits high endogenous technological newness (dimension 3), but exogenous technological newness is low (dimension 1). The product does not introduce a leap in the customer value proposition (dimension 2) and the market is quite familiar to the firm (dimension 4).

One version of the New Technology Platform is the firm that has been overtaken in its existing markets and, therefore, needs to establish familiarity with the Really New Technology Architecture introduced by the pioneer and to translate this into a New Technology Platform for the firm. This requires technological learning and competence building in order to understand and a create the firm's own version of the new technological principle. It may also have implications for product strategy and for the technical organization. The need for structural adaptation is exemplified by Christensen's (1997) study of the disk drive industry, where successful manufacturers of disruptive technologies tended to separate out the new venture in order to give it sufficient room to develop the new technology and launch it in an embryonic market.

Another version of the New Technology Platform is the firm that introduces a new technological platform for future product development (but without adding customer value). There may be various reasons for the firm to engage in such an effort: 1) clean up an existing product configuration that was, perhaps, the result of historical changes and adjustments; 2) introduce purchasing efficiencies by using standard components etc.; 3) introduce a product design that is more in line with other products in terms of production requirements in order to increase production efficiency; 4) create a modularized design that enhances production flexibility; 5) enable product adaptation (through modularization) to enhance the firm's ability to target specific customer needs and niche segments.

Such a change in the technology platform can start an internal S-curve of technology improvement (Garcia & Calantone 2002). In this sense, the technology platform is a micro-level equivalent of the Really New Technology Architecture, which creates a shift in the industry's technology paradigm and sets the stage for industry-wide technology improvements in an S-curve scenario.

New Market Initiative

The New Market Initiative takes the firm into a new market or represents a new value proposition over existing products (high on dimension 4). The product concept is not all that new to the market (dimension 2) and it is developed using existing technology (low on dimension 1 and 3).

In this sense, it is a firm-level equivalent to the *commercially discontinuous* product (Veryzer 1998a) and *niche creation* (Abernathy & Clark 1985). It is also described, in part, by *new product lines* (Booz, Allen & Hamilton 1982).[43]

It is not a bad proposition for the focal firm to use its existing technology resources to enter a new market or create a new and enhanced value proposition for its customers (compared to its existing offerings). Indeed, the notion of entering new markets by combining core technologies is the key idea behind the seminal article "The Core Competence of the Corporation," published by Prahalad & Hamel in 1990. Such efforts may even lead to products with high exogenous newness (such as the Sony Walkman), in which case the new product project would qualify as a Really New Market Approach.

[43] In Johne (1994).

Extant Literature on the New Market Initiative

One instance of the New Market Initiative is a firm that enters a market using existing technology know-how and resources. This can be thought of as a *firm-level equivalent* of the *commercially discontinuous* product (Veryzer 1998a), as exemplified by the Sony Walkman (ibid.).

In this sense it also resembles *new product lines* (Booz, Allen & Hamilton (1982)[44] since the project has high newness for the individual firm (in market terms), but the product is not all that new to the market.

The other instance of the New Market Initiative is a product that introduces a new or enhanced value proposition over existing products in the firm's portfolio (but uses existing technology). This can be considered a *firm-level counterpart* to *niche creation* (Abernathy & Clark 1985), where incremental technology is used to create a new market perception and address emerging market segments.

Indicators of the New Market Initiative

The innovativeness profile ranks high only on endogenous market newness (dimension 4). Granted, it may also have medium-level exogenous market newness (dimension 2), but it ranks low on the exogenous and endogenous technology dimensions of newness (dimensions 1 and 3).

In other words, it may be a product that takes the firm into a new and unfamiliar market and requires new marketing learning and competence building. As such, it may necessitate, or result in, a change in marketing strategy as well as changes to the marketing organization and distribution channels.

This is exemplified by the idea that Sony and Canon use their core competencies in microprocessor controls, optics, imaging etc. to enter new markets (Prahalad & Hamel 1990), ranging from scanners and laser printers to cameras and video cameras to hi-fis and portable CD players.

It may also be a product that introduces a new or enhanced customer value proposition, which the firm is able to develop with existing technology.

Summary

On observation, it is clear that innovation management, is very different in, say, radical innovation from incremental new product development. This brings to light the pivotal role of innovativeness to the study of innovation management.

On even closer inspection, though, it becomes clear that the moderating role of innovativeness for the study of innovation management is not sufficiently examined through the dichotomy of radical and incremental new products.

[44] In Johne (1994).

Specifically, it is vital to explore two aspects of innovativeness: 1) new to whom? and 2) new in what way? By examining these two perspectives, a more nuanced view of innovativeness arises. Based on a meta-analysis of the innovativeness literature, Garcia & Calantone (2002) found that innovativeness must be modeled as follows: 1) at the *macro* and the *micro* level (new to whom?), and 2) as *technological* and *marketing* newness (new in what way?).

This view of innovativeness has been adopted in this study, but has also been adapted in the sense that the distinction between the macro and micro level has been relabeled here in order to explicitly distinguish between *exogenous* and *endogenous* newness. The reason is that the micro level perspective, as defined by Garcia & Calantone (2002), includes the firm's customers, but since the firm's customers are a part of the general marketplace (i.e. the macro perspective), this can be said to be a bit arbitrary. More importantly, it is unfortunate for the study of innovation, since there is reason to believe that there is a basic difference in the way new products are developed if they are pioneering to the industry and market as opposed to those products that are new mostly to the focal firm itself.

This leads to the following four dimensions for the study of innovation management: 1) exogenous technological newness; 2) exogenous market newness; 3) endogenous technological newness; and 4) endogenous market newness. To underpin these four dimensions, a review of definitions and measures was conducted and four indicators were proposed for each dimension (see Figure 17)

Figure 17. Indicators of the Four Newness Dimensions

Own Development

New product typologies exist that deal with either of the two basic perspectives introduced in the above (but not both): 1) the typology by Booz, Allen & Hamilton (1982)[45] distinguishes between *new to the company* and *new to the firm;* 2) the typology by Veryzer (1998a) distinguishes between *technological capability* and *product capability*, and the typology by

[45] In Johne (1994).

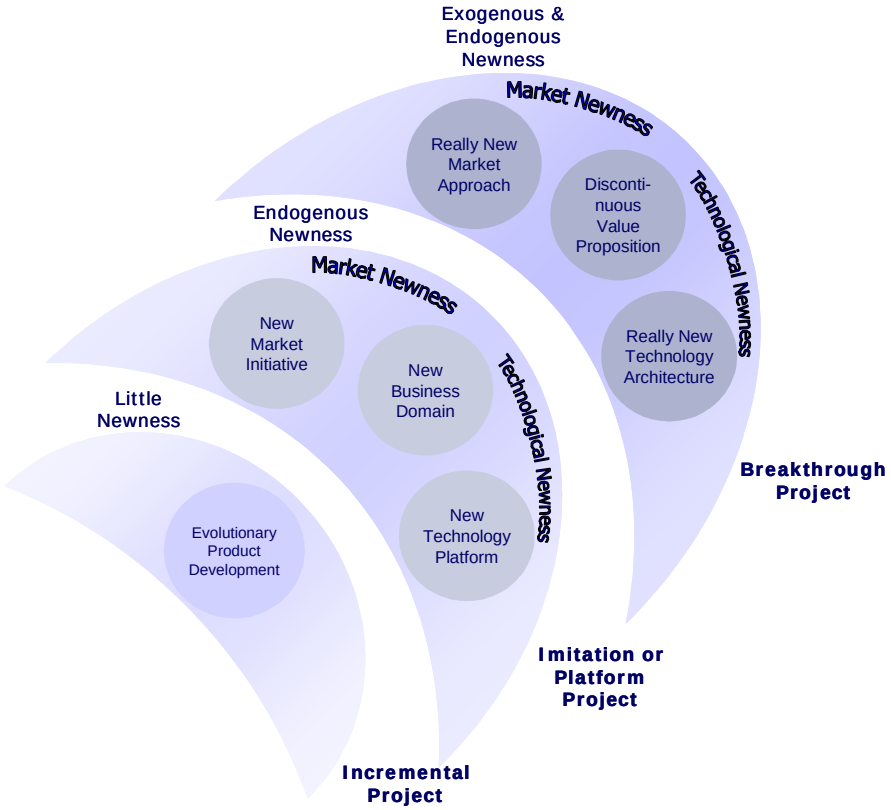
Abernathy & Clark (1985) distinguishes between *technology/production competences* and *market/customer linkage.*

Garcia & Calantone (2002) propose a typology that includes both perspectives (macro-micro and technology-marketing newness) and has three new product types: radical, really new and incremental. Their intention is to create a standard to help compare innovation studies.

Indeed, this typology can be a helpful standard for sector-level analysis of product innovativeness, but the problem is that it lumps together products that are technologically new with those that are new in 'marketing' terms. This takes out the focal distinction of some of the existing typologies and it leads the researcher to ignore the centrality of the distinction, identified by Garcia & Calantone (2002, p. 112) themselves: "Despite the varying perspectives for 'innovativeness' a single consistency does exist: it is always modeled as the degree of discontinuity in marketing and/or technological factors."

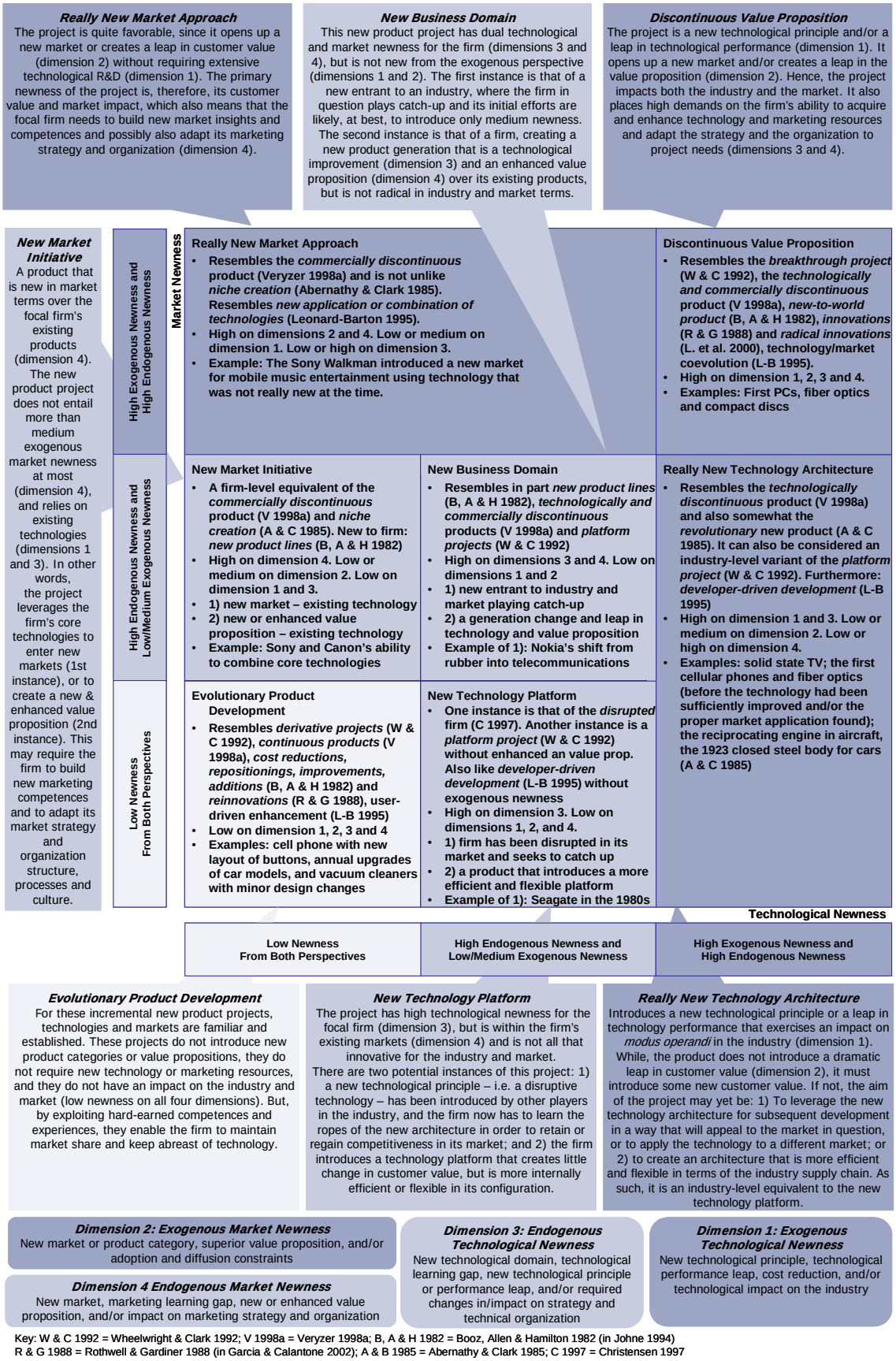
Therefore, a new typology is proposed here, which gives due consideration to the four dimensions. Since a pioneering product is *ipso facto* also new for the focal firm, it has been possible to collapse some of the combinations, leading to seven innovativeness profiles described above. Figure 18 presents these seven types and brings to light the kinship to the typology by Wheelwright & Clark (1992), which includes three project types: *breakthrough*, *platform* and *derivative* projects. The difference is that: 1) the typology introduced here has three variants of both breakthrough and platform projects; and 2) the intermediate category is not only concerned with platform projects, but also includes imitation projects.

Figure 18. Seven Innovativeness Profiles



Own Development

Figure 19. Summary Figure of the Seven Innovativeness Profiles



Key: W & C 1992 = Wheelwright & Clark 1992; V 1998a = Veryzer 1998a; B, A & H 1982 = Booz, Allen & Hamilton 1982 (in Johne 1994)
R & G 1988 = Rothwell & Gardiner 1988 (in Garcia & Calantone 2002); A & B 1985 = Abernathy & Clark 1985; C 1997 = Christensen 1997

Own Development

APPENDIX
CRITIQUE OF THE INNOVATIVENESS TYPOLOGY

In the following, the four newness dimensions and the innovativeness typology introduced in Chapter 4 will be critiqued.

Reflections on the Dimensions and the Typology

As argued in Chapter 4, the typology is intended for the purposes of studying contingencies in innovation management.

Having carried out a theory building effort to detail four newness dimensions and construct a typology, it is natural to reflect on the following issues: Are the four newness dimensions the appropriate ones for the study of innovativeness? What are the limitations of the typology for classification of new product projects? Are the seven innovativeness profile in the typology consistent and appropriate?

These issues will be discussed here. Yet, since the four dimensions and the final typology are built from inspired theoretical synthesis, the next logical step would be to test them empirically and to examine their relevance in practice. Since that is not the purpose of this study, the dimensions and the typology come with the caveat that a more confident assessment of their validity and reliability in evaluating new product innovativeness would require empirical testing.

The Appropriateness of the Four Newness Dimensions

A central tenet of the typology is that to really understand innovativeness, it is necessary to look at two aspects of newness: 1) new to whom? and 2) new in what way? These are the two perspectives that give rise to the four dimensions on which the typology is built.

1) New to Whom: Exogenous and Endogenous Newness. Garcia & Calantone (2002) highlight that it is important to distinguish between the macro and the micro perspectives. This is, in principle, similar to the distinction made in this study between exogenous and endogenous newness (although the distinction made here amplifies the analytical separation of the focal firm from its environment). In other words, a key issue for examining a product's newness is whether it is new to the industry and market, or just to the firm itself.

One instance of a new product project that has a high level of endogenous newness (but only low exogenous newness) is that of the follower firm that enters established – or emerging – industries or markets. While strategy literature gives due attention to the issues of first-mover advantages – and second-mover advantages – it does not, in fact, appear to be a recurring theme in the study of innovation management in general and market learning in particular. One inference from this could be that since little attention is paid to the issue, market learning is not dependent on the extent to which the firm is a pioneer or a follower. Another possibility, however, that makes natural sense is that market learning is quite different for the follower firm than for the pioneer, since hard-earned lessons about technology and market

applications are made by the pioneer, who smoothens the learning curve for followers, as it were.

The follower firm can learn by reverse-engineering product technology and studying market reactions to the pioneer's products. Indeed, such access to market learning may well be considered one of the key second-mover advantages available to the (fast) follower. Some of the examples above testify to the significance of the distinction between exogenous and endogenous newness for the study of market learning in product innovation. For instance, 3Com's handheld computer improved on the shortcomings of Apple's first Newton. Also, GE was able to snatch the leadership position in CT Scanners away from the pioneer EMI a few years after project inception, due to the possibility of rapidly assimilating the arduous learning made by EMI with this embryonic technology and market.

Another instance of innovativeness that is mostly of the endogenous kind, is when a firm introduces new generation product platforms that are not highly innovative from an exogenous perspective (e.g. the Honda Civic platform introduced in 1990), but may yet be quite important for the focal firm and its long-term competitive position.

Hence, for the study of innovation management, it is important to identify whether the new product project can be perceived as new only to the firm itself or also to the industry and the market.

2) New in What Way: Technological and Market Newness. The distinction between technological and market (or marketing) newness is a recurring theme in literature (Garcia & Calantone 2002, p. 112). Its relevance can, therefore, be considered well-documented. Even so, it is not always conceptually clear whether something is new in technological or in market terms. For example, a product feature that introduces a leap in technological performance can, in theory, do so without creating a new or enhanced value proposition. In reality, though, these are typically two sides of the same story.

In fact, the newness of a project goes across the firm's functions and is embodied in the nature of the project and product concept itself. As a case in point, some of the measures of exogenous newness introduced by Salomo (2003), under the heading 'external resources', belong neither to the technological nor to the market perspective:

- For the innovation to be adopted in the market, a new infrastructure (such as hydrogen stations for car refueling) must be created
- For the innovation to be adopted in the market, regulatory provisions (e.g. through governmental or business associations) must be considerably adjusted or new ones created
- The innovation is subject to intense public criticism

As should be clear from this, these measures are macroenvironmental in nature, and separate from the technology and market dimensions. They can, perhaps, be used as additional proxies in determining whether a new product is, indeed, of a radical nature. In other words, if the innovation requires new infrastructure, new regulation, and evokes criticism from the general public, the case is strengthened for labeling the new product 'radical'.

To illustrate one of these macroenvironmental measures, the fuel cell car envisioned by automakers will require a new infrastructure for hydrogen refueling. GM's idea of a hydrogen car will also require new roles and skills by auto dealers, who will be required to sell car bodies to fit on the bottom 'skateboard'. In this concept of the hydrogen car, customers will keep the 'skateboard' with the engine, steering control, etc. and will be able to fit different types of bodies on top of it by going to the local dealer (e.g. a minivan or a sports car could be fitted onto the same four wheels with the same fuel cell engine and drive-by-wire technology).

Even if the distinction between technological and market newness is not always crystal clear, however, it is useful for this study, since it identifies the kind of uncertainty in question. And, in particular, it can be presumed that the firm's access to, and understanding of, customers in its current markets (i.e. low endogenous market newness) is much better than for ventures that takes the firm into new markets (i.e. high endogenous market newness).

In sum, there is reason to believe that the two core perspectives, and the four resulting dimensions, hold promise for the study of contingencies in innovation management.

From Classification to Detailed Project Description

There are at least two problems with the kind of classification enabled by the typology. One of these is that there are only two basic values for each dimension ('high' or 'low'), which masks the underlying nuances. The second is that the 'high' rating of exogenous newness occurs more or less frequently in different contexts (and in some industries very rarely indeed). The different new product project classes, however, help to structure the discussion of the effects of different kinds of newness on innovation management. But it may bear fruit to focus more on a more detailed description of individual new product projects by examining the indicators of each of the four dimensions, thereby going beyond the constraints of a simple classification scheme. These issues are discussed below:

Classification in a Matrix Masks Nuances. Since the classification has only two values for each dimension ('high' or 'low'), nuances about the nature of the new product project's innovativeness are veiled.

To add to this, each newness dimension lumps together different kinds of newness. For example, market newness denotes a new market (totally new or new to the firm), but also market-perceived newness of the product (in broad terms or compared to the firm's existing products).

Yet, having several factors under each dimension and limiting the number of possible values for each dimension to two helps to limit the resulting amount of new product types. In fact, just adding a separate 'medium' value to each of the four dimensions would explode the number of potential classes in the typology.

Hence, the lumping together of several variables under each dimension, and the use of only two values for each dimension, helps to achieve simplicity and communicability. While a long list of potential new product project types could be dreamed up if indicators were separated out and more values added, the seven innovativeness profiles do bring out variety in ways that are helpful in discussing the ramifications of different kinds of innovativeness for innovation management. Even so, it is likely that a more detailed analysis of new product projects would

yield useful insights for the study of innovation management in general and market learning in particular.

The Exogenous 'High' Rating is Quite Rare in Some Setting. In some (mature) industries the 'high' innovativeness rating occurs much less frequently than in other industries. This might lead to the immediate conclusion that the framework is less useful in such settings (indeed, the study of contingencies for managing new product projects may be less relevant in industries where almost all projects have a comparable degree of newness). Yet, it is possible to adapt the use of the framework in such situations (where real exogenous newness is a rarity), by zooming in on the dimensions of technological and market-based newness, and by doing a more fine-grained analysis of the different indicators of newness (e.g. does the new product project represent a misfit with the company's core competences or is it 'merely' an unfamiliar technology domain?).

Additionally, it can be said about such settings that: 1) when discontinuous new products are very rare, the company has less need for the kind of flexible and adaptable processes that are necessary in firms with multiple project types; 2) when radical new products are, at odd instances, discovered by the firm, or introduced by a competitor, it is likely to be slightly dramatic for the organization since its structures, processes and culture are conditioned to a climate of stability and incrementalism (but inevitably real change sooner or later comes knocking on the door of any industry – however mature it may be).

In sum, the lumping together of factors under each dimension, the limited number of values for each dimension, and the rarity of the 'high' rating in some industries point towards the promise of a more detailed analysis of project characteristics.

Towards a Detailed Examination and Description of Project Characteristics. Even if the seven innovativeness profiles are useful in discussing key differences between new product projects, such initial classification can fruitfully be complemented by a more detailed analysis of the three to four indicators underlying each of the four dimensions.

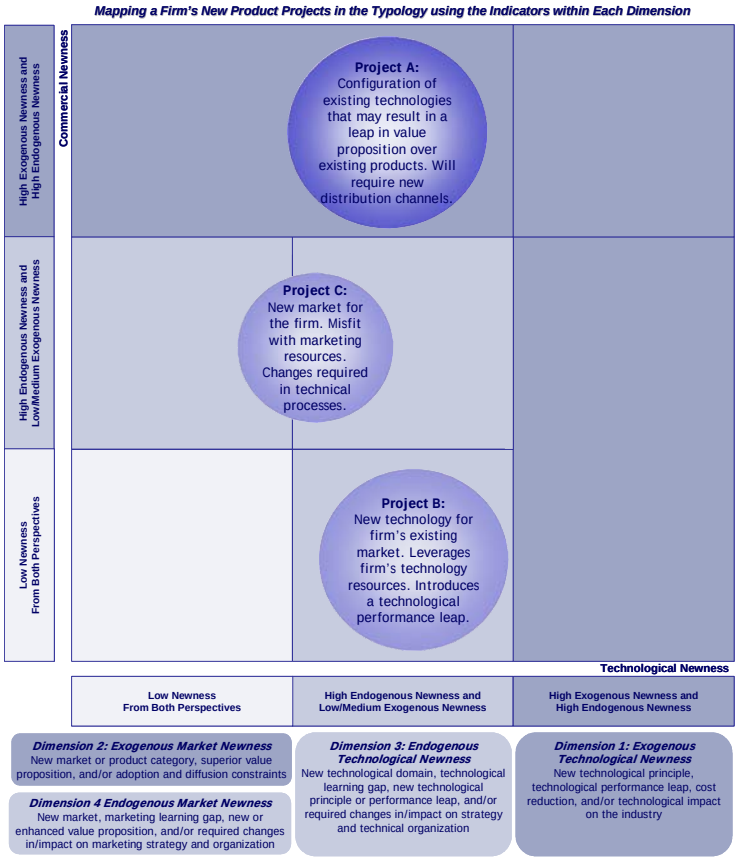
Benefits of such detailed analysis are also suggested by Danneels & Kleinschmidt's (2001) study of innovativeness, which led to the conclusion that a new product project, which ventures into unfamiliar technology or market domains but leverages existing technology and marketing resources, is more likely to be successful than a project which is in familiar domains but does not fit with current resources and competencies.

A possible application for more detailed analysis of newness indicators is illustrated in Figure B.1, where new product projects of a hypothetical firm are plotted into the matrix and described in terms of their key characteristics, i.e. the indicators (within the four dimensions) that highlight the key features of the project.

Such classification of projects can, potentially, have various practical applications, such as: Rating project potential and prioritizing funds; adapting processes to project needs and addressing the need for learning and new resources; and analyzing compatibility of different projects and the likely strain on the organization posed by differences in project characteristics.

While such detailed analysis holds potential, the classification scheme is useful in its own right to help conceptualize, discuss and assimilate distinctly different kinds of newness and their implications for innovation management.

Figure B.1. Beyond Classification to Detailed Description of Project Characteristics



Own Development

Consistency and Appropriateness of the Seven Innovativeness Profiles

The typology is not a classical two-by-two matrix, but is atypical in its design and slightly awkward to explain. Yet, the possible extra time required for the reader to assimilate the workings of the typology is merited on the grounds that removing complexity from the typology – by reducing the number of dimensions or collapsing some of the types – would take away important categories and combinations of dimensions, thereby making it a less powerful tool for examining contingencies in the management of innovation projects.

In fact, the categories in the typology have already been reduced from sixteen potential combinations to seven different new product project types (innovativeness profiles). Obviously, four dimensions with two values for each ('high' or 'low') would logically be expected to result in sixteen types. A brief explanation here of why it is, nevertheless, rational to only include seven types is, therefore, worthwhile. And after such a justification of collapsing the sixteen combinations into seven categories, it is useful to further explore whether the remaining seven types are, indeed, consistent.

From Sixteen Possible Combinations to Seven New Product Project Types. A basic rationale for the typology is that a very innovative product in the eyes of the industry and the market is *ipso facto* also new for the individual firm. In other words, if a product is a pioneering solution from the exogenous perspective, it is not necessary to ask whether it is also new from the firm itself (the endogenous perspective). Of course, a pioneer may face a more or less steep learning curve in developing the radical product in question, depending on the firm's past experiences and resource endowments (as illustrated by Garcia & Calantone's (2002) comment that IBM would be more challenged if it were to set out to develop a fuel-cell car than is GM).

Similarly, a product that is incremental from the endogenous point of view cannot be radical from the exogenous perspective (although there is a theoretical possibility that the firm's *process* used for developing the product could be very easy and somewhat incremental in nature – if the radically new product is discovered with extreme luck and serendipity and is easily put together for launch).

Finally, four boxes were collapsed into two categories: The Really New Technology Architecture and the Really New Market Approach cover two boxes each. For example, in the case of the Really New Technology Architecture, it has been done on the grounds that for a product that manages to score high on technological newness in industry terms, it is not so interesting to further discuss the degree of market newness for the focal firm. A similar argument can be made for the Really New Market Approach.

Consistency and Appropriateness of the Seven New Product Project Types. Given that the arguments for moving from sixteen combinations to seven categories are valid, the seven new product project types can be expected to fulfill the criteria of being *mutually exclusive and collectively exhaustive.* This would seem to be confirmed by the conceptual discussion of the seven innovativeness profiles above: For each profile it has been possible to relate the discussion to specific cases or situations that illustrate the intrinsic nature of the profile and each case or situation has been possible to uniquely classify within one of the seven categories.

Even so, there is an element of subjectivity inherent in the classification (as is often the case in such exercises). Indeed, it can be difficult to separate out the technological and market aspects of a product's innovativeness, as mentioned above, and to determine whether a particular product qualifies for being called 'highly' innovative. What is more, the mutual exclusiveness and the collective exhaustiveness of the categorization scheme is only true for the selected four dimensions.

In sum, there seems to be reasonable grounds for taking out and collapsing some of the sixteen possible combinations in order to arrive at seven classes. Additionally, it appears that the seven categories are mutually exclusive and collectively exhaustive (with the caveat that classification is a somewhat subjective exercise).

Yet, to say anything about the empirical validity and practical applicability of the framework would require further research

Future Research and Management Implications

The four dimensions and the resulting typology have been put together drawing on a study of extant innovation literature. The typology has been explained above and will be applied in subsequent chapters.

The first test of the framework could well be to examine whether researchers and practitioners find that it holds promise for studying innovation management.

If so, it would make sense to test the validity of the dimensions and the framework empirically. In other words, to seek to establish whether the dimensions are the appropriate ones for studying innovation management, and whether the resulting new product project types are correct and consistent.

Also, it would be interesting to examine whether the framework is useful as a practical tool. For a start, the categorization of a firm's innovation projects and the analysis of the nature of their newness within the indicators of the four dimensions, may be insightful for managers But ultimately, the framework would be a useful addition to practice if a classification and further examination of the nature of the product's newness could help managers effectively adapt processes and market learning to new product project's needs in a way that speeds up development or improves the chances of commercial success for the new product in question.

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