RESEARCH PAPER

SAN DIEGO STATE UNIVERSITY

STRATEGIES FOR DEVELOPING HIGH TECH PRODUCTS BY COMBINING TECHNOLOGY, INNOVATION AND MARKETING STRATEGIES IN INDUSTRIAL ENTERPRISES

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Klaus Allerstorfer

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Table of content

1. Significance and Structure **4**

2. Introduction **5**

2.1. Definition of High Tech Industry 5

2.2. Trends in High Technology 6

2.3. The Product Development Process 8

3. Technology Management **12**

3.1. Definition of Technology Management 12

3.2. Technology and its Link to other Disciplines 13

3.3. Implementing Technology Management into the Product Development Strategy 15

4. Innovation Management **16**

4.1. Definitions and Terminologies 16

4.2. The Innovation Management Process 16

5. Marketing Management **18**

5.1. Marketing Technologically advanced Products 18

5.2. Customer Value as a Key to Success 19

5.3. Strategic Postures 20

6. Strategic Development **21**

6.1. Basic Strategic Development 21

6.2. Detailed Strategic Development 22

7. Summary and Conclusion **24**

7.1. Summary 24

7.2. Introducing a High Tech Product Development Model 25

7.3. Outlook 27

8. Literature **27**

9. Tables and Figures **28**

1. Significance and Structure

New product development around the world is growing more complex and is becoming more difficult to manage – especially in the high technology environment. It requires adequate techniques and strategies in order to keep up with technological change, globalizing markets as well as the competition for market shares and better positions within the industry.[1] By implementing an effective and efficient management of technological innovations, combined with a well-defined marketing strategy and maintaining awareness of the highly unpredictable changes within the high tech industry, some of those challenges can be met and the long-term success of a company is obtainable more easily.[2] Within the solid foundation of a well-developed strategy, the sum of actions in new product development goes hand in hand with creating a sustainable competitive advantage in selected market segments.[3]

The goal of this thesis is to give an overview of the baseline foundation of three major management disciplines in the product development process in a technological environment. Furthermore, the thesis aims to point out the potential of gaining competitive advantage by developing an adequate business strategy that takes the special implications of managing the development of high tech products into consideration.

The paper is structured in an introduction part, in which *high technology* gets defined and trends are investigated as well as a generic product development process model is described. In chapter 3, 4 and 5 the three disciplines technology management, innovation management and marketing management are defined and analyzed – in each case considering the relevance to the development of high tech products. Chapter 6 first explains the basic approach of developing a product strategy. It then provides an analysis of the CSV strategy development framework specially applicable for high tech products. In conclusion, the links between the key disciplines are drawn and new model for managing high tech product development is introduced.

[1] cf. SHRM (2004), p. 8,10,17
[2] cf. Tidd, Bessant, Pavitt (2005), p. XIV
[3] cf. Thomas (1993), p. 7

2. Introduction

2.1. Defining High Technology

The word *technology* is derived from the synthesis of two greek words: *techne* (meaning art) and *logos* (meaning logic or science). [4]

Technology is an open concept that relates to how people use their tools and knowledge – usually the product of science and engineering – to create solutions to problems. High technology generally refers to cutting-edge or advanced technology – which means that the definition shifts constantly with time passing. What was high tech in the 1960s would be considered primitive technology by today's standards. This common - however unclear - definition has led to describing nearly all new products as high tech.[5]

The traditional domains of high tech include areas such as information technology, computer hardware and software, telecommunications and Internet infrastructure, and a variety of consumer electronics, among others. In addition, this paradigm of high tech can include a broad cross section of industries including biotechnology, pharmaceuticals, medical equipment, nanotechnology, robotics, and, with the focus on using technology to solve global problems, it can also include energy and transportation technologies and green building technologies – evidently a wide range of industries and products. Furthermore, high tech environments manifest a set of common characteristics like market uncertainty, technological uncertainty, and competitive volatility – with specific implications for marketing. Other characteristics include amongst others high unit-one costs, tradability problems, knowledge spillovers and network externalities. [6]

[4] cf. International journal of technology management (1997),p. 352
[5] cf. Mohr, Sengupta, Slater (2009), p. 9
[6] cf. Mohr, Sengupta, Slater (2009) p. 10

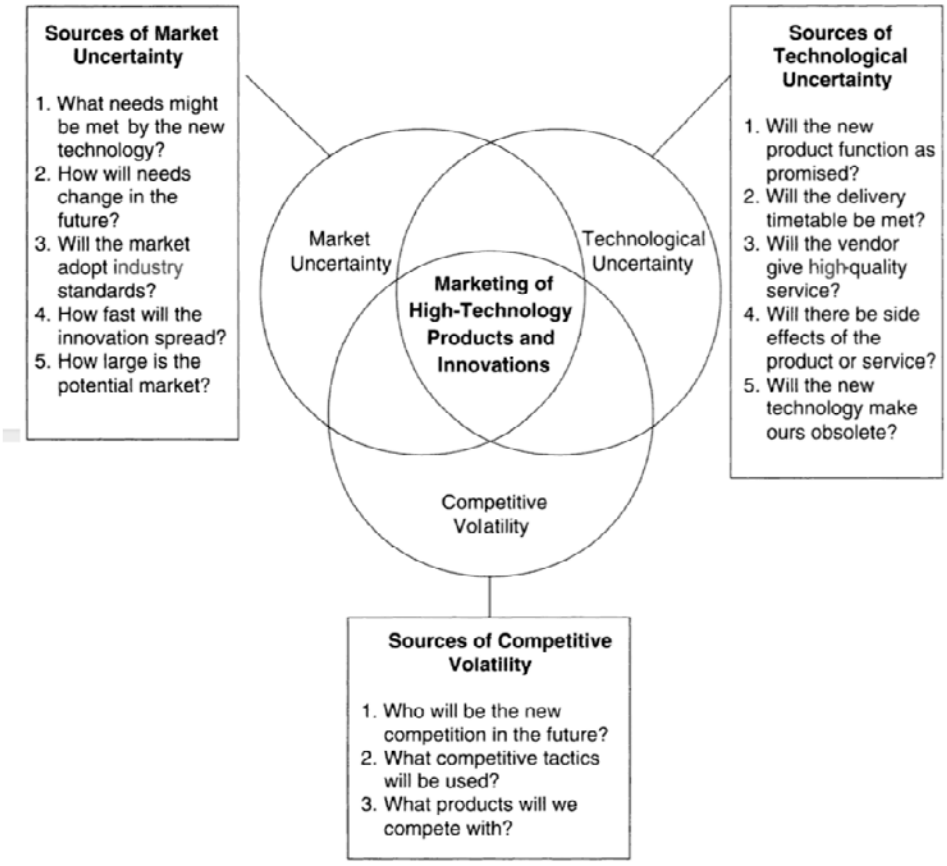

Figure 1: Marketing of High-Technology Products and Innovations[7]

Although one or two of the three characteristics might be present in several environments, the simultaneous presence of all three factors characterizes most high-tech environments. [8]

2.2. Trends in High Tech Industry

The high tech industry faces several challenges of growing significance. Consistently delivering new products and services that customers like and want, increasing revenue growth and profitability, and the efficient management of a global operation are just a few of today's top-of-mind issues.[9] Also, the accelerating rate of technological diffusion and the globalization of technology are seen as trends with growing importance.[10]

[7] cf. Mohr, Sengupta, Slater (2009), p. 10
[8] cf. Mohr, Sengupta, Slater (2009), p. 10
[9] cf. Saksena (2009), p. 1
[10] cf. Verburg, Ortt, Dicke (2006) p. 7

Saksena (2009) furthermore highlights following trends in today's high-tech environment:

Competitive advantages gained from innovations are increasingly short-lived. Developments like the transition from analog to digital technologies in the 1990s shrunk product lifecycles dramatically and made it easier for new products to be duplicated.
The competitive and price-sensitive consumer electronics segment - rather than the more predictable business segment - increasingly dominates the industry. Even firms such as Intel have begun to refer to themselves as consumer product companies. This shift makes demand forecasting for new products more difficult than ever.
Globalization has also introduced a change in the customer mix. Emerging economies, especially in Asia, are now significant markets for certain high tech products. Localizing products for the Chinese and Indian markets is yet another challenge for high tech manufacturers.

Table 1: Trends in today's high-tech environment[11]

Due to the fact that the length of product life cycles nowadays tend to decrease, the period in which investments can be earned back also shortens and the risk of this investment increases accordingly. To compensate for this, innovation processes should become more efficient and the return of these processes should increase. A shorter product life cycle also means that the time-to-market becomes more important, implying that Innovation processes need to be completed more quickly.[12]

[11] cf. Saksena (2009), p. 1, 2ff
[12] cf. Verburg, Ortt, Dicke (2006) p. 8

2.3. Product Development Process

A variety of models for product development processes can be found in the literature.[13] Since the model of Cooper's Stage-Gate™ product development process is already predominant in a variety of manufacturing firms in the United States[14], this thesis follows this approach.

Cooper's process is a systematic approach for moving a new product project through the various stages and steps from idea to launch. This idea breaks the generic product development process into a predetermined set of stages, with each one consisting of a set of prescribed, cross-functional and parallel activities and helps to make decisions based on a variety of critical success factors and goals.[15]

The following table provides a summary of these goals, and their possible effects on a firm's product development performance.

Quality of Execution	There is an evident need for a systematic new product process to guide and facilitate the new product project from idea to launch. The Stage-Gate process is a solution to correct lacks of the quality-of-execution and performance of many firm's new product efforts.
Management of Risk	The parallel activities in a certain stage must be designed to gather vital information – above all technical, market, financial and operations – in order to decrease the technical and business risks. However, total risk avoidance in new product development is not possible, unless a company decides to avoid all forms of innovation and face a severe decrease of competitiveness in the foreseeable future.
Understanding of Gates as a central Function	The processes gates provide the quality-control mechanism – before a project is allowed to proceed to the next stage, certain tasks and deliverables must be completed successfully. Gates also serve as go/kill decision points to weed out bad projects and focus recourses on the high-value ones. By this, gates determine tasks and deliverables of the previous and following stage.
Parallel Processing	Parallel processing balances the need for a complete and quality process with the desire for a speedier course of action. Following the Stage-Gate principle, activities and tasks get worked on concurrently rather than

[13] cf. Bröring (2005), p. 30
[14] cf. Cooper, R. Gravlin (1999), p. 77
[15] cf. Cooper (2001), p. 129

	sequentially. There is less temptation to delete key activities due to lack of time - As a result, a faster, more intense multifunctional process is the outcome.
Cross-functional Team Approach	The team is a cross-functional factor with active involvement and commitment by members from different functions in the firm. It must be empowered by high management, but it is also accountable for results, with rewards tied to results. The leader is given formal authority over the resources (people) on the team.
Market- and Consumer Focus	Successful businesses and teams that drive winning new-product projects have a strong dedication to the voice of the customer. Customer input and constant customer focus throughout the process are paramount and build – together with other marketing actions – a central feature of the innovation process.
Consistent and systematic up-front Homework	Like the marketing actions, those steps that go before the development of the project are typically weak, yet they can make all the difference between winning and losing. Predevelopment preparation and research are crucial to success, and these activities must be built into the product development plan in a consistent and systematic way.
Product Differentiation	Products with unique customer benefits and superior value have on average five times the success rate, more than four times the market share and four times the profitability of products that lack this ingredient. Many products yield poor results because they are "me too" products with little to distinguish them from competitors. Another classical scenario of failing products is a technical solution in search of a market.

Table 2: Goals in new product development[16],[17]

The stages in Cooper's process model are cross-functional: There is no classified R&D or marketing stage. Rather, each stage consists of a set of parallel activities undertaken by various people from different functional areas in the firm, working together as a team and typically led by a project team leader. The diagram below shows the generic stage-gate process.[18]

[16] cf. Cooper (2001), p. 130-132
[17] cf. Cooper (2000), p. 4-6
[18] cf. Cooper (2000), p. 6

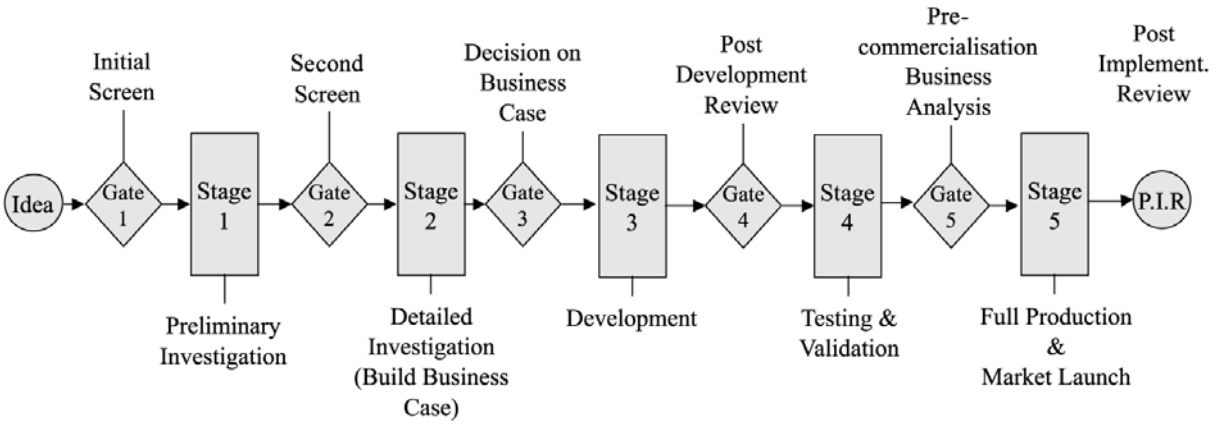

Figure 2: Schematics of a stage-gate process [19]

In case of (product) idea generation, the five stages can be described as in the following table:

Stage 1	Scoping: a quick investigation of the project
Stage 2	Building the business case: a detailed investigation involving primary research – both market and technical environments – leading to a business case, including product and project definition, a business justification and a detailed plan of action for the next stages.
Stage 3	Development: the actual design and development of the product. Additionally, the manufacturing (or operations) process gets mapped out, the marketing launch and operating plans get developed, and the test plans for the next stage are defined.
Stage 4	Testing & validation: the verification and validation of the proposed new product, its marketing and production.
Stage 5	Launch: full commercialization of the product – the beginning of full production and commercial launch.

Table 3: Stages in product development[20]

Gates serve as quality-control checkpoints, as go/kill and prioritization decisions points, and as points where the path forward to the next play or stage of the process is decided. Also, the structure of each gate is similar. Gates consist of the following:

[19] cf. Cooper (2001), p. 1
[20] cf. Cooper (2000), p. 6

A set of required deliverables	Criteria against which the project is judged	Defined outputs
Each gate describes a set of activities or actions which have to be completed, before the project can be pushed forward. These deliverables are visible and are decided at the output of the previous gate.	These include a set of "must-meet" and "should meet" criteria. That helps to weed out misfit projects and prioritize projects worth pursuing.	The outputs include a decision, an approved action plan for the next stage, and a listing of deliverables and dates for the next gate.

Table 4: Characteristic of Gates in the Stage-Gate Process [21]

Gates are usually tended by senior managers from different functions. They control the resources required by the project for the next stage. [22]

Strategy formulation is not part of the typical stage-gate process. Cooper, however, identifies it as an essential activity within product development and suggests a superimposed position over (or atop) the model of the stage-gate process. [23]

[21] cf. Cooper (2001), p. 130, 131
[22] cf. Cooper (2001), p. 131
[23] cf. Cooper (2001), p. 132

3. Technology Management

Technology plays a central role in almost all aspects of modern life and also a decisive role in corporate development, as well as the competitive positioning of firms.[24]

Of all the challenges faced within today's fast changing business environments, the management of technological innovation is one of the most demanding. If firms are able to create value and profit by developing a sustainable competitiveness, they become vibrant, attractive places to work, being able to retain the most productive and creative staff. However, firms can face severe or even terminal problems through losing money, workers, and reputation.[25] In the vast majority of business sectors, if firms do not innovate, their competitors will, and they will be put out of business in many cases. The overarching objectives of managers lie in improving cost-effectiveness and enhancing sustainable competitiveness in their organizations. Technological innovation plays a key role in helping managers meet these objectives.[26]

3.1. Definition

Largely due to the fact that the field is young and fundamentally interdisciplinary, different conceptualizations of the phenomenon of management of technology can be found in the literature. Verburg, Ortt, Dicke provide a good overview of the existing concepts[27]: Bayraktar (1990) defines management of technology as a rational and systematic view of responding to technological opportunities and innovations, and dealing with their consequences. Dankbaar (1993) defines management of technology as management activities associated with the procurement of technology, with research, development, adaptation and accommodation of technology in the enterprise, and the exploration of technologies for the production of goods and services. The US National Research Council holds that management of technology links engineering, science and management disciplines and addresses the issues involved in planning, development and implementation of technological capabilities in

[24] cf. White, Bruton (2010), p. 14
[25] cf. Dodgeson, Gann, Salter (2008), p.30
[26] cf. Dodgeson, Gann, Salter (2008), p.30
[27] cf. Verburg, Ortt, Dicke (2009), p. 8

order to shape and accomplish the strategic and operational objectives of an organization (NRC, 1987). According to Badawy (1998) management of technology evolves around integrating technology strategy with business strategy. [28]

In the often-cited definitions mentioned above, management of technology is described as a systematic and rational way of responding, a management activity, an activity of linking different disciplines, and as a field of study and practice. The goals of the activities may vary and range from responding to technological opportunities and innovations to shaping and accomplishing the strategic and operational objectives of an organization to maximize customer satisfaction, corporate productivity, profitability and competitiveness (Badawy, 1998). All authors implicitly or explicitly take the understanding of technology as a corporate resource to be the key object of study and knowledge. This object includes issues of procurement of technology and accommodation of technology and technical knowledge within companies. In the management of technology field, technology determines the strategic and operational capabilities of companies. This means that management of technology is only relevant in contexts where technology has such a determining force, like it has in the high tech industry.[29]

3.2. Technology and its Link to other Disciplines

The definition of Technology also implies a process that involves the elements of strategic management. Therefore, the definition of the management of technology should also reflect this systematic, strategic approach. Such an approach requires an integration of different disciplines to the management of technology. Figure 3 illustrates the various disciplines that can influence the management of technology and innovation.[30]

[28] cf. Verburg, Ortt, Dicke (2009), p.8
[29] cf. Verburg, Ortt, Dicke, (2009), p.9
[30] cf. White, Bruton (2010), p. 15f

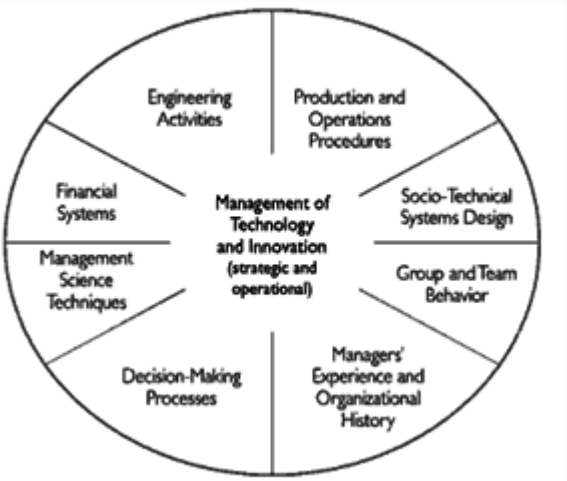

Figure 3: Areas influencing the management of technology and innovation[31]

As already mentioned in the beginning, accelerated technological change has become a fact and will continue to challenge industrial and societal development into the next century. The fact that all areas of life and the economy are increasingly affected by technology is undisputed. Coping with technological change affects not only R&D and production but also the entire enterprise.[32] Viewing technology as a corporate resource implies an important role for both line managers and strategic decision makers in dealing with technology issues on a day-to-day basis[33]. Nevertheless, a comparison of general management theory and the practice of solving a technology management related problem, reveals a critical gap between today's management theory and technological reality. Management of Technology links engineering, science, and management disciplines to plan, develop, and execute technological capabilities to shape and accomplish the strategic and operational objectives of an organization. [34]

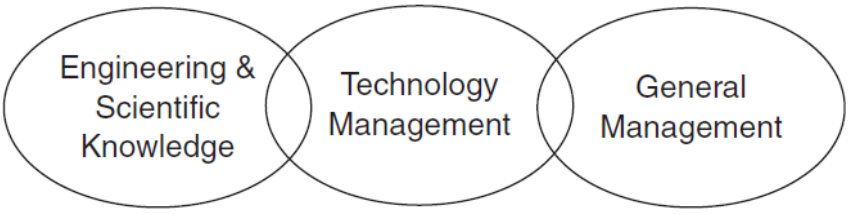

Figure 4: The Links of Technology Management[35]

[31] cf. White, Bruton (2010), p. 16
[32] cf. Tschirky (2004), p.7
[33] cf. Verburg, Ortt, Dicke (2009), p. 8
[34] cf. Tschirky (2004), p.13
[35] cf. Tschirky (2004), p.13

The following tasks are identified as key elements of technology management in practice: [36]

- Identification and evaluation of technological options
- Management of R&D itself, including project feasibility
- Integration of technology into the company's overall operations
- Implementation of new technologies in a product and/or process
- Obsolescence and replacement

Another important group dealing with management of technology is entrepreneurs. Bringing an innovative idea to the market and building your own company along the way appeals to many ambitious people. Students of traditional technological disciplines, such as engineering, industrial design, and the applied sciences, are often capable of generating promising product innovations and interesting new concepts. Good technology management is a key factor in bringing great ideas to the market and entrepreneurs may benefit from the various insights that are generated by the management of technology discipline.[37]

3.3. Implementing Technology into Product Development Strategy

Technology and strategy are, especially in this era of fast technological developments, interrelated. Several studies are known wherein technology induces the development of corporate strategy; however the number of studies that focus on how different strategy models approach technology is limited. [38]

This thesis follows the model of Industry-based strategic management, a method closely related to the Harvard industrial organization theory. Within the model of industry-based strategic management, technology itself is not a determinant of a successful strategy. The competitive position of a defined industry and the position a firm holds within the industry are the two main criteria for the success of companies. As a result technology may influence the attractiveness of the industry or the firm's position in the industry. Therefore,

[36] cf. Tschirky (2004), p.13
[37] cf. Verburg, Ortt, Dicke (2009), p. 9
[38] cf. Verburg, Ortt, Dicke (2009), p. 209

technology research is always related to business opportunities, which improves the competitiveness of the company. [39]

4. Innovation Management

"Innovation is the commercialization of an invention."[40]

4.1. Definition and Terminologies

Innovation generally refers to introducing something new, with the intent either to increase value (either to customers or producers) or to solve some problem. These new "things" can include ideas, methods, digital content, or devices. However, not all innovations are high tech in nature.[41]

OECD and Eurostat (2005) defines innovation as the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations.[42]

4.2. The Innovation Management Process

Innovation starts with identifying a customer or market need. Importantly for the innovator, neither the customer nor the market may recognize that need. This first stage usually requires creative thinking. [43]

Once the customer opportunity has been created, the solutioning is where most people recognize innovation as taking place. After this second stage, the concept is finished and a working solution must be developed. The third stage in the process of making the solution work is where so many organizations lose momentum and lose the advantage they gained in stages one and two. Speed to market is essential. Finally, getting to market is where far too many companies run into problems. The production, service delivery, and sales people need

[39] cf. Verburg, Ortt, Dicke (2009), p. 215
[40] cf. Al-Hakim, Jin (2010), p. 137
[41] cf. Mohr, Sengupta, Slater (2009), p. 9
[42] cf. OECD,Eurostat (2005), p. 48, 49
[43] cf. Merrill (2008), p. 8

to have been involved in the earlier stages if a long-term and continuous innovation process is desired.[44]

The activities that need to be performed in an innovation process are:

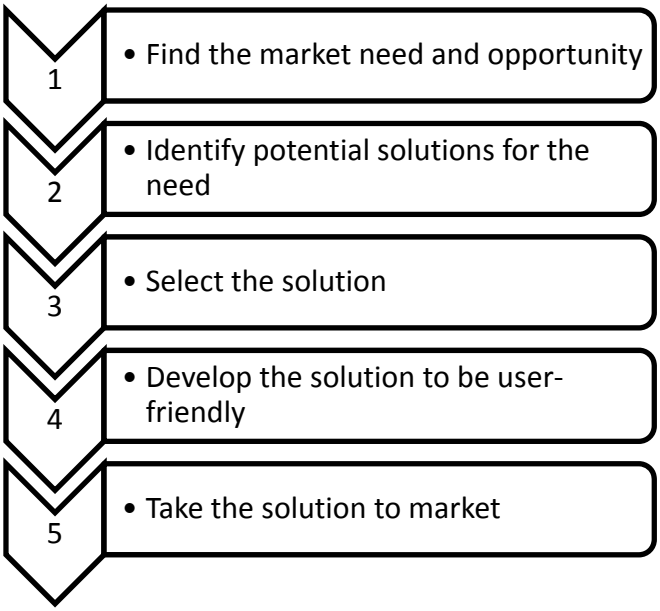

Figure 5: Activities in the Innovation Process[45]

The organizational functions that perform these activities typically are:

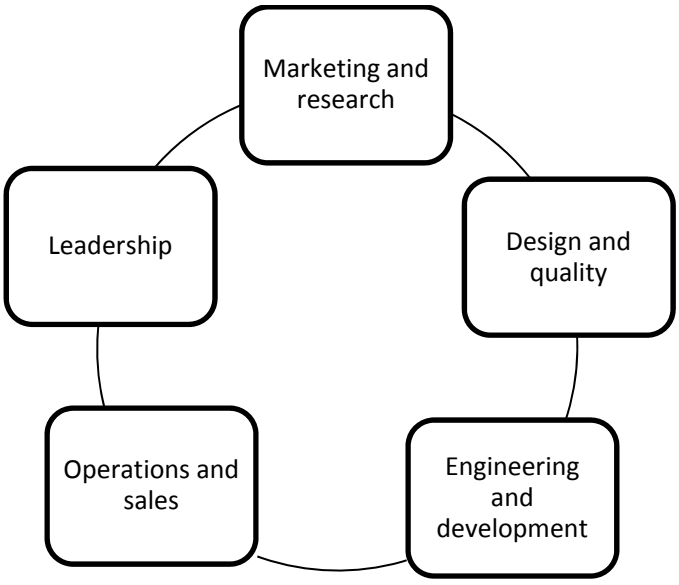

Figure 6: Organizational functions in Innovation Management[46]

[44] cf. Merrill (2008), p. 8
[45] cf. Merrill (2008), p. 10

The difficult task of valuing promising ideas for new products in monetary terms has forced companies to view their spending on innovation and product development as a cost rather than an investment. Accounting rules require that investments in R&D are treated as a cost; even though the economic reality is that it is more of an investment. Furthermore, the measurement of innovation seems to be essential to sustain them. Especially the internal performance measurement is essential to for generating high innovation output. The measurement of the outcomes of the innovation process is also important. [47]

5. Marketing Management in Product Development

5.1. Marketing Technologically Advanced Products

The market for technologically advanced products has become global in the past decade. Technology-based firms - which not too long ago used to launch their new products first in the home market, then their hemisphere of origin, and only ultimately the rest of the world - now strive for world leadership positions through world-wide product introductions. [48]

The global competition in the industrial, consumer durable and high technology sectors rests largely in technological innovation. The technological boundary - what is technologically feasible - has advanced dramatically in many sectors of the economy. This has translated into more rapid rates of product and process innovation and has led to a shortening of product and process life cycles. All over the world, previously static industrial and consumer markets have become dynamically competitive. The rules of competition in the national product-marketplaces have changed accordingly.[49]

The Market and Competitive Environment seems to be a trigger or driving force for innovations. Low performing companies might not be close enough to the market to experience the pressure of global competitors. It seems to be important for innovations to monitor the actions of local, national and global competitors to know their market

[46] cf. Merrill (2008), p. 10
[47] cf. Al-Hakim, Jin (2010), p. 111
[48] cf. Bender (1989), p. 159
[49] cf. Bender (1989), p. 159

movements. [50] A market environment analysis is the main activity that serves as the foundation for the information input to the company. It is important that the analysis covers all aspects for the intended customer and market segment e.g. technology, competitors, the customer's future business and process, market and more. The market environment analysis activity is important since the sources of innovation are typically found among users, manufacturers, suppliers and others[51]

Confronted with rapid change - in procurement, research, development, engineering, manufacturing marketing, distribution and logistics - the technology-based firm more than ever needs to strive for synergy at the technology/marketing interface. It needs to encourage entrepreneurship in new product development, and to gain greater interdepartmental integration. Above all, it must implant more of a marketing orientation in each and every business function. Non-linear solutions are called for in response to these taxing problems.

It has long been recognized that technological innovation is a major agent of growth and change. However, only first-order derivatives of the technological innovation literature have found their way into marketing via the new product development discipline. Technological innovation as much a marketing as a technological phenomenon: it is the result of a matching process linking technology to market. The key idea is to combine two basic sources of competitive advantage: a technological innovation orientation (with concentrates on technical product characteristics) with a customer value focus (which concentrates on user needs). [52]

5.2. Customer Value as a Key to Success

The essence of marketing has been stated by Levitt in simple terms as follows:

1. Marketing is concerned with generating and keeping customers.
1. Customers are generated and kept through offerings that provide superior customer value.
2. Superior profit performance will result from the provision of customer value.

[50] cf. Al-Hakim, Jin (2010), p.112
[51] cf. v. Hippel (1988)
[52] cf. Bender (1989), p. 159

Marketers assume that consumer and industrial customers will buy the product that offers the highest value. The mission of the firm then is to generate differential customer value and to exercise control over costs. [53]

5.3. Strategic Postures

To enhance customer value, the company can opt to increase the technical, service or relationship value of the offering or to lower the price (strategies which are described as product differentiation and cost leadership postures).

- A company pursuing a product differentiation strategy strives to enhance product value through enhancing the technical, service or relationship value of the marketed good. Product differentiation can be accomplished through product and/or service innovation.
- A firm following a cost leadership strategy aims for the low cost producer position through assuming a process innovation thrust and through passing this cost position on to its customers in the form of a lower price of the marketed good. [54]

[53] cf. Bender (1989), p. 160
[54] cf. Bender (1989), p. 160f

6. Strategy Development

6.1. Basic Strategy Development

The purpose of developing a strategy is to formulate a way to reach competitive advantage, a position where a firm is able to create more value for customers than its competitors. Competitive advantage exists when the firm possesses resources and competencies that are valuable, rare, durable, and difficult for competitors to imitate. Companies must determine whether the strategy and its supporting competencies and assets lead to a position of sustainable superiority. This assessment determines whether the strategy is likely to be successful or whether it needs to be adjusted.[55]

Various analysis methods and frameworks that guide businesses to formulate a strategy can be found in the literature.[56] Every firm's strategy formulation process should answer at least the following three key questions[57]:

- Who are the target customers?
- What values can be offered?
- How can that value be created and delivered both efficiently and effectively?

There are various ways to answer these three strategy questions. However, four basic archetypes can be distinguished.[58]

Table 4 shows an overview of these approaches:

[55] cf. Mohr, Sengupta, Slater (2009), p. 48,51
[56] cf. Baker, Hart (2007), p. 172
[57] cf. Mohr, Sengupta, Slater (2009),p. 54
[58] cf. Mohr, Sengupta, Slater (2009), p. 55,62

	Who are the customers?	What Value?	How is Value Created?	Advantages
Product Leader (Pioneer, First Mover)	Innovators, Early adopters	Innovative new products	Focus on speed, commercializing ideas quickly	Establish barrier to entry, May gain higher profits, Define ideal product attributes
Fast Follower	Early adopters, Early majority	Superior products Lower prices New business models	Focus on cost, distribution	Innovative late entrants grow faster
Customer Intimate (Differentiated Defender)	Early and late majority, Narrow niches, Individual customers	Customized solutions, Superior service	Relationship marketing, intimate customer knowledge	High margins, High customer lifetime value
Operationally Excellent (Low-Cost Defender)	Early and late majority, Mass market, Price sensitive customers	Superior combination of quality, price and ease of purchase, cost leadership	Value chain efficiency	High asset turnover and return rates

Table 5: Basic Strategy Archetypes[59]

6.2. Detailed Strategy Development

In combination with other models, more detailed strategies can be developed. Due to its relevance for the high tech environment[60], this thesis will focus on the core strategic vision (CSV) model. Due to M. McGrath, who coined the term[61], core strategic vision provides the destination and the general direction from where a company currently stands. It supplies the context for product strategy by identifying the future development of the company, how it is expected to get there, and why it is believed to be successful[62]. A good core strategic vision has to be sufficiently focused, brief, clear and complete by answering another three basic questions[63]:

[59] cf. Mohr, Sengupta, Slater (2009), p. 55,62
[60] cf. McGrath (2001), p. 36
[61] cf. Clough, Kittlaus (2009), p. 55
[62] cf. McGrath (2001), p. 3
[63] cf. McGrath (2001), p. 11, 12

- Where do we want to go?
- How will we get there?
- Why do we think we will be successful?

The core strategic framework establishes both constraining and enabling boundaries, at the same time making sure the strategic vision is achievable. A realistic CSV is aligned with corporate strategies as well as the outside world.[64] These corporate strategies are expressed in

- Core competencies (value chain)
- Financial plan (economic model)
- Business charter
- Technology trends/strategy
- Product strategy
- Market trends/competitive strategy

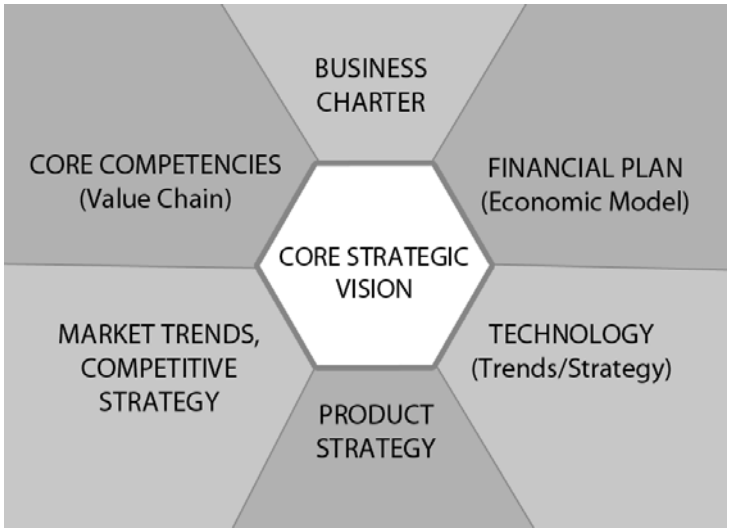

Figure 7: CSV: corporate strategy boundaries[65]

These boundary conditions aim to align the strategic vision with a variety of factors and open it up to new possibilities. They represent different edges that shape the strategic vision - external factors such as technology, market trends, and competitive position, as well as internal considerations such as company's business charter, core competencies, and

[64] cf. McGrath (2001), p. 35,36
[65] cf. McGrath (2001), p. 37

economic goals[66], most of which are described as typical characteristics of a high tech environment.

7. Summary and Conclusion

7.1. Summary

This thesis provides a systematic overview of three crucial management disciplines within the new product development in the high technology environment. It also tries to point out links and overlaps between those disciplines. By investigating Cooper's model of the stage-gate process and defining high technology as well as its implications on various management functions, this thesis starts to build up the paradigm of a systematic and comprehensive product development process, consisting of technology-, innovation-, and marketing management tasks.

In the final parts, generic strategic approaches in product development are described. Additionally, an approach to develop a product strategy that combines both characteristics of the high tech environment with corporate strategies and a well-defined vision is explained.

In conclusion, an all-new model for developing high tech products gets introduced. It combines the three management disciplines innovation-, technology-, and marketing management by setting up a common product development process – embedded in the strategic postures of a CSV strategy foundation.

[66] cf. McGrath (2001), p. 37

7.2. Introducing a High Tech Product Development Model

Management of technologies, the marketing of technological products and a well-defined innovation management are linked together at many stages in the process of (new) product development. Following the idea of uniting the three management disciplines in one efficient product development process probably turns out to be a difficult task. On the other hand, the possibility of being able to combine and cumulate the potentials of the respective areas in one common process can be seen as a challenge worth pursuing:

Consistent focusing on the customer and his needs – which can be achieved by a well-organized marketing management – enables the generation of high-quality products with high customer value. Along with the increase in efficiency by aligning business processes to shifting market conditions, an additional reduction of resource input is possible. Innovation management functions encourage the generation of creative ideas and ensure that product concepts and development processes are reviewed and evaluated systematically, which serves as an integral part of being able to develop user-friendly high tech products. The integration of technology management promotes that technological evolution and trends can be forecasted and observed in time – enabling the company to use today's fast-changing technological environment as opportunity rather than a threat.

A systematic and clearly defined innovation process, combined both with an understanding of the importance to act on technological change, as well as a precise focus on customer value is the foundation of an efficient new product development process. Only the combination of those disciplines will allow shaping and accomplishing the strategic and operational objectives of an organization to maximize customer satisfaction, corporate productivity increase, profitability and competitiveness.

If combined in a high tech product development process – i.e. following Cooper's Stage-Gate model (cf. chapter 2.1) – all crucial disciplines of managing high tech products can be taken into account at once. Following Cooper's model ensures an effective and efficient execution of tasks necessary to push the new product project through the various stages towards a successful market launch. It makes sense to link the requirements and knock-out criteria of the stages and gates with corresponding tasks of the three disciplines.

The CSV framework is a strategy development model that allows formulating a sustainable high tech product development strategy that takes the potential of a firm's core competencies as well as a variety of factors – including many typical high tech characteristics – into account. The model is especially applicable in the technology-driven areas, because it allows quicker reactions to changes in all of the three disciplines.

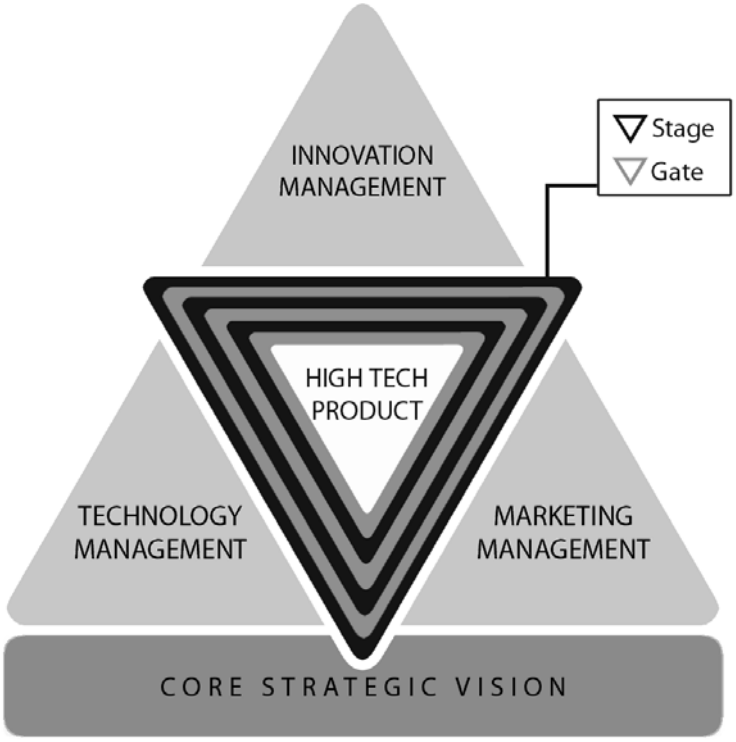

Figure 8: Model of High Tech Product Development (self-generated)

In conclusion, the model of the high tech product development process can be drawn (Figure 8): Based on the solid strategic foundation of the CSV framework, innovation-, technology-, and marketing management drive the stage-gate process forward – with the goal to generate a high tech product in the most effective and efficient way possible. The Stages and Gates surrounding the high tech product need to be passed – starting from the outermost black rectangle (stage) towards the center of the model – in order to complete the product development process. Every gate consists of a set of activities or actions which has to be completed, before the project can be pushed forward. Furthermore, the action plan for the respective next gate is defined in every gate. The quantity and defined tasks of stages and gates can vary depending on the product that gets developed.

7.3. Outlook

The profession of strategy development and finding management tools for product development – above all in the high technology environment – grow and change almost as fast as the respective markets and industries.
Within more detailed analysis, precise methods for certain niches and industries could be developed and the ongoing race for efficiency and competitive advantage continued. Trends like the sheer unstoppable globalization of technology and workforce, the shortening of product lifecycle times and time-to-market will most certainly influence future investigations and implications on product development methods.

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9. Tables and Figures

Table 1: Trends in today’s high-tech environment 7

Table 2: Goals in new product development 8

Table 3: Stages in product development 10

Table 4: Characteristic of Gates in the Stage-Gate Process 11

Table 5: Basic Strategy Archetypes 22

Figure 1: Marketing of High-Technology Products and Innovations 6
Figure 2: Schematics of a Stage-Gate Process 10
Figure 3: Areas influencing the Management of Technology and Innovation 14
Figure 4: The Links of Technology Management 14
Figure 5: Activities in the Innovation Process 17
Figure 6: Organizational functions in Innovation Management 17
Figure 7: CSV: Corporate Strategy Boundaries 23
Figure 8: Model of High Tech Product Development (self-generated) 26