13

Innovation and new product development

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Chapter Topics

Chapter objectives

This chapter is concerned with how innovation and new product development (NPD) can be conceptualized as a developing body of knowledge. Drawing on literature spanning some 30 years, this chapter reveals NPD as a fundamentally cross-disciplinary field of study that has markets and customers as twin focal points around which theoretical and practical perspectives of management are examined. The primary objectives of the chapter are:

1. To present the multi-disciplinary nature of new product development
2. To identify the centrality of the process in NPD and distinguish other factors leading to the successful development of new products, including organizational structures, people and information
3. To describe the core activities (models) commonly used to guide new product success
4. To calibrate the utility of process models for theory and practice managerial guidance.

Learning outcomes

On completion of this chapter you will:

1. Appreciate the multiplicity of perspectives in models of new product development
2. Understand NPD model utility and shortcomings as tools of management
3. Be able to integrate contemporary ideas impacting the models in NPD, including organization, people management and information.

Introduction

The chapter attempts to synthesize the major issues involved in developing successful new products. Traditionally, the term 'new products' was quite specific, largely confined to physical products, and, in much of the early writing on NPD, implicitly denoting *consumer* physical products. Alternative terminology, reflected in the major organ of dissemination of NPD research (the *Journal of Product Innovation Management)* is the term 'product innovation'. In recent years, wider attention given to the dominance of service as the focus of exchange has resulted in more attention being given to new service development – also known as service innovation. Even so, a recent comparison of 16 years of NPD research, noted that only 52 out of 815 articles included data from service organizations and that only 21 articles actually focused on the specifics of new service development (Page and Schirr, 2008). In this chapter, therefore, the terms new product development and product innovation are coloured by the context of physical products, since the theory is based on research whose predominant subject is, at least implicitly, concerned with physical products. The author, however, having conducting studies specifically focusing on service innovation, would contend that many of the ideas relating to product innovation are equally applicable to service innovation (Hart et al., 2008).

One of the enduring features of new product development theory is that it is developed in many different disciplines and sub-fields of business studies. A recent analysis of highly-cited articles on NPD showed that three broad journal domains accounted for a majority of high-impact research during the period 1989–2004: management, marketing and research and development, accounting for 16 per cent, 14 per cent and 23 per cent of all articles respectively. (The remaining 58 per cent, the single biggest 'domain', was accounted for by the multi-disciplinary *Journal of Product Innovation Management* (Page and Schirr, 2008)). In addition, this analysis traced the leading knowledge domains in NPD research, noting the following as important: management and strategy, marketing, organizational behaviour, finance, psychology and technology management. Two further 'domains' were identified – NPD and exploratory/theoretic approaches. In addition to these conclusions regarding the disciplinary roots of developing

NPD schema, other research domains which feature studies of NPD include operations research, design management, engineering and creativity/aesthetic studies. These bases give rise to a wide array of 'topics of study'.

Forty-two streams of research were identified, including supply chain considerations, networking, organizational learning, entrepreneurship, organization for innovation, process development technology and international considerations. Given the thematic diversity of NPD research and theory emanating from relatively few, mostly US journals, any attempt to produce 'new product development theory' in the confines of one chapter would be misleading. Central to the ideas of developing new products, however, are a number of themes forming the foundations of the development of knowledge in NPD. These are:

- The basic activities required to develop new products
- The knowledge of what separates success and failure in NPD
- The necessary considerations for NPD activities to be managed effectively.

This chapter, therefore, is split into three sections. The first gives an overview of various models of NPD in order to identify the tasks required to bring new products and services to market; next, a summary of research into the factors associated with success and failure in NPD is given; and the final section presents methods for developing the models with insights from studies of success and failure, including considerations of organizational structure, and people and information management.

New product development models

New product development (NPD) process models attempt to distill the essence of the activities needed to complete a project; they are therefore general in their orientation and often criticized for not being applicable to individual contexts. For instance, does the development of new services require different stages in the models? Will hi-tech product development follow the same steps as fast-moving consumer goods? In a recent reflection on de-bunking the myths of his Stage-Gate model, Cooper (2008) points out that models take numerous forms and have evolved in their level of prescription over the years. Early representations of new product development models were confining, often describing the NPD process by focusing on the departments or functions that were presumed to carry out various tasks. Through the last three decades these early representations evolved, becoming increasingly based on activities, which were recognized to be fluid, overlapping, open systems, which retain a reference process, widely-known examples being those of Booz Allen Hamilton, and Cooper's Stage-Gate™ shown in Figures 13.1 and 13.2 respectively.

These commonly comprise periods of development activity, followed by points of evaluation (gates), where the decision to continue (or not) with the development

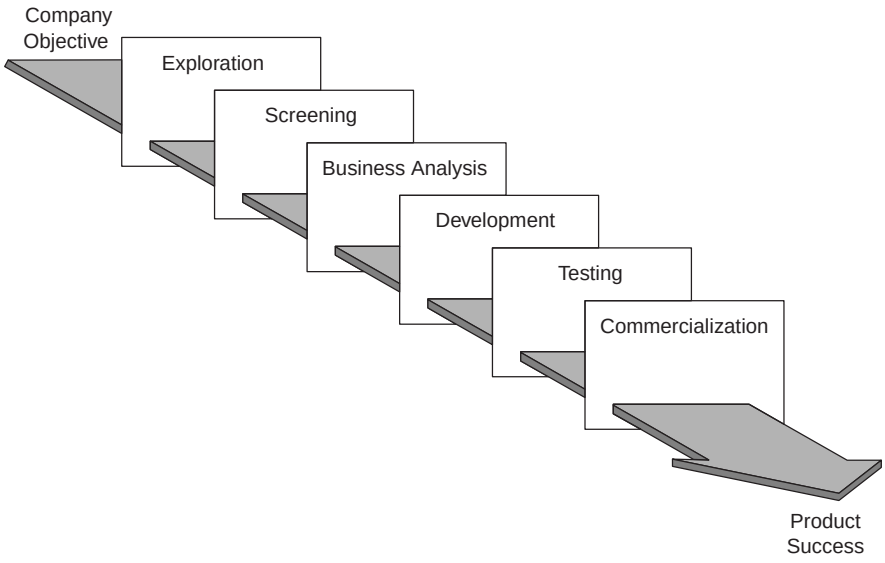

Figure 13.1 The Booz Allen Hamilton model of new product development

Source: Baker, M. and Hart, S. (2007) *Product Strategy and Management*, 2nd edn. Electronically reproduced by permission of Pearson Education, Inc., Upper Saddle River, New Jersey.

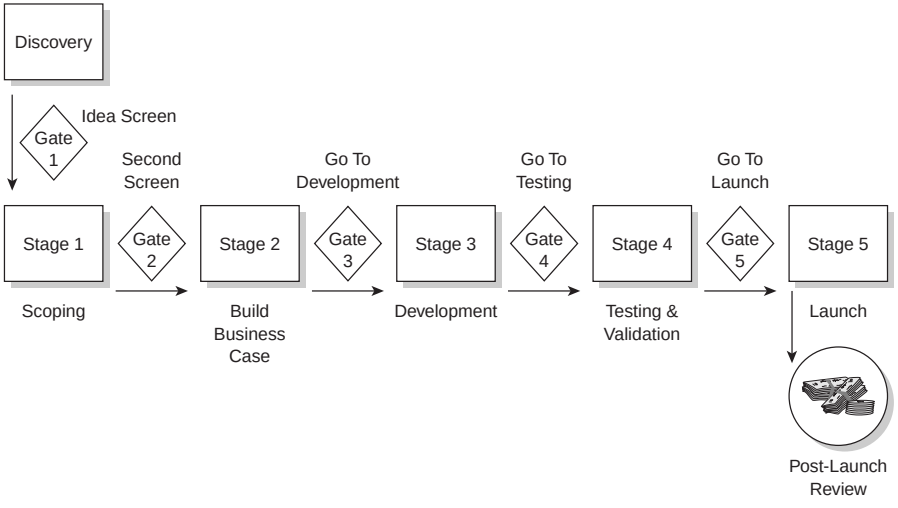

Figure 13. 2 Cooper's Stage-Gate™ model

Source: Baker, M.J. and Hart, S.J. (2007) *Product Strategy and Management*, 2nd edn. Harlow: Pearson Education. Reproduced with permission.

is made . Both the existence and importance of feedback loops are explicit, where each stage is viewed in terms of its potential output into the next stage of the development, as shown in the further refinement of the process in Figure 13.3.

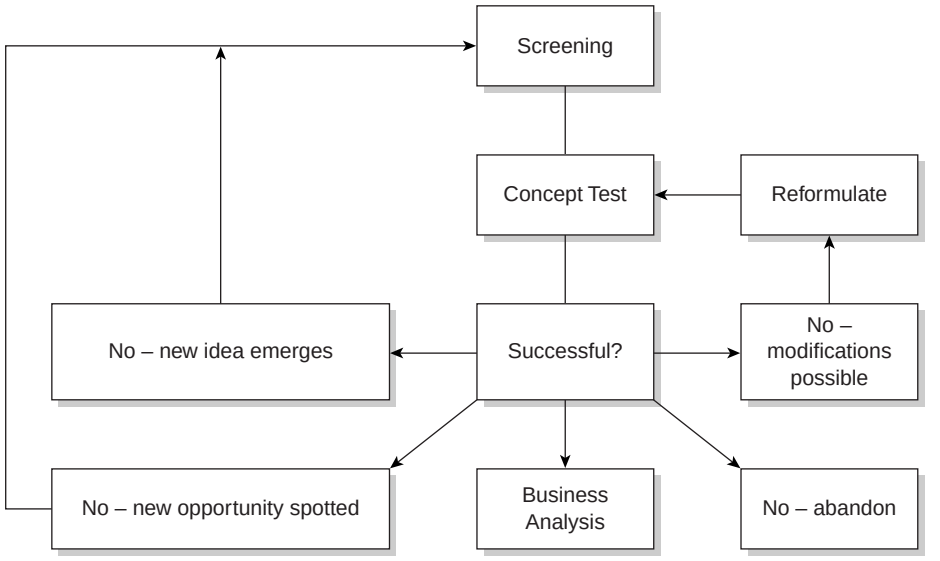

Figure 13. 3 Evaluative gates in NPD

The key stages are briefly summarized below.

Idea generation

In many instances, the term idea *generation* might be inappropriate because although ideas abound and do not have to be 'generated', they must be managed. The outputs of this stage in the process is the production of ideas that fall within the mission of the organization and what it seeks to achieve with its NPD efforts. New product idea sources exist in and outside the firm. Internal sources include technical areas such as R&D, design, engineering; all of which work on translating applications and technologies into new product ideas. Customer-facing functions such as sales and marketing can provide ideas and many company employees may have actionable ideas. Outside the company, distributors, inventors and universities, as well as competitors and customers, provide rich sources of information from which new product ideas may flow, if organized in such a way as to extract ideas. Much of the theory in NPD deals explicitly with how fertile repositories of information might be activated, using a battery of techniques, including simple brainstorming or one of its many derivatives such as morphological analysis, or perceptual mapping and scenario planning. The output from this stage is a pool of ideas which can be further evaluated for their suitability as future products or services of a company.

Screening

An initial assessment of the extent of demand for the ideas generated and of the capability the company has to make the product is at the core of this second stage in the NPD process. It is, therefore, the first of a number of stages of evaluation and, as such, only a rough estimation of an idea can be made as the latter is not yet fully expounded in terms of design, materials, features or price. The primary locus for the initial judgement of the viability of ideas will be internal company opinion from R&D, sales, marketing, finance and production, against criteria such as whether the idea would fit a market demand and could be produced by existing plant, and the estimated payback period. The output of this stage in the process is typically a bank of ideas which are suitable for further development. Much research has served to produce tool kits and checklists designed to guide this early appraisal of ideas.

Concept development and evaluation

The initial screening of ideas allows the development team to turn fewer, high-potential propositions into more clearly specified concepts and testing them for fit with company capability and customer expectations may commence. The task of transforming a new product idea into a fully elaborated new product concept is more than semantic labelling. As Montoya-Weiss and O'Driscoll (2000) explain:

> **an idea is defined as the initial, most embryonic form of new product or service idea – typically a one-line description accompanied by a high-level technical diagram. A concept, on the other hand, is defined as a form, technology plus a clear statement of customer benefit. (2000: 145)**

Essentially, there are two sub-phases concerned, the first requires that the idea be more fully elaborated, to include drafting of product or service features, levels of specification, materials, design, aesthetic values and so on. This in turn allows for a more careful presentation of the concept to potential customers, to allow assessment of market fit, done through direct customer research. In addition, the development team needs to assess which configurations are most compatible with current production plant, which require plant acquisition and which require new supplies. Together with idea generation and screening, concept development is worth spending time and effort on, collecting sufficient data to provide adequate information upon which the full business analysis will be made. These activities make up what is often referred to as the 'fuzzy front end', proficiency in which is often associated with superior NPD outcomes (Cooper et al., 2004). The outcome of this step in the process is the information required to carry out the analysis of the full business case.

Business analysis

A pivotal stage, it is at this juncture that the major 'go vs. kill' decision will be made. There needs to be conviction at this point in time, that the venture is potentially viable,

because once physical development resource has been committed, expenditure will increase exponentially after this stage. The analysis of the business case, therefore, has to be thorough and comprises:

1. Estimation of potential total market, market share within specific time span, evaluation of competing products, likely price bracket, break-even volume, identification of early adopters and specific market segments
2. Specification of technical aspects: production methods and implications, supplier identification and management, any further R&D required, or investment in plant, equipment or other know-how
3. Justification of the project's fit with corporate strategy.

The sources of information for this stage are both internal and external, incorporating any market or technical research carried out thus far. Where the result of the business analysis is the decision to 'go' with the development, a further stage output will be the development plan with budget and an initial marketing plan.

Product development and testing

In the case of physical products, at this stage prototypes are physically made, involving several tasks. First, the prototype will be tested for its level of functional performance, sometimes called 'alpha testing'. Until this point, the product has only taken theoretical form – a description, drawing or model. Now that component parts are brought together in a functioning product, the viability of the theoretical product can be established. Second, although manufacturing considerations have entered into previous deliberations, only when the prototype is developed, can adjustments to the design or to manufacturing specifications be drafted and implemented. Third, potential customers now have the opportunity to assess their reactions to the product in its real, rather than depicted form. Some kinds of product are more easily tested by customers than others. Services and capital equipment are difficult to 'test', the former due to inseparability, and the latter due to logistics and cost implications. In the case of the latter, however, in-situ testing of new equipment, called 'Beta-testing', is practised widely. In consumer markets, numerous market research techniques are commonly used to test new products.

Product testing has been much aided by the use of the internet for a number of reasons. The cost of 'building' and 'testing' prototypes virtually is small compared to that required by physical prototypes. Consequently, market research costs are lower, and more concepts can be tested by potential customers than is the case with physical products, resulting in a final design which is more attuned to the voice of the customer. In addition, more end customers can be sampled more efficiently via the internet, although the risk of population deterioration is increased as is the likelihood of bias, since not all potential customers selected will be willing to 'test' the product virtually. Research by Dahan and Srinivasan (2000) reported that 'virtual parallel prototyping and testing on the Internet provides a close match to

the results generated in person using costlier physical prototypes … ' (2000: 108). The output of this stage in the process is the final specification of the product which will then be produced for the whole market, including the segment or geographical variations.

Test marketing

Test marketing consists of small-scale tests with customers. Until now, the idea, the concept, and even the product have been 'tested' or 'evaluated' in contexts other than a 'real' purchase situation. Other elements of the marketing mix have not been tested, nor has the likely marketing reaction by competitors, nor the attractiveness of the product once offered alongside competing products. For test marketing, the total product appeal is evaluated among the mix of activities comprising the market launch: salesmanship, advertising, sales promotion, distributor incentives and public relations.

As an expensive stage, developers must decide whether the costs of test marketing can be justified by the additional information that will be gathered. Moreover, some new offerings are unsuitable for a small-scale test launch: cars have market testing complete before the launch, while services such as personal insurance cannot be withdrawn once launched on a small scale. The delay caused by a test market to the 'real' launch of the new product to market may benefit competitors who, appraised of a new product launch in the offing, can use the delay to be 'first-to-market'. Alternatively, competitors may profit from the results of a test market as input to their own launch. Further, for some new services, a direct market entry (perhaps on a limited scale) is a viable strategy because new product launch has fewer tangible elements in which to invest, so costs (and therefore risks) are lower.

Test-market simulations use basic models of consumer buying as inputs. Elements such as consumer awareness, trial and repeat purchases, collected via limited surveys or store data, are used to predict adoption of the new product. The output of this stage in the process is the final marketing mix and plan for the market launch.

Commercialization or launch

The last stage of the NPD process comprises decisions such as when to launch the product, where to launch it, how and to whom to launch and is very costly. These decisions are based on information collected throughout the development process and will be moderated by the resources available. Launch strategy includes advertising and necessary trade promotions, together with the production of materials both for the launch proper and for the pre-sales into the distribution pipeline. Sales force and service personnel training may also need to be planned pre-launch to sell and deliver the new product/service effectively.

Attention is focused on reaching the likely early 'innovators' or 'early adopters' of innovation and on targeting communications to them. In industrial markets, early

adopters are often innovators in their own markets. These categories are described under the theory of the adoption and diffusion of innovation (Rogers, 1962).

A critique of the NPD process model

The usefulness of the staged process models is attributable to the indication they provide of the magnitude of the project required to develop and launch a new product. Cooper, Edgett and Kleinschmidt (2004) have shown that using a model or 'roadmap' for product development was not a majority practice in US businesses, but was more commonly used by the best NPD performers (38 per cent using) than the worst performers (19 per cent using).

Despite this endorsement, models have been criticized on a number of counts. First, a general view that no two firms will seek to develop products in the same way using the same steps calls the validity of NPD process models into question. The sequence and shape of any step-by-step representation of new product activities will depend on the type of new product being developed and its relationship with the firm's current activities. Moreover, in real situations there is no clear beginning, middle and end to the NPD process. One idea, for example, may spawn several product concept variants, each of which might lead the development process in directions different from those originally intended, challenging the view of linearity in the process model. Equally challenging is the notion of iteration in NPD, resulting from the fact that after each evaluative episode (gate), numerous outputs might be produced, implicating both previous development work and future development progress. Uncritical following of the linear view gives little, if any, guidance of what to do if, for example, a new product concept fails the concept test. Figure 13.4 shows alternative courses of action, after the screening stage, further described below.

It is possible that although the original concept is faulty, a better one is found through the concept tests; it would then re-enter the development process at the screening stage. Alternatively, a new customer may be identified through the concept testing stage, since the objective of concept testing is to be alert to customer needs when formulating a new product. These and other possibilities are shown in Figure 13.4, underlining that process models viewed simply as linear or sequential, are inadequate, particularly regarding up-front activities, which have been shown to be critical to the success of NPD outcomes.

As noted above, the topic of NPD is multi-disciplinary, mirroring the multi-functional tasks required to identify and develop a new product that is fit for purpose in the market. The single-strand linear representation ignores these multi-functional inputs, which include marketing, technical (design) and production tasks or decisions that occur as the process unwinds. Each of these strands of development creates both problems and opportunities within the other two. For example, if, at the product development stage, production has difficulties, costs may increase affecting market potential through increased pricing and rendering the product less attractive to potential buyers. In this case, the new information requires reworking of the market and technical assumptions. New courses of action might include a

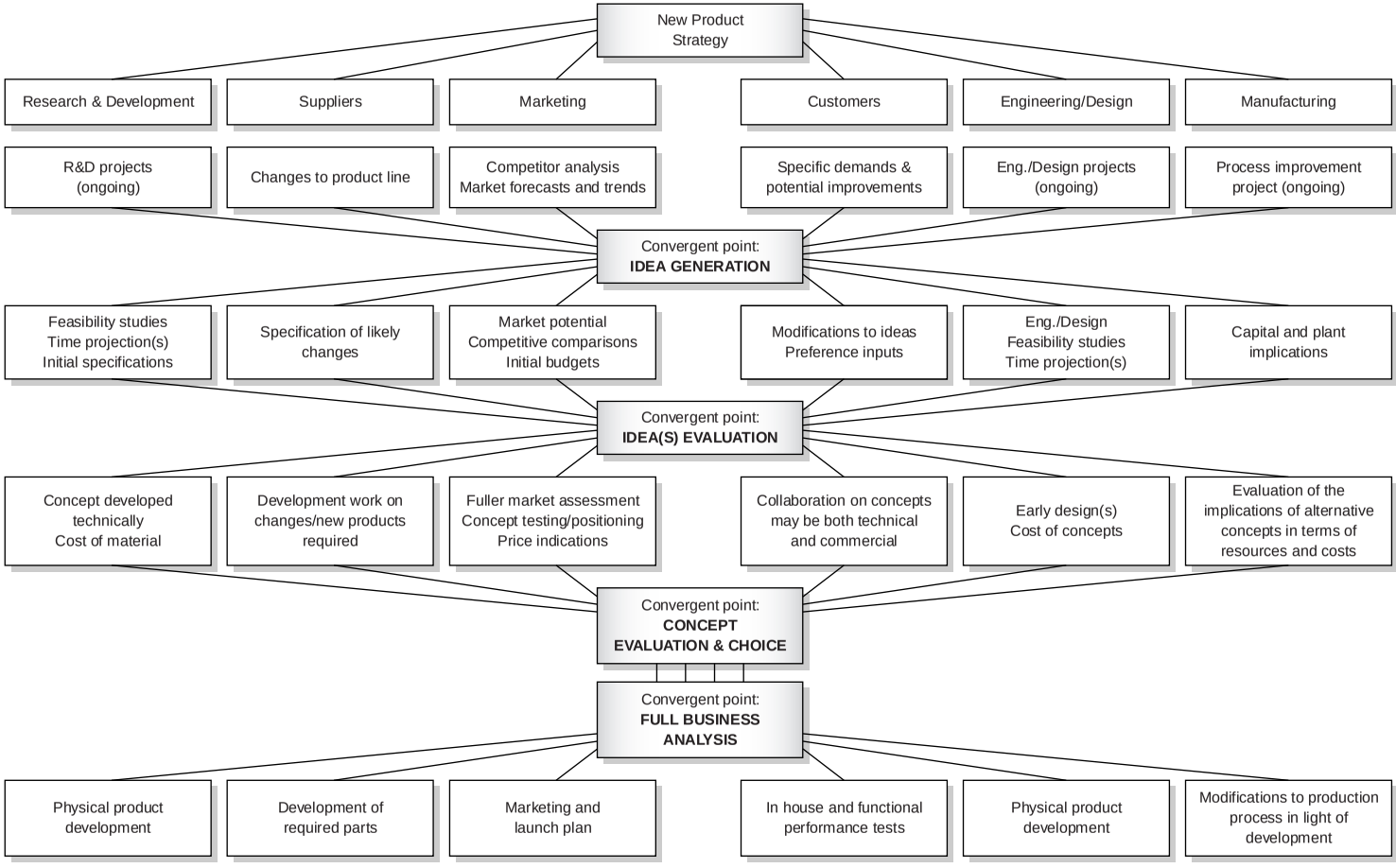

Figure 13.4 Horizontal and vertical iteration in the NPD process (Baker and Hart, 2007: 185)

new design, alternative distribution, acceptance of longer payback horizons, none of which are represented by the single-strand view of NPD. Whatever the nature of the final solution, it has to be based on the interplay of technical, marketing and manufacturing development issues, meaning that product development activity is iterative, not only between stages, but also within stages.

This shortcoming has resulted in the advancement of a number of 'new style' process models, including Nexgen (Cooper, 2008). These amended activity-decision models acknowledge the iterations between and within stages, include principles from related disciplines and functions, such as 'lean and rapid' product development, are recommended for bespoke tailoring to the demands of specific industries and market conditions and have become scalable to match different levels of risk and complexity. They are particularly designed to emphasize multi-disciplinary integration, embracing technical and commercial functions, as well as external parties, since these too are seen as crucial to the outcome of new products. In short, the development of the process theory acknowledges that the management of the NPD process goes beyond the number and sequencing of its constituent tasks. An example of one of these newer processes is the Multiple Convergent Process™ by Baker and Hart (2007), shown in Figure 13.5.

The next section looks at the wider body of literature which informs theory by identifying factors beyond the process activities which have an impact on new product success and failure.

Factors affecting success and failure of new product development

The recent overview by Page and Schirr (2008) suggested that the proportion of published articles analysing factors which differentiate successful and unsuccessful NPD is somewhat low (at about 4 per cent of the total the authors consulted), whilst Guo (2008) estimated that 16 per cent of the articles published in the *Journal of Product Innovation Management* between 1984 and 2005 were concerned with NPD performance measures and drivers. Whatever the precise figures, it is fair to say that the 'performance' studies have had a large and enduring impact on theory development in the field. Also, many of these studies' influence is derived from being supported directly by the Product Development Management Association, under the auspices of 'Best Practices' research. In the PDMA best practices research, for example, 59 per cent of products in development made it to market and, of these, 60 per cent were commercially successful. For decades, success (or failure) rates for new product development, reported in aggregate, tended to give varying results. Cooper (2001) gave a market success rate of 15 per cent, whilst Hultink, Hart, Robben and Griffin (2000) reported an average 60 per cent successful launch rate in the US, the UK and the Netherlands, and in 2004, Cooper, Edgett and Kleinschmidt reported success rates of 60 per cent on average. Despite this variation, it is clear that a sizeable proportion of new product development effort goes to waste, encouraging researchers to continue to research

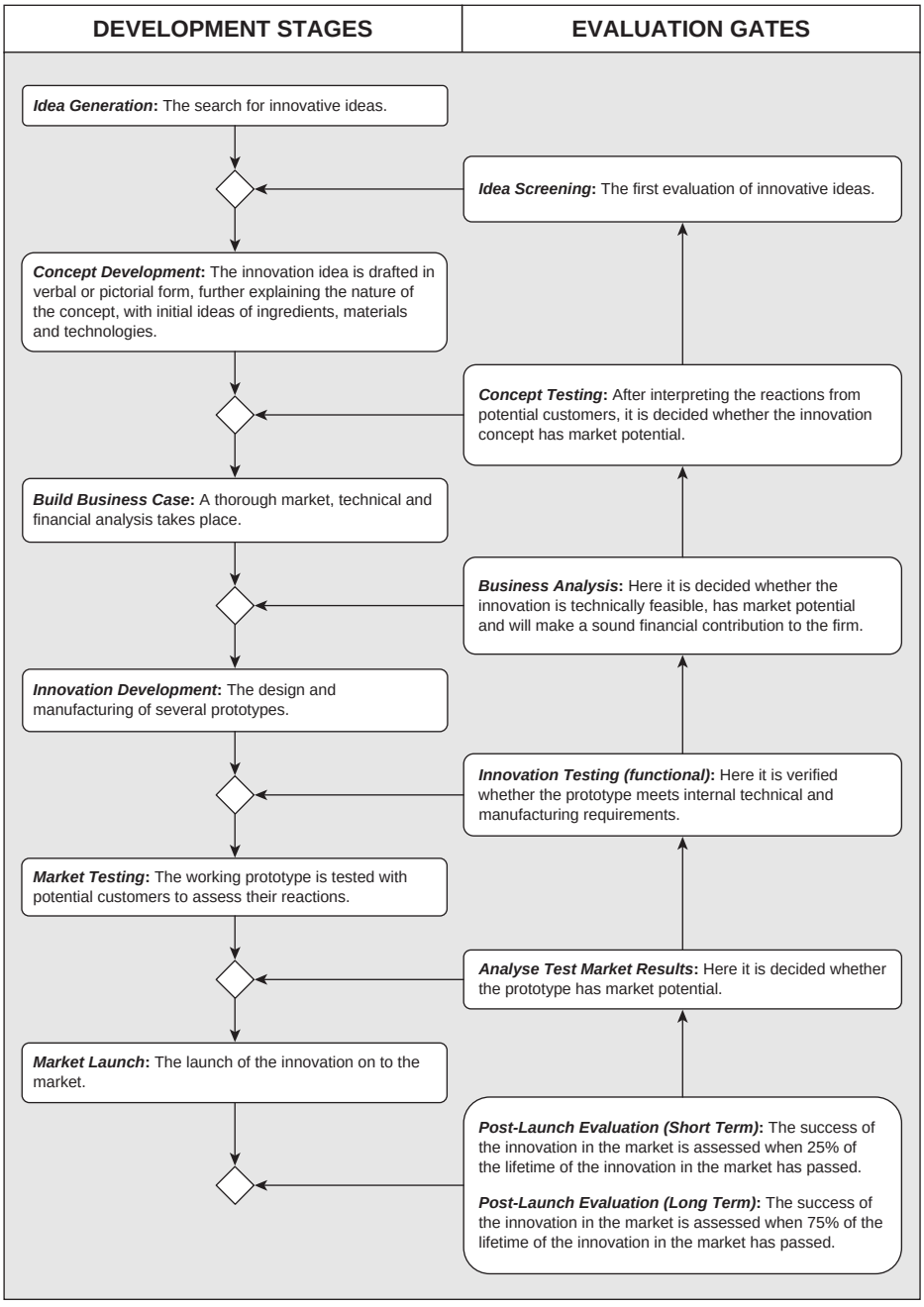

Figure 13.5 The Multiple Convergent Process™ (Baker and Hart, 2007)

factors that make a difference in bringing new products to market successfully. The results of these studies are summarized in the next section.

Previous reviews of the literature (Craig and Hart, 1992; Henard and Szymanski, 2001; Montoya-Weiss and Calantone, 1994) have identified key themes in the NPD literature as being crucial to the success of NPD activities.

The themes can be grouped at two levels: strategic and operational. The former is comprised of those factors that describe how an organization is managed as a whole, its strategic orientation, strategy for NPD, or top managers' styles. These have a vital contribution in setting the scene for new product development and can and do have a profound effect on the outcomes of development programmes. The latter refers to a number of task-specific factors, which although influenced by the strategic issues, exert their own influence on the outcome of *a particular* NPD project. This brief review, therefore, summarizes findings on success and failure across these two levels.

Strategic level success factors

Innovation strategy

The strategy of a company contextualizes its internal operation as well as its interfaces with the outside world. To be successful, theory advocates that NPD should be derived from the corporate strategy of the company, that in turn sets clearly defined objectives for its NPD endeavours. The Beerens et al. (2004) report for Booz Allen Hamilton found that most companies have difficulty in controlling their product development activities. Symptoms included ignorance of the NPD roles and responsibilities, frequent reprioritizing of projects and the discovery of projects by top management previously unknown to them, as well as lack of robustness in the process and its management. In other words, a lack of a strategic focus on product innovation. Setting a clear strategy for new product development, on the other hand, not only provides guidelines for resource allocation, but also sets up the key criteria against which all projects can be managed through to the market launch. The approach Komatsu took to compete with Caterpillar throughout the 1970s and 1980s consisted of numerous strategies, amongst which feature the frequent launch of new products developed to extend the product lines, future new products based on envisioning programmes and a period of matching increased product variety with efficiency gains. The NPD benchmarking study by Cooper, Edgett and Kleinschmidt (2004) found that more of the best performing companies defined the strategic arena for NPD, clearly identified NPD goals, took a long term view of NPD and strategically allocated resources to portfolios of NPD projects. While it is often argued that new product development should be guided by a new product strategy, the strategy should not be so prescriptive as to restrict, or stifle, the creativity necessary for NPD. The history of Canon's success is described by Hamel and Prahalad (2005) as one where their strategic intent ('beat Xerox') was broken down into a series of product (and market) development tasks, including competitive study and technology licensing to gain experience, developing technology in-house and selective market entry to exploit the weakness of competition, before going on to develop completely new technological solutions in the form of disposable cartridges.

The way in which the strategic focus or intent of product development is formed can be seen as a function of four, inter-related aspects: technology and marketing inputs, product differentiation, synergy and risk acceptance.

Technology and marketing. The emphasis on a balance between the technological and the marketing orientations in the literature reflects an overall trend away from arguing the benefits of one orientation above the other, towards an acceptance that there should be a *fusion* between technology-led and market-led innovations at the strategic level. The examples of Komatsu and Canon show how both market and technology orientations have played their part.

Product differentiation. Many of the success–failure studies refer to new product strategies pursuing differential advantage, through the product itself, comprising: technical superiority, product quality, product uniqueness and novelty, product attractiveness and high performance to cost ratio (Hultink and Hart, 1998).

Synergy. The relationship between the NPD and existing activities describes the extent of synergy, high levels of which are seen to be less risky, because a company will have more experience and expertise. In their 2001 meta-analysis, Henard and Szymanski called for more research into both product advantage and marketing synergy as these had a strong predictive power with success rates.

Risk acceptance. Successful new product strategies account for the creation of an internal orientation or climate which accepts risk. Although synergy might help avoid risk associated with lack of knowledge, the pursuit of product differentiation and advantage must entail acceptance that some projects will fail. An atmosphere that refuses to recognize this tends to stifle activity and the willingness to pursue something new.

Top management influence

Early research into success and failure examined the role of top management in the eventual success of NPD. The classic Stanford Innovation Project (Maidique and Zirger, 1984) found new product successes underpinned by a high level of top management support, as did the work of Hart and Service (1988), whilst Cooper and Kleinschmidt (1987) found less proof of top management influence, discovering that new product failures often do have the support of top management.

Top management plays a crucial role in setting the climate for innovation by signalling the nature of the corporate innovation culture (Goltz, 1986; Gupta and Wilemon, 1988 Gupta, Raj and Wilemon, 1986; McDonough, 1986). In some cases it is necessary for the firm to change its philosophy on NPD, in turn causing a change in the whole culture. Nike's NPD process changed dramatically during the 1990s, from a belief that every new product started in the lab to the view that it is the consumer who leads innovation. Research by Wei and Morgan (2004) in China has shown that the relationship between organizational climate and new product performance is in fact increased as climate affects market orientation. In

other words, the climate of the firm affects how those responsible for NPD respond to the changing market conditions, which in turn affects the performance of NPD. Although a theoretical focus on top management's influence on NPD has become less fashionable as a topic in recent years, again, the meta-analytic study of research-based correlates of NPD success found that amongst the strategic factors predicting success, market orientation was a significant variable (Henard and Szymanski, 2001). In addition, a recent study by Gumusluoglu and Ilsev (2009) found strong positive associations between transformational leadership and the level of innovation in SMEs.

Operational level success factors

The previous paragraphs have reviewed the major *strategic* themes of theory development in NPD. Much of the research and theory base of product innovation, however, has been derived from examination of the way in which *specific* processes are executed, the people involved and the role of information being instrumental in its outcome.

NPD process activities

Over the past 30 years, much research has examined what steps comprise the efficient and effective execution of the development process, an example of which was described earlier in this chapter. Companies including ExxonMobil, Bausch and Lomb, and Air Products and Chemicals have specific processes guiding the development of new products in the belief that the payback from following these guidelines has improved their success rates (Cooper et al., 2004).

Although a fulsome completion of the NPD process may be desirable, each additional activity extends the overall development time and may lead to late market introduction, for which there can be penalties in terms of competitive advantage. Therefore a trade-off has to be made between completing all the suggested activities in the NPD process and the time which these activities take.

Cooper, Edgett and Kleinschmidt's (2004) benchmarking report highlights that in general, marketing tasks were more poorly carried out than the technical activities and that, in particular, many firms do not have adequate go-no-go decision points. A study of the Korean telecommunications market also highlights that in new service development, factors such as 'poor demand forecasting' and 'ineffective marketing strategies' are often associated with failure (Ahn et al., 2005). The importance of the market research activities in the NPD process has been highlighted often yet there is still a valid argument to suggest that any notion of formal market research may well be redundant, particularly if the customers' technical knowledge is inferior to that of the developer. That said, a study by Varela and Benito (2005) found that both marketing and technical activities were ranked as more important to new product projects where there was a high degree of novelty. In addition, there has been much attention given to the need for increasing proficiency in the early stages of the NPD process, often called 'the fuzzy front end', because uncertainties loom larger at the early stages of the process.

Given that uncertainty is a defining feature of developing new products, it is unsurprising that information and theories relating to its management feature in successful new product development.

Information management

Central to efficient NPD *processes* and achievement of *functional co-ordination* is information management. Since the NPD process is often viewed as one in which uncertainties are inherent (Souder and Moenart, 1992) information is central to the diminution of uncertainty and progress in the process. At the beginning of the NPD process uncertainties regarding the optimal technological solution to a particular problem abound, as does uncertainty about which of the technological solutions will be adopted by the market. As the NPD process proceeds, these uncertainties may be reduced, although new kinds of uncertainties arise, such as those related to manufacturing, delivery and specifics of the marketing mix. Research by Tzokas, Hart and Saren (2001) identified seven types of uncertainty:

- Customer-need uncertainty
  - How stable is the need in the long run?
  - How strongly is it felt by customers?
- Market-based uncertainty
  - Is the market big enough?
  - Do we have access to distribution?
  - Do we have experience in this market?
- Technological uncertainty
  - Can the chosen technology deliver the benefit?
  - Will the chosen technology become the standard?
  - Do our people have good knowledge of the chosen technology?
  - Which OEMs and/or suppliers should we collaborate with?
- Competitive uncertainty
  - What will be the reaction of our immediate competitors?
  - What would be the new competitive products?
  - What is the threat of other technologies from other industries?
- Resource-based uncertainty
  - Do we have the resources to complete the project on time?
  - Do we have the resources to support the product in the market?
- Product strategy uncertainties
  - What would be the effect on other products in the firm?
  - What would be the effect on resources for other NPD projects?
- Organizational uncertainties
  - Do we have the support of top management?
  - Are there any interdepartmental conflicts?

A further thread of research relating to information impact in NPD success is that of knowledge management and organizational learning in NPD. Specifically, the role of learning from past projects by reviewing and using information that is stored in the organization's memory is yet another seam of NPD research (Lynn et al., 2000; Sherman et al., 2000). More recently, Sherman, Berkowitz and Souder (2005) found that 'effective recording of information from past projects and the efficient retrieval of that information, coupled with effective cross-functional integration, result in improved prototype development and product launch proficiency.

Accommodation of third parties and networks

Several studies have shown the importance of involving users in the NPD process to increase success rates (Hillebrand and Biemans, 2004; Thomke and von Hippel, 2002; von Hippel, 1988). Equally, there is growing interest in the need for greater supplier involvement, in order to benefit from the advantages of supplier innovation and just-in-time (JIT) policies. For example, Dell has shifted much of its component design work – laptop screens, optical drives – to supplier partners (Dolan, 2005). Recent research has emphasized the benefits of leveraging networks through the NPD process (Story et al., 2008), again requiring a flexible approach to modelling NPD processes.

This brief review of research into the correlates of success and failure in NPD does not claim to be exhaustive, but it does give a flavour of the variety of issues and disciplines central to furthering our understanding of the processes of product and service. Nearly all contributions to the literature on NPD, irrespective of the 'base discipline' of the author, will touch on aspects of either the process of development, or the people responsible for carrying out the process. The inter-relationships between the two, however, are rarely given explicit attention, yet the development of theory requires acknowledgement of their interdependence and how they might be integrated from a theoretical perspective. The next section reviews these interdependencies and concludes with recent trends in thinking about how to manage the process and structure the people involved in the process.

Inter-relationships in process, people and management of NPD

The processes involved in developing new products and the people who carry them out are related to three of the most commonly cited critical success factors in NPD.

- *The need for interdisciplinary inputs*. In order to combine technical and marketing expertise, a number of company functions have to be involved: R&D, manufacturing, engineering, marketing and sales. As the development of a new product may be the only purpose for which these people meet professionally, it is important that the NPD process adopted ensures that they work well and effectively together. One of Samsung's practices is to have designers and engineers visit labs around the

world to gauge views from the potential consumers (Edwards et al., 2005). Linked to this is also the need for the voice of the suppliers, where changes to supply may be required or advantageous.

- *The need to develop product advantage*. Technical and market information – the building blocks of NPD – have to be both accurate and timely, and must be constantly reworked in the light of changing circumstances during the course of the development to ensure that the product under development does have competitive advantage in the eyes of the customer. Therefore the *people* must deliver the appropriate expert information to inform the *process*.
- *The need for speed in the process*. The NPD process has to be managed in such a way as to be quick enough to capitalize on the new product opportunity before competitors do. The extent to which *people* work together enhances the speed of the *process*. Flextronics, the worldwide electronics design, fabrication, assembly and test company, shrank its mobile phone development time from between 12 and 18 months two years ago to three months currently, by linking all steps of the NPD process (which were previously independent), from initial artists' renderings to producing the mould, through software which encourages far more interaction among the players (Dolan, 2005).

Much of the knowledge regarding NPD, based on empirical research, underlines the importance of processes, information and people – all of which require management in circumstances of high risk and uncertainty. It follows, then, that it is critically important for firms to have structures which allow not only for professional specialism and expertise, but also for sharing information across disciplinary boundaries to ensure the development is fulfilling both sides of the success mandate: technological competence and market relevance. The structures discussed in the body of literature refer to the need for 'coordination' and 'integration' of the perspectives of different disciplines and are discussed below.

Research has covered a variety of aspects, for example, the R&D–Marketing interface (Gupta and Wilemon, 1988), the Marketing–Design interface (see the *Journal of Product Innovation Management* Volume 22 (1& 2) (2005) for several articles in this area) and the Marketing–Engineering interface (Michalek et al., 2005). Whatever the precise focus of the integration, companies need to institute processes and design structures which promote integration and coordination, at the same time as preserving the efficiencies and, importantly, the expertise within functional speciality. Many alternatives have been described over the years, from bureaucratic control mechanisms to more organic and participative structures, where the structural complexity of the mechanisms increases. Generally accepted principles agree that the more organic and participative approaches are more likely to share information across functional boundaries and to undertake interdependent tasks concurrently rather than sequentially (Olson et al., 1995), echoing the classic theoretical contribution of Burns and Stalker (1961). Relatively organic mechanisms such as 'design teams' or 'new venture groups' have some important potential advantages for coordinating product development. Such participative

structures can also create an atmosphere where innovative ideas are proposed, criticized and refined with a minimum of financial and social risk whilst the participative decision making, consensual conflict resolution and open communication processes of such a structure can help reduce barriers between individuals and functional groups.

Fewer functional barriers also help ensure that unanticipated problems appearing during the development can be tackled directly by the people concerned, reducing the chances of vital information being delayed, lost or altered.

More participative structures also carry potential disadvantages, especially in terms of costs and temporal efficiency. Creating and supporting several development teams can lead to overabundance in staff and facilities. The main reason for this is that employees have less relevant experience when developing innovative product concepts and then depend more heavily on other functional specialists for the expertise, information and other resources needed to achieve a creative and successful product. Thus, there is potential for stagnation in the process if the focus of control is unclear. O'Reilly and Tushman (2004) describe what they call 'the ambidextrous organisation', to describe the challenges facing many organizations where they have to be able to exploit current products at the same time as exploring the future. Looking at the example of Ciba Vision, a Unit of the Swiss pharmaceutical company Ciba-Geigy (now Novartis), their article describes how Ciba Vision's management realized that radical new products were required to grow the company (and even to fend off decline) at the same time as continuing to make money from its more conventional portfolio of contact lens and eye care products. The decision was taken to launch six formal development projects aiming at revolutionary change, two in manufacturing processes and four in new products. Many smaller R&D projects, aimed at on-going product improvement were cancelled to release cash for the more ambitious R&D imperatives. Traditional business sections were still able to pursue incremental innovations of their own, but the R&D budget was dedicated to the development of real breakthroughs. These were freed from the structures of the old organization and instead autonomous units for the new projects were developed, each with its own R&D, finance and marketing functions.

There is, however, a final set of issues which impact upon the management of product and service innovation projects, namely, the extent to which this now takes place in networks that cross firms' traditional boundaries.

Managing networks for NPD

Although there has been an implicit within-firm perspective on much of the research into NPD and innovation, attention in specific quarters – for example, radical innovation and 'open' innovation, the importance of 'inter-organisational collaboration' and 'innovation networks' – has also been highlighted (Powell et al., 2005; Pyka, 2002). The fortunes of companies such as Wal-Mart and Microsoft have been attributed to their system of networks (Ianitsi and Levien, 2004). Due to the emphasis on speed in the NPD process, together with the fact that it is a

resource-hungry activity, firms will have to be engaged in learning races, requiring the capacity to work with specialized companies in their networks so that all participants get better and faster (Hagell and Seely Brown, 2005; Powell, 1998). In addition, due to the many different technologies involved in new product development, networks will be needed to leverage the functional integration required for success. (Håkansson et al, 1999; Owen-Smith and Powell, 2004).

Powell (1998) argues that in order to reduce the inherent uncertainties associated with new products or markets, inter-organizational learning in firm's networks plays a crucial role in creating a firm's competitive advantages. Eisenhardt and Martin (2000) define 'dynamic capability' as 'the firm's processes that use resources to integrate, reconfigure, gain and release resources – to match and even create market change … by which firms achieve new resource configurations …' (2000: 1107). Dynamic capabilities consist of processes such as alliancing – product development by which managers combine varied skills and functional backgrounds through inter-firm collaboration. Moreover, 'dynamic capabilities', by achieving new resource configurations, turns the inter-organizational relationships in new product development networks into another important topic: 'the changing dynamics of competition and cooperation' (Wind and Mahajan, 1997).

More recently, Dittrich and Duysters (2007) have examined how innovation networks can be used to deal with a changing technological environment, concluding that innovation networks offer flexibility and speed in innovation together with the ability to adjust more smoothly to changing market conditions. Although there are some adjacent topics such as knowledge creation and transferring in studying inter-firm learning in new product development networks, it is far from developed enough to be able to propose normative theory in this context. Of course, the wider topic of relationship marketing has not been widely studied in relation to innovation and product development, but as relationships are conceptualized as the means by which companies cope with their increasing interdependence, and build themselves into a network of interactions that are linked by economic, technical and social dimensions, this is a promising field for future theory development in NPD. In particular, the theoretical perspectives of transaction cost economics (Williamson, 1985), resource dependency theory (Pfeffer and Salancik, 1978), relational exchange theory (Dwyer et al., 1987) and models of business networks (Håkansson and Snehota, 1995) present fertile furrows for the NPD researcher to plough.

Conclusion

This chapter has presented an overview of some of the key themes in the development of NPD theory. Essentially a cross-disciplinary field, NPD researchers come from general management, organizational behaviour, economics, technology, operations, design, engineering and marketing management. Most, however, recognize some form of skeletal process at the core of NPD, bringing different perspectives and inflections to bear on the steps and procedures that make up their view of the

core. Three such models are shown in this chapter and a brief discussion of some generic stages is offered. An influential sub-field of NPD research has been the long tradition of deciphering what factors distinguish success from failure and this is summarized in this chapter, concluding with the implications of the success–failure studies for the development of themes and theories in NPD.

Recommended further reading

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