

# Success factors of new product development: a review of the empirical literature

Holger Ernst

The continuous development and market introduction of new products can be an important determinant of sustained company performance. For approximately 30 years, conceptual and empirical research has been undertaken to identify the critical success factors of new products. This paper reviews the findings of empirical work into the success factors of new product development (NPD). It is the prime objective of this work to summarize the most important findings in a compact and structured way. In addition, shortcomings of previous empirical work on NPD success factors will be discussed and suggestions for improvement in future empirical NPD studies will be made.

## Introduction

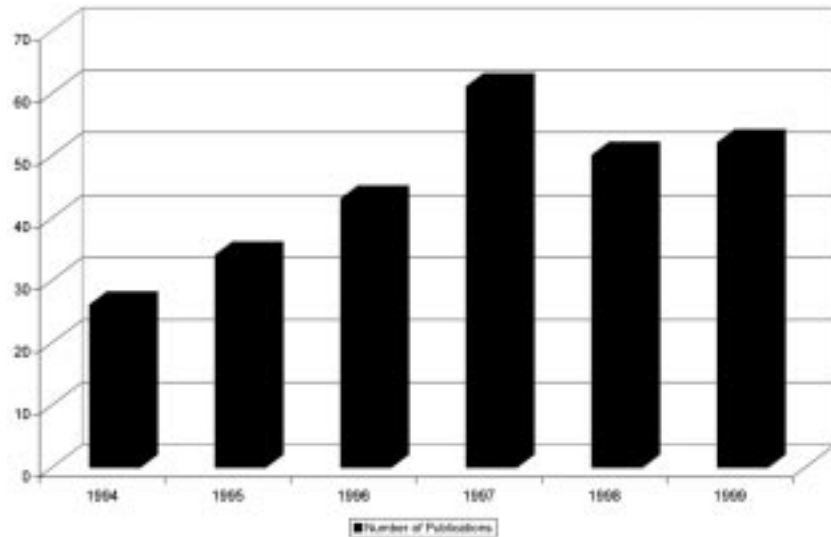
The continuous development and market introduction of new products is an important determinant of sustained company performance (Blundell *et al.* 1999; Brockhoff 1999b; Capon *et al.* 1990; Chaney and Devinney 1992; Urban and Hauser 1993). Although new products open up new opportunities for companies, the substantial risk associated with these new products should not be neglected. Empirical studies thus point to high failure rates of new products, especially in consumer markets (Brockhoff 1999b; Crawford 1987; Urban and Hauser 1993). It is therefore obvious that management is highly interested in learning about those

factors which impact the success of new products. The identification of these factors based on empirical research is the objective of success factor studies in new product development (NPD). These works will be referred to as NPD research or NPD studies throughout this paper. Management can use the results of NPD research, e.g. by means of benchmarking, in order to improve NPD activities in their respective firms. Because of its direct practical relevance as well as its inherent appeal to researchers, it is not surprising that NPD research has retained a high level of popularity over the last 30 years. Figure 1 shows that empirical NPD research still receives great attention in the scientific community today.

Holger Ernst is from the Otto Beisheim Graduate School of Management (Wissenschaftliche Hochschule für Unternehmensführung WHU), Burgplatz 2, D-56179 Vallendar, Germany.

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## Success factors of new product development: a review of the empirical literature



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**Figure 1.** Annual development of publications in referred international journals on success factors of new products (1994–1999).

It is the prime objective of this work to present a compact summary of the results to date of empirical studies into the success factors of new products.<sup>1</sup> Because of the numerous works available on this topic, a fact expressed in the many publications of review articles and meta-analyses (Albers *et al.* 2001; Balachandra and Friar 1997; Hauschildt 1993; Johne and Snelson 1988; Lilien and Yoon 1989; Montoya-Weiss and Calantone 1994; Mowery and Rosenberg 1979), it is advisable to limit and structure our presentation. This cannot be accomplished by referring to a theoretical model of determinants of innovation success, as this is not yet available in the field of innovation research. Hauschildt accurately observes:

It has already been demonstrated during the development of our organizational framework, that a universally valid *theoretical framework for the network of correlations [between variables and successful innovation, added by the author]* does not exist. Two consequences arise: on the one hand, one cannot be certain that all relevant factors have been considered; on the other hand, one is not in a position to dismiss definitively those variables

which have repeatedly proved to be meaningless and not worthy of consideration. (Hauschildt 1993, 320)

We limit our analyses to those works which have empirically analysed the relationship between potential success factors and the success of new products on the basis of relatively large samples and which contain explicit information about the statistical significance of the empirical results. Thus, we shall exclude studies which simply ask for success factors (e.g. Booz *et al.* 1982; Edgett *et al.* 1992), case studies (e.g. de Cotiis and Dyer 1979) and work undertaken without an explicit focus on the success of new products (e.g. Womack *et al.* 1990). Furthermore, results of empirical NPD research which may be relevant at the programme level will be presented here as these are more general in nature (Cooper and Kleinschmidt 1995a; Montoya-Weiss and Calantone 1994). Consequently, project or product-specific success factors such as a relative product advantage or the competitive situation at the time of the introduction of the product to the market will not be discussed here.<sup>2</sup> A further

selection criterion is the extent to which the success factors under examination can be influenced by management. Hauschildt (1993) differentiates between external background data (such as socio-political continuity or the legal system) which must be viewed by the organization as given, and internal background data (such as the legal form or the size of the organization), which cannot directly be changed by management. Both aspects will be excluded from the following undertaking, and we shall focus entirely on those factors which can be instantly influenced by management. The meta-studies addressed earlier verify that management can influence the success of a new product through a number of internal activities. The company is typically tied up in a network of potential competitors and/or partners (Hauschildt 1997; Walter 1998). In addition to internal organizational elements which shape new product development, certain external relationships can also exert a considerable influence on the success of new products. However, with the exception of customer integration into NPD, all other external factors are disregarded. Thus, it becomes very clear that the following discussion of the findings of previous NPD research to date cannot claim to be all-encompassing.

There remains considerable methodological divergence among the individual works, in particular with regard to the sample, the methods of data analyses and the measurement of new product success (Hauschildt 1991).<sup>3</sup> Because of its central importance, the latter aspect is taken into consideration to the extent that we will report the success measures used in each empirical study and that we discuss deviations of the findings with respect to the specific success measures. It is further problematic that the 'degree of newness' of an innovation is either not at all or not consistently defined in the various empirical studies and that consequently, the comparability of the findings is somewhat limited. In particular, one cannot disregard the possibility that the 'degree of newness'

especially at the project level exercises some influence on the organization and management of NPD (Hauschildt and Schlaak 2001; Schlaak 1999).

In order to structure our presentation, we use five broad categories (Cooper and Kleinschmidt 1995a), where we will look at further variables in each of the individual categories: (1) NPD process (including customer integration);<sup>4</sup> (2) organization; (3) culture; (4) role and commitment of senior management and (5) strategy. The findings of the selected NPD-studies are categorized accordingly and are subsequently presented in the second section. The relevant works by Cooper and Kleinschmidt are addressed separately within each category.<sup>5</sup> This makes it easier for the reader to acquire an overview of the numerous works of these authors, which are often based on the same data. In addition, both authors have had a profound effect on NPD research and are among the most cited researchers in the area of NPD. Important information concerning the NPD studies, especially about the sample and the measurement of NP success, as well as a summary of the essential findings, are summarized in the tables. Thus, we do not repeat the findings in detail again in the text. Rather we limit ourselves to commenting on the respective tables.

## **Success Factors of New Product Development**

### *NPD Process*

Table 1 summarizes the results of Cooper's and Kleinschmidt's work concerning the NPD process. From the early work at the project level (New Prod I) until the end of the 1970s, we can clearly see that two aspects have had a significant positive influence on the success of new products. These are (1) the proficiency of activities carried out in the individual phases of new product development, especially in development, test marketing and market introduction, and (2) the use of market



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**Table 1.** Empirical results: NPD process (Cooper and Kleinschmidt)

Publication	Success measure	Main results
<i>NewProd I: 103 companies; 195 projects (102 successes/93 failures); written questionnaire about 77 characteristics of NPD projects; industrial products; Canada</i>		
Cooper, 1979a, 1980a	Analysis of variance between successful and unsuccessful projects	<ol style="list-style-type: none"> <li>1. Proficiency of NPD process activities (+), esp. regarding the following aspects: <ul style="list-style-type: none"> <li>• Market launch</li> <li>• prototype test with customer</li> <li>• test marketing-trial sell</li> </ul> </li> <li>2. Information acquired (+), esp. regarding the following aspects: <ul style="list-style-type: none"> <li>• Knowledge of customers' price sensitivity</li> <li>• understanding of buyer behaviour</li> <li>• knowledge of customers' needs, wants and specifications for the product</li> </ul> </li> </ol>
Cooper, 1979b, 1980b	Reduction of independent variables to 18 factors; discriminant analysis between successful and unsuccessful projects	<ol style="list-style-type: none"> <li>1. Market knowledge and marketing proficiency (+)</li> <li>2. Proficiency of development activities (+)</li> <li>3. Proficiency of market launch (+)</li> </ol>
<i>Intermediate studies: 122 companies; NPD programme; written questionnaire about 66 characteristics of NPD programme; industrial products; Canada</i>		
Cooper, 1983	Reduction of 8 success variables to 3 success dimensions: <ol style="list-style-type: none"> <li>1. Overall performance</li> <li>2. Success rate</li> <li>3. Impact</li> </ol> Correlation analyses between the success dimensions and 66 variables	<ol style="list-style-type: none"> <li>1. Extensive use of market research studies (+; 1, 2)</li> <li>2. Strong market orientation of the NPD process (+; 1)</li> </ol>
Cooper, 1984b, c, d, 1986	Cluster analysis based on 3 success dimensions (Cooper, 1983): <ol style="list-style-type: none"> <li>1. Top performer</li> <li>2. High impact firms</li> <li>3. High success (low impact firms)</li> <li>4. Low success (low impact firms)</li> <li>5. Worst performer</li> </ol> 19 strategy dimensions out of 66 variables; analyses of variance between 5 clusters	<p>Significant characteristics of 'top performer':</p> <ol style="list-style-type: none"> <li>1. Strong market orientation (+), esp. regarding the following aspects: <ul style="list-style-type: none"> <li>• very strong market research efforts</li> <li>• proactive in identifying customer needs</li> </ul> </li> <li>2. Customness (–). Firms that develop custom products, which are aimed at a few customers, have an inferior relative performance</li> </ol>

Cooper and Kleinschmidt, 1986; Cooper, 1988, 1990	<p>4 success variables:</p> <ol style="list-style-type: none"> <li>1. Overall success rate (profitability)</li> <li>2. Payback period</li> <li>3. Domestic market share</li> <li>4. Foreign market share</li> </ol> <p>Correlation analyses between 13 NPD process activities and success</p>	<p>Positive impact on profitability (+, 1):</p> <ol style="list-style-type: none"> <li>1. Initial screening</li> <li>2. Preliminary market/technical assessment</li> <li>3. Detailed market study/marketing research</li> <li>4. Business/financial analysis</li> <li>5. Product development</li> <li>6. In-house product testing</li> <li>7. Formal market launch stage</li> <li>8. A complete new product process</li> </ol>
Cooper and Kleinschmidt, 1987a; Cooper, 1990	<p>10 success measures:</p> <ol style="list-style-type: none"> <li>1. Profitability level</li> <li>2. Payback period</li> <li>3. Domestic market share</li> <li>4. Foreign market share</li> <li>5. Relative sales</li> <li>6. Relative profits</li> <li>7. Sales objectives</li> <li>8. Profit objectives</li> <li>9. Opportunity window on new categories</li> <li>10. Opportunity window on new markets</li> </ol> <p>13 constructs out of 40 variables; correlation analyses between constructs and success measures</p>	<p>Positive impact on profitability (+, 1):</p> <ol style="list-style-type: none"> <li>1. Proficiency of pre-development activities, esp. regarding the following aspects: <ul style="list-style-type: none"> <li>• initial screening</li> <li>• preliminary market/technical assessment</li> <li>• detailed market study/marketing research</li> <li>• business or financial analysis</li> </ul> </li> <li>2. Protocol, esp. regarding the following aspects: <ul style="list-style-type: none"> <li>• well-defined target market</li> <li>• customer's needs, wants and preferences well defined</li> <li>• product concept well defined</li> <li>• product specifications and requirements well defined</li> </ul> </li> <li>3. Proficiency of market-related activities, esp. regarding the following aspects: <ul style="list-style-type: none"> <li>• preliminary market assessment</li> <li>• detailed market study/marketing research</li> <li>• customer test of prototype or sample</li> <li>• trial selling/test market</li> <li>• market launch</li> </ul> </li> <li>4. Proficiency of technological activities, esp. regarding the following aspects: <ul style="list-style-type: none"> <li>• preliminary technical assessment</li> <li>• product development</li> <li>• in-house product testing</li> <li>• trial pilot production</li> <li>• production start up</li> </ul> </li> </ol>
Cooper and Kleinschmidt, 1987b, c	<p>Reduction of 8 success variables to 3 success dimensions:</p> <ol style="list-style-type: none"> <li>1. Financial performance</li> <li>2. Opportunity window</li> <li>3. Market share</li> </ol> <p>Correlation analyses between NPD characteristics and 3 success dimensions:</p>	<ol style="list-style-type: none"> <li>1. Protocol or project definition prior to product development (+, 1), esp. regarding the following aspects: <ul style="list-style-type: none"> <li>• clearly defined target market</li> <li>• customer's needs, wants and preferences well defined</li> <li>• product concept well defined</li> <li>• product specifications and requirements well defined</li> </ul> </li> </ol>

Table 1. Continued

Publication	Success measure	Main results
<i>Studies in the international chemical industry: 21 companies; 103 projects (68 successes/35 failures); written questionnaire about 298 characteristics of NPD projects; chemical industry; Canada, USA and Great Britain</i>		
Cooper and Kleinschmidt, 1993b	Successful and unsuccessful projects; overall success measure (OS; 0–10 scale); correlation analyses	<ol style="list-style-type: none"> <li>Quality of execution of the activities that comprise the innovation process (+), esp. regarding the following aspects: <ul style="list-style-type: none"> <li>initial screening</li> <li>preliminary market assessment</li> <li>detailed market study</li> <li>test market/trial sell</li> <li>pilot or trial production</li> <li>pre-commercialization business analysis</li> </ul> </li> <li>Product definition prior to development (+), esp. regarding the following aspects: <ul style="list-style-type: none"> <li>target market defined</li> <li>product concept/features defined</li> <li>benefits of products to customer clear</li> <li>positioning strategy defined</li> </ul> </li> </ol>
Cooper and Kleinschmidt, 1993c	Reduction of 8 success variables into 2 success dimensions: <ol style="list-style-type: none"> <li>Financial index (FT)</li> <li>Cycle time (CT)</li> </ol> Correlation analyses with 95 NPD project characteristics	Positive impact on financial index (+, 1): <ol style="list-style-type: none"> <li>Sharp, early product definition (e.g. target market, product concept etc.)</li> <li>Quality of executing pivotal activities (e.g. initial screening, preliminary market and technical assessment, business and financial analysis)</li> <li>Strong market orientation of NPD process</li> <li>Overall quality of activities along the entire NPD process</li> </ol>
Cooper, 1994	Reduction of variables into 13 constructs; split of projects into 3 groups (top/mid/bottom) according to the 13 constructs; analyses of variance between the 3 groups with respect to 8 single success measures	Positive impact on profitability (+): <ol style="list-style-type: none"> <li>Quality of marketing actions</li> <li>Quality of pre-development activities</li> <li>Sharp and early product definition</li> <li>Market launch effectiveness</li> </ol>
Cooper and Kleinschmidt, 1994	Reduction of independent variables into 10 constructs; 2 success dimensions for measuring speed: <ol style="list-style-type: none"> <li>Staying on schedule</li> <li>Time efficiency</li> </ol> Various multivariate analyses (correlations, analysis of variance)	Positive impact on speed (+): <ol style="list-style-type: none"> <li>Up-front homework (initial screening, preliminary technical and market assessment, full-fledged market research, market research to understand customers' needs, competitive analysis, test of market acceptance, detailed business and financial analysis)</li> <li>Strong market orientation (early customer involvement, market research for product design, work closely with the customer, well-planned customer tests and field trials)</li> <li>Product definition before 'go to development' (define target market, product concept, benefits to customer, positioning strategy, product specifications)</li> </ol>

Cooper and Kleinschmidt, 1995c

Reduction of success variables into 2 success dimensions:  
1. Financial performance  
2. Time performance  
Cluster analysis based on the success dimensions:  
1. Stars  
2. Technical success  
3. Fast hits  
4. Fast dogs  
5. Big losers  
13 constructs measuring the characteristics of the NPD projects; analyses of variance between the 5 clusters

Significant characteristics of 'stars':

1. Quality of execution of the homework activities (+), esp. regarding the following aspects:
  - initial screening of product idea
  - preliminary market assessment
  - business and financial analysis prior to development
2. Quality of execution of the marketing task (+), esp. regarding the following aspects:
  - preliminary market assessment
  - detailed market study or market research
  - customer test/field trial of the product
  - market launch
3. Early sharp project definition (+), esp. regarding the following aspects: (clearly defined prior to development):
  - target market, project concept, benefits to customer, positioning, product features

Cooper and Kleinschmidt, 1995b

Success measures:  
1. Success rate  
2. Profitability rating  
3. Technical success rating  
4. Domestic market share  
5. Impact on company  
6. Time efficiency  
7. On time project  
12 constructs measuring the characteristics of the NPD projects; correlation analyses

1. Quality of execution (+), esp. regarding the following aspects:
  - quality of execution of marketing activities (1–7)
  - quality of execution of technical activities (1, 2, 3, 6, 7)
  - quality of execution of market launch (1, 2, 3, 5)
2. Pre-development homework (+, 1–7)
3. Sharp and early product definition (+, 1, 2, 3, 4, 5, 7)

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*Latest international study: 135 companies; NPD programme; written questionnaire about 48 characteristics of NPD programme; industrial products; Canada, USA and Europe*

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Cooper and Kleinschmidt, 1995a, 1996

2 success dimensions out of 10 single success variables:  
1. Programme impact (sales)  
2. Programme profitability  
Cluster analysis based on the 2 success dimensions:  
1. Solid performer  
2. High-impact technical winners  
3. Low-impact performer  
4. Dogs  
Reduction of independent variables into 9 constructs; analysis of variance (t-tests)

Significant characteristics of 'solid-performer' (+):

1. High-quality product process (construct), esp. regarding the following aspects:
  - quality of process execution
  - completeness and thoroughness
  - emphasis on up-front work (pre-development)
  - sharp, early product definition (prior to development work)
  - tough go-kill decisions points where projects really get killed
  - flexibility of process
  - strong market orientation

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information along the entire NPD process (market orientation). The latter aspect is confirmed in a follow-up study at the company level. It is interesting to mention that intense concentration of new product development on a few customers ('customness') has a negative influence on success. Obviously, 'market orientation of the NPD process' and 'customer integration into new product development' are two distinctively different aspects. The latter need not always have a positive influence on the success of new products (Brockhoff 1997, 1998).

In later work at the project level (New Prod II), the contents of the NPD process are subdivided into more detailed phases. It is shown that, in particular, the preparatory work for the project in the early phases of the NPD process ('initial screening', 'preliminary market and technical assessment') are decisive for the success of new products. Furthermore, the commercial evaluation of the intended NPD project before the actual development is undertaken is also necessary. The success factors identified in previous papers are confirmed. The orientation along phases in Cooper's and Kleinschmidt's 'Stage Gate Model' is noteworthy. In this regard, it is important to emphasize that the phase model cannot be understood from today's perspective in a stringent, sequential form. Rather, overlapping and parallel activities in NPD, e.g. in concurrent engineering, do occur in NPD (Brockhoff 1999a,b). Nonetheless, then as now, the idea of phases retains a conceptual meaning by structuring actions and their content in the course of NPD.<sup>6</sup>

The findings discussed above are confirmed by the study in the international chemical industry. In one of the works of Cooper and Kleinschmidt (1993c), the essence of their findings becomes clear. Four aspects have a positive influence on the financial success of a new product: (1) clear definition of the product before development begins – among other things, the product concept and the target market need to be clearly defined; (2) high-quality preparatory work on the project,

in which the idea is initially broadly defined – subsequently, more detailed technical and market-oriented feasibility studies, along with a commercial evaluation of the NPD project must be conducted; (3) clear orientation of the NPD process to market demands, principally in the form of market research activity and observation of the competition; and (4) the existence of a high-quality NPD process. With reference to the third point, the difference between market orientation of the NPD process and explicit customer integration into product development becomes blurred. The individual variables and the summarizing of these variables into groups leads to the assumption that, basically, the market orientation of the NPD process is measured. By definition, this serves the purpose of consultation with the customer leading to her/his inclusion into the NPD process. At this point, it becomes apparent, that the form of customer integration into the NPD process needs to be defined better. Hence, it is worth differentiating between different types of customers (Brockhoff 1998) in order to develop the appropriate framework to measure customer integration into NPD adequately.

In the most recent international study at the company level, the aforementioned success factors reappear. To these the flexibility of the NPD process and the decision to terminate a project during the NPD process must be added. In this study, market orientation of the NPD process and customer integration into the NPD process are explicitly differentiated, where the latter variable does not influence success.<sup>7</sup>

Table 2 summarizes the findings of all other authors with respect to the NPD process. On the whole, one can see that these findings barely differ from those of Cooper and Kleinschmidt. A partial explanation for this may be traced to the fact that many of the authors relied on Cooper's and Kleinschmidt's preliminary conceptual work (e.g. de Brentani 1989; Calantone *et al.* 1997; Dwyer and Mellor 1991a,b; Kotzbauer 1992; Mishra *et al.* 1996; Parry and Song 1994; Song and



Parry 1996, 1997).<sup>8</sup> Basically, the results show that the existence of a formal NPD process, which is comprehensive and characterized by professionalism throughout the process, especially in terms of evaluation and selection of new ideas (e.g. Kotzbauer 1992), development (e.g. Parry and Song 1994) and market introduction (e.g. Schmalen and Wiedemann 1999), has a positive effect on the success of new products (e.g. de Brentani 1989; Griffin 1997; Song and Parry 1996).<sup>9</sup> Within the NPD process, the following activities and/or contents are of specific importance for the success of new products:

- (1) The quality of planning before entry into the development phase: the necessary preparations for the project include, in particular, the first broad evaluation of ideas, the execution of technical and market-directed feasibility studies and a commercial evaluation of the NPD project. Beyond this, the product concept, the target market and the relative utility gain for the customer by using the new product as opposed to the competing product all need to be clearly described. (e.g. Barczak 1995; Calantone *et al.* 1997; Dwyer and Mellor 1991a,b; Maidique and Zirger 1984; Mishra *et al.* 1996; Kotzbauer 1992; Parry and Song 1994; Rothwell *et al.* 1974; Song and Parry 1996, 1997; Souder and Chakrabarti 1978).
- (2) The continuous commercial assessment of the NPD project during all phases of the NPD process (Dwyer and Mellor 1991b; Parry and Song 1994; Song and Parry 1996): this can, in the sense of a process-oriented controlling approach, serve as the basis for the decision whether to terminate a project at certain milestones. The timely and consequent termination of unprofitable NPD projects was earlier identified as an important success factor (Cooper and Kleinschmidt 1995a). The initial selection decision made before entering the development

stage is of decisive importance (Rothwell *et al.* 1974; Song and Parry 1996).

- (3) The orientation of the NPD process to the needs of the market (Atuahene-Gima 1995; Souder *et al.* 1997). This refers to the quality of market research with reference to the understanding and evaluation of customer needs (e.g. Mishra *et al.* 1995; Parry and Song 1994; Schmalen and Wiedemann 1999), the accurate prognosis of the market potential (e.g. Balbontin *et al.* 1999; Maidique and Zirger 1984), the observation of the competition (e.g. Calantone and di Benedetto 1988; Mishra *et al.* 1996), the execution of test markets (e.g. Dwyer and Mellor 1991a,b) etc. Ideally, this information should be updated during the course of the entire NPD process (Rothwell *et al.* 1974).
- (4) One must distinguish between market orientation and customer integration into NPD. The guidelines for measuring customer orientation lead one to assume that, as in the work of Cooper and Kleinschmidt, it is in principle intended to capture whether the NPD process is aligned with the needs of the customer and/or the market. Thus, it can be assumed that the consistently positive findings reflect the previously discussed importance of market orientation for NPD success (e.g. de Brentani 1989; Maidique and Zirger 1984; Rothwell *et al.* 1974; Utterback *et al.* 1976). In the sense of Brockhoff's (1998) framework, in which customers are classified according to their various contributions to NPD, customers in the aforementioned studies are understood as 'demanders', who, in the classical sense of market research, make their needs known and thus offer ideas for product development. The explicit integration of pilot customers into the NPD process as active figures or solution-providers in the sense of 'Lead Users' (Hippel 1986) is not considered.



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**Table 2.** Empirical results: NPD process (other authors)

Publication	Level of analyses, n	Success measure	Main results
Atuahene-Gima, 1995	Programme, n = 275	Building of 2 success dimensions from multiple success variables: 1. Market performance 2. Project performance	1. Market orientation (+), esp. regarding the following aspects: <ul style="list-style-type: none"> <li>● collection and use of market information</li> <li>● development of market-oriented strategy</li> <li>● implementation of market-oriented strategy</li> </ul>
Balbontin et al., 1999	Project, n = 208	Selection of successful and unsuccessful projects by respondents	1. Good proficiency of marketing and design activities (+) 2. Accurate market forecasts and predictions about customer requirements (+)
Barczak, 1995	Programme, n = 140	Reduction of 6 success variables into one success dimension: performance index	1. A professional NPD process, esp. regarding the following aspect (+): <ul style="list-style-type: none"> <li>● screening ideas</li> </ul>
De Brentani, 1989	Project, n = 276	Reduction of 16 success variables into 4 success dimension: 1. Sales and market share performance 2. Competitive performance 3. 'Other booster' 4. Cost performance	1. Strong market/customer orientation (+, 1, 3) 2. Existence of a NPD process (+, 1, 2, 4)
Calantone and di Benedetto, 1988	Project, n = 189	Selection of successful and unsuccessful projects (from a profitability standpoint) by respondents	1. Marketing activities (+), esp. regarding the following aspects: <ul style="list-style-type: none"> <li>● marketing resources and skills</li> <li>● competitive and market intelligence</li> </ul> 2. Technical activities (+), esp. regarding the following aspects: <ul style="list-style-type: none"> <li>● technical resources and skills</li> <li>● competitive and market intelligence</li> </ul>
Calantone et al., 1997	Project, n = 142	Selection of successful and unsuccessful projects (from a profitability standpoint) by respondents	1. Predevelopment marketing activities (+) 2. Predevelopment technical activities (+) 3. Marketing activities (+) 4. Technical activities (+)
Dwyer and Mellor, 1991a	Project, n = 95	Selection of successful and unsuccessful projects by respondents; 3 success measures: 1. Profitability level 2. Sales 3. Opportunity window	1. Initial screening (+, 1–3) 2. Preliminary market and technical assessment (+, 1–3) 3. Product development (+, 1–3) 4. Trial production (+, 1) 5. Test market/trial sell/market launch (+, 2)

Dwyer and Mellor, 1991b	Project, n = 114	Selection of successful and unsuccessful projects by respondents; 3 success measures: 1. Profitability level 2. Sales 3. Opportunity window	1. Initial screening (+, 1, 2) 2. Preliminary market and technical assessment (+, 1, 2) 3. Product development (+, 1, 2, 3) 4. Production start up (+, 1, 2) 5. Pre-commercialization business analysis (+, 1, 2) 6. Customer tests, test market/trial sell, market launch (+, 2)
Griffin, 1997	Programme, n = 383	4 success dimensions out of 7 single economic success variables: 1. Overall success 2. Relative success 3. Market success 4. Financial success Classification of firms in 'Best' and 'Rest' based on the 4 success dimensions	Significant differences between 'Best' (+) and 'Rest' (-): 1. Existence of a formal NPD process where the 'Best' include any particular step in the NPD process
Gruner and Homburg, 1999	Project, n = 310	4 success dimensions out of 16 single economic success variables: 1. New product quality 2. Economic success with new product 3. Quality of NPD process 4. Cost advantages derived from new product Cluster analysis based on the 4 success dimensions; 'Big hits' and 'flops' form the basis for further analyses	Significant differences between 'Big hits' (+) and 'Flops' (-) are: 1. Intensity of customer involvement in: • idea generation • concept development • assessment and selection of prototypes • market launch 2. Characteristics of customers involved in NPD: • high economic attractiveness • lead-user characteristics • scope of business relationship with customer
Kotzbauer, 1992	Project, n = 120	Selection of successful and unsuccessful projects by respondents; 3 success measures: 1. Market success 2. Financial success 3. Strategic success	1. Marketing impact (Degree and efficiency of marketing activities) (+, 1, 2, 3) 2. Planning quality (planning prior to development: early definition of target market, analysis of customer requirements, development of product concept, assessment of technical specifications) (+, 1, 2)
Maidique and Zirger, 1984	Project, n = 158 (118)	Selection of successful and unsuccessful projects by respondents (achievement of financial breakeven)	1. Successful innovations were planned more effectively and efficiently (+), esp. regarding the following aspects: • formalized on paper soon • forecast more accurately (market) • developed with a clearer market strategy 2. Better matched with user needs (+)

Table 2. Continued

Publication	Level of analyses, <i>n</i>	Success measure	Main results
Mishra and Kim and Lee, 1996	Project, <i>n</i> = 288	Selection of successful and unsuccessful projects by marketing managers	<ol style="list-style-type: none"> <li>Impact of proficiency of the formal NPD activities (+), esp. regarding the following aspects: <ul style="list-style-type: none"> <li>initial screening</li> <li>detailed market study or market research</li> <li>prototype testing in-house</li> </ul> </li> <li>Intelligence acquired about the market (+), esp. regarding the following aspects: <ul style="list-style-type: none"> <li>knew customers needs, wants, and specifications for the product</li> <li>knew customer price sensitivity</li> <li>knew competitor products strategies</li> </ul> </li> </ol>
Parry and Song, 1994	Project, <i>n</i> = 258	Selection of successful and unsuccessful projects by NPD managers	<ol style="list-style-type: none"> <li>Proficiency of process activities (+), esp. regarding the following aspects: <ul style="list-style-type: none"> <li>product development</li> <li>market research</li> <li>preliminary market assessment</li> <li>initial screening</li> <li>financial analysis</li> </ul> </li> <li>Information acquired during the new product process (+), esp. regarding the following aspects: <ul style="list-style-type: none"> <li>knew customers needs, wants and specifications</li> <li>knew the market size</li> </ul> </li> </ol>
Rothwell et al., 1974	Project, <i>n</i> = 86	Selection of successful (commercial standpoint) and unsuccessful projects by respondents	<ol style="list-style-type: none"> <li>Strong customer orientation (+), esp. regarding the following aspects: <ul style="list-style-type: none"> <li>better understanding of customer needs</li> <li>early identification of customer dissatisfaction</li> <li>intensive customer training</li> <li>update of customer information during the NPD process</li> </ul> </li> <li>Careful project selection (+)</li> </ol>
Rubenstein et al., 1976	Project, <i>n</i> = 103	3 success measures: <ol style="list-style-type: none"> <li>Technical success</li> <li>Overall economic success</li> <li>Both technical and economic success</li> </ol>	<ol style="list-style-type: none"> <li>Project structure and process (+), esp. regarding the following aspects: <ul style="list-style-type: none"> <li>level of project planning (2)</li> <li>clarity of performance requirements (3)</li> </ul> </li> <li>Availability of technical information (+, 1)</li> <li>Availability of information about characteristics of potential market (+, 2)</li> </ol>

Schmalen and Wiedemann, 1999	Project, n = 40	Selection of successful and unsuccessful projects by respondents	<ol style="list-style-type: none"> <li>1. Proficiency of market launch</li> <li>2. Market research capabilities</li> </ol>
Song and Parry, 1997	Project, n = 1.400	3 success dimensions (see 1996): <ol style="list-style-type: none"> <li>1. Relative profitability</li> <li>2. Relative sales</li> <li>3. Relative market share</li> </ol>	<ol style="list-style-type: none"> <li>1. Proficiency of activities in business/market opportunity stage (+)</li> </ol>
Song and Parry, 1996	Project, n = 788	4 success dimensions out of 12 single economic success variables: <ol style="list-style-type: none"> <li>1. Product profitability</li> <li>2. Relative sales performance</li> <li>3. Relative market share performance</li> <li>4. Window of opportunity</li> </ol>	<ol style="list-style-type: none"> <li>1. Proficiency of the predevelopment planning process (+, 1–4)</li> <li>2. Concept development and evaluation proficiency (+, 1–4)</li> <li>3. Market information (+, 1–4)</li> <li>4. Technological information (+, 1–4)</li> <li>5. Marketing research proficiency (+, 1–4)</li> </ol>
Souder and Chakrabarti, 1978	Project, n = 114	2 success variables: <ol style="list-style-type: none"> <li>1. Commercial success</li> <li>2. Technical success</li> </ol>	<ol style="list-style-type: none"> <li>1. Clarity of problem definition (+, 1, 2)</li> <li>2. Clarity of understanding user needs (+, 1, 2)</li> </ol>
Souder et al., 1997	Product, n = 150	Consensus of multiple respondents on the success or failure (commercial standpoint) of the project	<ol style="list-style-type: none"> <li>1. Proficiency of marketing activities during the NPD process (+)</li> <li>2. Proficiency of technical activities during the NPD process (+)</li> <li>3. Marketing skills (knowledge about the market) (+)</li> </ol>
Utterback et al., 1976	Project, n = 117	Selection of successful and unsuccessful projects by respondents	<ol style="list-style-type: none"> <li>1. Market-oriented factors (+), esp. regarding the following aspect:             <ul style="list-style-type: none"> <li>• project intended for specific user or end product</li> </ul> </li> </ol>

## Success factors of new product development: a review of the empirical literature

In this respect, only the work by Gruner and Homburg (1999) goes substantially further methodologically and substantively. In their work, the integration of customers is analysed on the basis of constructs that measure the interaction between customer and manufacturer in the different phases of the NPD process. Furthermore, differences between customers are made according to various criteria. It can be seen (see Table 2) that the integration of customers into the early and the later phases of NPD has a positive effect on success. While in the early phases it is a question of aligning the product concept with market requirements, in the later phases, prototype testing and support during market introduction gain in importance. It becomes clear that the contribution of customers during the total NPD process can turn out differently and that these contributions can be provided by one or more customers (Brockhoff 1998). Customers who have participated in successful NPD projects set themselves apart in three ways (Gruner and Homburg 1999). They have (a) a high commercial attractiveness, (b) the characteristics of a 'Lead User', and (c) maintained a close business relationship with the manufacturer. These findings make it clear that no sweeping statement about the effect of customer integration in the NPD process can be made (Brockhoff 1998; Hauschildt 1993). As such, the conclusions reached in other, less precise NPD works about the effects of customer integration on the success of new products are less meaningful.

### Organization

From Table 3, it becomes clear that Cooper and Kleinschmidt did not concern themselves with questions regarding the organization of new product development until their later work. The findings of the studies provide a consistent picture of five essential organiz-

ational success factors for new products. These are: (1) a cross-functional NPD team; (2) a strong and responsible project leader; (3) an NPD team with responsibility for the entire project; (4) the commitment of the project leader and the team members to the NPD project; and (5) intensive communication among team members during the course of the NPD process.

Table 4 summarizes the findings from all other authors on the organization of the NPD process. Generally, one can see that these findings hardly differ from those of Cooper and Kleinschmidt. In principal, the success of new products depends on the type and strength of a project organization for NPD in a company.<sup>10</sup> The following individual aspects should be highlighted:

- (1) A number of works verify that the project team should comprise members from several areas of expertise who can make substantial contributions to the development of a new product (Griffin 1997; Pinto and Pinto 1990; Song *et al.* 1997; Song and Parry 1997). This team includes, above all, members from R&D, Marketing and Production (Song *et al.* 1997). The formation of a cross-functional project team can be seen as an instrument to overcome organizational interfaces (Brockhoff 1994). Cross-functional project teams foster interfunctional communication and co-operation which, in turn, promote success (Balbontin *et al.* 1999; Maidique and Zirger 1984; Yap and Souder 1994). As a result, cross-functional teams have both a direct and an indirect effect on the success of new products.<sup>11</sup>
- (2) The project leader has an obviously important role. S/he must demonstrate the necessary qualifications (Balbontin *et al.* 1999), command sufficient authority (Schmalen and Wiedemann 1999) and be able to devote sufficient attention to the project (Cooper and Kleinschmidt 1995a). The authority of the project

leader is reflected especially in the success with which s/he commands individuals from the various areas of expertise and in the manner in which the responsibility for decision-making is delegated to the project level.<sup>12</sup>

- (3) Closely related to this last aspect is the autonomy or area of responsibility given to the NPD team, including the project leader. Some studies have shown that autonomy for the NPD team has a positive effect on team performance and the success of the NPD project (Gerwin and Moffat 1997; Thamhain 1990). The team should bear responsibility for the entire NPD process and not only for parts of it (Cooper and Kleinschmidt 1995a).
- (4) Commitment of the project leader and the team members to the NPD project influence its success (Balachandra 1984; Thamhain 1990). One must assume that this aspect is not to be viewed independently of the aforementioned organizational success factors.<sup>13</sup>
- (5) Successful NPD projects are characterized through intensive communication and interactive relationships (e.g. the sharing of information and project meetings) among the members of the NPD team (Balachandra *et al.* 1996; Ebadi and Utterback 1984; Rothwell *et al.* 1974; Souder and Chakrabarti 1978; Thamhain 1990). Again, one may expect that these aspects are not independent of the previously mentioned organizational success factors.<sup>14</sup>
- (6) Finally, one must ask what form of project organization ought to be chosen in order to enable the aforementioned success factors to come into effect. In the work of Larson and Gobeli (1988), both matrix and task force models are suitable for project organizations, while in Barczak's (1995) work, the latter form of project organization is the only one to have a positive effect on the success of the new product. Decisive in Barczak's

(1995) findings could be that in the telecommunication industry, which she studies, time to market is of central importance. In this case, the task force model emerges as the superior form of project organization for new product development (Hauschildt 1997).<sup>15</sup>

### Culture

Tables 5 and 6 illustrate the empirical findings of NPD studies with respect to cultural aspects. A few NPD studies show that the existence of a systematic scheme for suggesting new products, separate from other company-based suggestion schemes, can have a positive influence on the success of new products (Barczak 1995; Cooper 1984b,c,d, 1986; Cooper and Kleinschmidt 1995a).<sup>16</sup> An innovation-friendly climate in the organization together with risk-taking behaviour have occasionally been identified as being relevant to success (Voss 1985). In the most recent work by Cooper and Kleinschmidt (1995a), the construct 'entrepreneurial climate' is measured through four variables. In addition to the aforementioned scheme for suggesting ideas, the following aspects are examined: (1) the possibility for employees, particularly those in R&D, to use a set portion of their work day for independent work developing their own ideas; (2) support for work on unofficial projects which may have already been stopped by management; and (3) the availability of internal 'venture capital' to assist the realization of creative ideas.

3M Corporation is a prominent example of the first two aspects. In an interview on the firm's strategy the 'Chairman' of 3M, de Simone, stressed, among other things: "Researchers are allowed to devote 15% of their time to projects that pique their interest, even those on which management has already pulled the plug ... If you want to encourage innovation, you have to close your eyes when people are so excited about a project that they refuse to stop," he said, noting that Thinsulate, a big-selling clothing insulation material,



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**Table 3.** Empirical results: organizational aspects of NPD (Cooper and Kleinschmidt)

Publication	Success measure	Main results
<i>Studies in the international chemical industry: 21 companies; 103 projects (68 successes/35 failures); written questionnaire about 298 characteristics of NPD projects; chemical industry; Canada, USA and Great Britain</i>		
Cooper and Kleinschmidt, 1993b	Successful and unsuccessful projects; overall success measure (OS; 0–10 scale); correlation analyses	<ol style="list-style-type: none"> <li>1. Existence of a strong and accountable project leader (+)</li> <li>2. Existence of a multidisciplinary (Marketing, R&amp;D, Production) NPD team (+)</li> <li>3. Team carried project from beginning to end no hands off (+)</li> </ol>
Cooper and Kleinschmidt, 1993c	Reduction of 8 success variables into 2 success dimensions: <ol style="list-style-type: none"> <li>1. Financial index (FT)</li> <li>2. Cycle time (CT)</li> </ol> Correlation analyses with 95 NPD project characteristics	<ol style="list-style-type: none"> <li>1. Organization around a cross-functional new product team (+, 1, 2)</li> <li>2. Team was accountable for project from beginning to end (+, 1, 2)</li> </ol>
Cooper, 1994	Reduction of variables into 13 constructs; split of projects into 3 groups (top/mid/bottom) according to the 13 constructs; analyses of variance between the 3 groups with respect to 8 single success measures	Positive impact on profitability (+): <ol style="list-style-type: none"> <li>1. Cross-functional team approach, esp. regarding the following aspects: <ul style="list-style-type: none"> <li>• dedicated and focused cross-functional team</li> <li>• accountability for the entire project</li> <li>• strong project champion</li> <li>• (top management commitment and support)</li> </ul> </li> </ol>
Cooper and Kleinschmidt, 1994	Reduction of independent variables into 10 constructs; 2 success dimensions for measuring speed: <ol style="list-style-type: none"> <li>1. Staying on schedule</li> <li>2. Time efficiency</li> </ol> Various multivariate analyses (correlations, analysis of variance)	Positive impact on speed (+): <ol style="list-style-type: none"> <li>1. Project organization (cross-functional and accountable team, strong leader, dedicated team)</li> </ol>
Cooper and Kleinschmidt, 1995c	Reduction of success variables into 2 success dimensions: <ol style="list-style-type: none"> <li>1. Financial performance</li> <li>2. Time performance</li> </ol> Cluster analysis based on the success dimensions: <ol style="list-style-type: none"> <li>1. Stars</li> <li>2. Technical success</li> <li>3. Fast hits</li> <li>4. Fast dogs</li> <li>5. Big losers</li> </ol> 13 constructs measuring the characteristics of the NPD projects; analyses of variance between the 5 clusters	Significant characteristics of 'Fast hits': <ol style="list-style-type: none"> <li>1. Project organization, esp. regarding the following aspects: <ul style="list-style-type: none"> <li>• project undertaken by cross-functional team</li> <li>• strong champion drove the project</li> <li>• same team for entire project</li> <li>• dedicated teams</li> </ul> </li> </ol>



Cooper and Kleinschmidt, 1995b

- Success measures:
1. Success rate
  2. Profitability rating
  3. Technical success rating
  4. Domestic market share
  5. Impact on company
  6. Time efficiency
  7. On time project
- 12 constructs measuring the characteristics of the NPD projects; correlation analyses

1. Cross-functional new product team (+, 1, 2, 3, 6, 7)

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*Latest international study: 135 companies; NPD programme; written questionnaire about 48 characteristics of NPD programme; industrial products; Canada, USA and Europe*

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Cooper and Kleinschmidt, 1995a, 1996

- 2 success dimensions out of 10 single success variables:
1. Programme impact (sales)
  2. Programme profitability
- Cluster analysis based on the 2 success dimensions:
1. Solid performer
  2. High-impact technical winners
  3. Low-impact performer
  4. Dogs
- Reduction of independent variables into 9 constructs; analysis of variance (t-tests)

- Significant characteristics of 'solid-performer' (+):
1. High quality development teams (construct), esp. regarding the following aspects:
    - dedicated project leader (project leaders did not have a multitude of projects underway at once)
    - frequent communication and team meetings
    - efficient decisions (decisions from outside the team were handled efficiently with a minimum of bureaucracy)
  2. Cross-functional teams (construct), esp. regarding the following aspects:
    - every project had an assigned team of players
    - team was multifunctional, i.e. players from different functions in the company
    - all projects had an identifiable and accountable team leader
    - project leader and team were accountable for all facets of the project

**Table 4.** Empirical results: organizational aspects of NPD (other authors)

Publication	Level of analyses, <i>n</i>	Success measure	Main results
Balbontin <i>et al.</i> , 1999	Project, <i>n</i> = 208	Selection of successful and unsuccessful projects by respondents	<ol style="list-style-type: none"> <li>1. High level of information flow/contact between technical and commercial entities (+)</li> <li>2. Project manager with necessary (management, marketing, technical) skills (+)</li> </ol>
Balachandra, 1984	Project, <i>n</i> = 114	Selection of successful and unsuccessful (termination) projects by respondents	<ol style="list-style-type: none"> <li>1. Commitment of team members to the project (+, no termination)</li> </ol>
Balachandra <i>et al.</i> , 1996	Project, <i>n</i> = 245	Selection of successful and unsuccessful (termination) projects by respondents	<ol style="list-style-type: none"> <li>1. Frequency of use of different methods of communicating project decisions (+, no termination), esp. regarding the following aspects: <ul style="list-style-type: none"> <li>• meetings with project members</li> <li>• information of project managers</li> </ul> </li> </ol>
Barczak, 1995	Programme, <i>n</i> = 140	Reduction of 6 success variables into one success dimension: performance index	<ol style="list-style-type: none"> <li>1. Project team (Task Force) (+)</li> </ol>
Ebadi and Utterback, 1984	Project, <i>n</i> = 117	Selection of successful (technical, commercial) and unsuccessful projects by respondents	<ol style="list-style-type: none"> <li>1. Frequency of communication within the project team</li> </ol>
Gerwin and Moffat, 1997	Project, <i>n</i> = 53	3 success dimensions out of 7 single economic success variables: <ol style="list-style-type: none"> <li>1. Task measures</li> <li>2. Task oriented process measures</li> <li>3. Psychosocial process measures</li> </ol>	<ol style="list-style-type: none"> <li>1. Withdrawing autonomy from a team is negatively (–) associated with the team's performance</li> </ol>
Griffin, 1997	Programme, <i>n</i> = 383	4 success dimensions out of 7 single economic success variables: <ol style="list-style-type: none"> <li>1. Overall success</li> <li>2. Relative success</li> <li>3. Market success</li> <li>4. Financial success</li> </ol> Classification of firms in 'best' and 'rest' based on the 4 success dimensions	Significant differences between 'Best' (+) and 'Rest' (–): <ol style="list-style-type: none"> <li>1. Use of multi-functional teams</li> </ol>

Johne, 1984	Programme, n = 16	Selection of 8 innovative (successful new product introductions) and 8 non-innovative firms by experts	Significant differences between innovative (+) and non-innovative (-) firms are: <ol style="list-style-type: none"> <li>1. Temporary project teams</li> <li>2. Loose infra-structural arrangements are functional for initiation</li> <li>3. Tight infra-structural arrangements are functional for implementation</li> </ol>
Larson and Gobeli, 1988	Project, n = 540	4 success measures: <ol style="list-style-type: none"> <li>1. Meeting schedule</li> <li>2. Controlling cost</li> <li>3. Technical performance</li> <li>4. Overall results</li> </ol>	<ol style="list-style-type: none"> <li>1. Project teams (a project manager is put in charge of a project team, assigned on a full-time basis) (+, 1-4)</li> <li>2. Project matrix (a project manager is assigned to oversee the project and has primary responsibility and authority for completing the project) (+, 1-4)</li> </ol>
Maidique and Zirger, 1984	Project, n = 158 (118)	Selection of successful and unsuccessful projects by respondents (achievement of financial breakeven)	<ol style="list-style-type: none"> <li>1. More experienced project team (+)</li> <li>2. Developed by better-coupled functional areas (+)</li> </ol>
Pinto and Pinto, 1990	Project, n = 262	2 success dimensions out of multiple economic success variables (project implementation success): <ol style="list-style-type: none"> <li>1. Perceived task outcomes</li> <li>2. Psychosocial outcomes</li> </ol>	<ol style="list-style-type: none"> <li>1. Cross-functional co-operation (+, 1-2)</li> </ol>
Rothwell et al., 1974	Project, n = 86	Selection of successful (commercial standpoint) and unsuccessful projects by respondents	<ol style="list-style-type: none"> <li>1. Internal communication</li> </ol>
Rubenstein et al., 1976	Project, n = 103	3 success measures: <ol style="list-style-type: none"> <li>1. Technical success</li> <li>2. Overall economic success</li> <li>3. Both technical and economic success</li> </ol>	<ol style="list-style-type: none"> <li>1. Organizational structure (+), esp. regarding the following aspects: <ul style="list-style-type: none"> <li>• level of interdepartmental communication (3)</li> <li>• level of project team communication (3)</li> <li>• clarity in communication of project demands and responsibilities (3)</li> <li>• effectiveness of communication among organizationally independent groups (3)</li> </ul> </li> </ol>
Schmalen and Wiedemann, 1999	Project, n = 40	Selection of successful and unsuccessful projects by respondents	<ol style="list-style-type: none"> <li>1. Sufficient project resources (responsibilities of project leader)</li> </ol>

**Table 4.** Continued

Publication	Level of analyses, <i>n</i>	Success measure	Main results
Song et al., 1997	Project, <i>n</i> = 291	1 success dimension (new product performance) combining 4 success variables: 1. Relative product quality 2. Relative NPD cycle time 3. NPD objectives met 4. NPD programme was successful	1. Cross-functional co-operation (+, 1–4)
Song and Parry, 1997	Project, <i>n</i> = 1.400	3 success dimensions: 1. Relative profitability 2. Relative sales 3. Relative market share	1. Cross-functional integration (+)
Souder and Chakrabarti, 1978	Project, <i>n</i> = 114	2 success variables: 1. Commercial success 2. Technical success	1. Completeness of information exchanged during project work (+, 1, 2)
Thamhain, 1990	Firm, <i>n</i> = 52	5 success measures: 1. No. of innovative ideas 2. Meeting goals 3. Change orientation 4. Commitment 5. Senior management perception of innovative performance	1. Team autonomy (+, 5) 2. Experienced and qualified project team (+, 5) 3. High team involvement and visibility (+, 5) 4. Good communication (+, 5)
Yap and Souder, 1994	Project, <i>n</i> = 48	Selection of successful (financial standpoint) and unsuccessful projects by respondents	1. Ensuring high quality interdepartmental communication (+)

**Table 5.** Empirical results: cultural aspects of NPD (Cooper and Kleinschmidt)

Publication	Success measure	Main results
<i>Intermediate studies: 122 companies; NPD programme; written questionnaire about 66 characteristics of NPD programme; industrial products; Canada</i>		
Cooper, 1984b, c, d, 1986	Cluster analysis based on 3 success dimensions (Cooper 1983): 1. Top performer 2. High impact firms 3. High success (low impact firms) 4. Low success (low impact firms) 5. Worst performer 19 strategy dimensions out of 66 variables; analyses of variance between 5 clusters	Significant characteristics of 'top performer' (+): 1. Firm's orientation and commitment towards new products, esp. regarding the following aspects: <ul style="list-style-type: none"> <li>• active new product idea search</li> <li>• NPD programme a leading edge of corporate strategy</li> <li>• venturesome projects and programme</li> </ul>
<i>Studies in the international chemical industry: 21 companies; 103 projects (68 successes/35 failures); written questionnaire about 298 characteristics of NPD projects; chemical industry; Canada, USA and Great Britain</i>		
Cooper and Kleinschmidt, 1993b	Successful and unsuccessful projects; overall success measure (OS; 0–10 scale); correlation analyses	1. Existence of a strong project champion driving the project (+)
Cooper and Kleinschmidt, 1993c	Reduction of 8 success variables into 2 success dimensions: 1. Financial index (FT) 2. Cycle time (CT) Correlation analyses with 95 NPD project characteristics	1. A strong champion as project leader driving the project (+)
<i>Latest international study: 135 companies; NPD programme; written questionnaire about 48 characteristics of NPD programme; industrial products; Canada, USA and Europe</i>		
Cooper and Kleinschmidt, 1995a, 1996	2 success dimensions out of 10 single success variables: 1. Programme impact (sales) 2. Programme profitability Cluster analysis based on the 2 success dimensions: 1. Solid performer 2. High-impact technical winners 3. Low-impact performer 4. Dogs Reduction of independent variables into 9 constructs; analysis of variance (t-tests)	Significant characteristics of 'solid-performer' (+): 1. Entrepreneurial climate (construct), esp. regarding the following aspects: <ul style="list-style-type: none"> <li>• idea generation, where a new product idea suggestion scheme solicited ideas from employees</li> <li>• free time, where technical employees were provided 'free time' 'scouting time' (up to 10–20% of their work week) to do creative things or to work on their pet projects</li> <li>• bootstrapping, where resources or 'seed money' were made available for creative work or pet projects</li> <li>• skunk works, where the formation of 'skunk works' was encouraged</li> </ul>

**Table 6.** Empirical results: cultural aspects of NPD (other authors)

Publication	Level of analyses, <i>n</i>	Success measure	Main results
Barczak, 1995	Programme, <i>n</i> = 140	Reduction of 6 success variables into one success dimension: performance index	<ol style="list-style-type: none"> <li>1. Idea generating (+)</li> <li>2. Product champions (+)</li> </ol>
Chakrabarti, 1974	Project, <i>n</i> = 45	Selection of successful and unsuccessful projects by respondents	<ol style="list-style-type: none"> <li>1. Existence of a product champion (+)</li> </ol>
Maidique and Zirger, 1984	Project, <i>n</i> = 158 (118)	Selection of successful and unsuccessful projects by respondents (achievement of financial breakeven)	<ol style="list-style-type: none"> <li>1. A clearly identifiable product champion (+)</li> </ol>
Rothwell et al., 1974; Jervis, 1975	Project, <i>n</i> = 86	Selection of successful (commercial standpoint) and unsuccessful projects by respondents	<ol style="list-style-type: none"> <li>1. Strength of management and characteristics of managers (+), esp. regarding the following aspects: <ul style="list-style-type: none"> <li>• the business innovator responsible for success has more power, responsibility, diverse experience, enthusiasm and a higher status than his counterpart in the unsuccessful firm</li> <li>• there is someone who plays the role of 'product champion'</li> </ul> </li> </ol>
Song and Parry, 1997	Project, <i>n</i> = 1.400	3 success dimensions: <ol style="list-style-type: none"> <li>1. Relative profitability</li> <li>2. Relative sales</li> <li>3. Relative market share</li> </ol>	<ol style="list-style-type: none"> <li>1. Internal commitment (existence of individuals in the firm who were dedicated to the success of the project), esp. regarding the following aspect: <ul style="list-style-type: none"> <li>• existence of a project champion (+, 1)</li> </ul> </li> </ol>
Voss, 1985	Project, <i>n</i> = 18	3 success variables: <ol style="list-style-type: none"> <li>1. Installation success</li> <li>2. Commercial success</li> <li>3. Composite measure of success</li> </ol>	<ol style="list-style-type: none"> <li>2. Good management practice, esp. regarding the following aspect: <ul style="list-style-type: none"> <li>• risk taking climate (+, 1–3)</li> </ul> </li> </ol>
Yap and Souder, 1994	Project, <i>n</i> = 48	Selection of successful (financial standpoint) and unsuccessful projects by respondents	<ol style="list-style-type: none"> <li>1. Recruiting influential product champions (+)</li> </ol>

resulted from a project he had officially scuttled (Deutsch 1999,16). The establishment of venture capital funds can be seen in a number of generally larger companies including, for example, T-Nova from Deutsche Telekom AG, Vodafone Pilot Development and SVC at Siemens AG. Mixed empirical findings on the prospects for the success of such programmes have been submitted. It is clear that the success of internal 'corporate venture capital' or 'corporate venturing' depends on the manner in which it is carried out. Recommendations for this have been made in the literature (e.g. Chesbrough 2000; Garud and v.d. Ven 1992; Siegel *et al.* 1988; Simon and Houghton 1999; Sykes 1990). Thus, it may not be advisable to ask for the existence of those activities and analyse their impact on success on this aggregate level as proposed by Cooper and Kleinschmidt (1995a).

In the classic English-language literature by Chakrabarti (1974), Rothwell *et al.* (1974) and Jervis (1975), the existence and the effect of a so-called product champion is identified as a success factor for new products. This finding was subsequently verified by a number of studies (e.g. Barczak 1995; Cooper and Kleinschmidt 1993b,c; Maidique and Zirger 1984; Song and Parry 1997; Yap and Souder 1994). Accordingly, the success of new products depends on the commitment of individuals within the organization who believe in the new idea and who advance it through the organization with great personal commitment. Song and Parry describe the "product champion" as "individuals in the firm who were dedicated to the success of the project" (Song and Parry 1997, 7).

In the German-language literature, the 'promoter model' was developed at the same time (Hauschildt and Chakrabarti 1988; Witte 1973). Promoters make personal contributions to overcome internal barriers which are blocking new products. These studies demonstrate that, in general, a team made up of a skilled (champion) and a powerful promoter (power promoter) will have a positive influence on the success of a new product

(Kirchmann 1994; Witte 1973). While champions bring project-specific, usually technical knowledge to the project, the power promoter, who normally comes from senior management, secures the necessary resources for the project. The result is an efficient division of labour between different people in the process of NPD.<sup>17</sup>

Recognizably, cultural aspects are *not* in the foreground in the idea of 'product champions' or 'promoters'.<sup>18</sup> In the framework chosen here, for example, the role of management as a power promoter with reference, among other things, to its material and non-material support for NPD activities, is examined separately (see the next section). Furthermore, in the articles mentioned, it is often unclear whether the product champion is a different person from the project leader. If this is not the case, our discussion about project organization and the role of the project leader is relevant at this point (see the previous section). Certainly, one can assume that interaction between the impact of project champions or promoters on innovation success and firm culture occurs. It is hypothetically conceivable that, because of the theoretical grounding of the promoter concept, postulated on the notion of overcoming barriers, an innovation-enhancing culture and the person-centred promoter model could act as substitutes for one another. In this sense, the personal activity of promoters to champion new products would only be necessary in organizations which are characterized by an organizational culture that is less supportive to innovation.<sup>19</sup> In contrast, Cooper and Kleinschmidt (1995a) argue that the success of product champions depends on the culture within the company which will allow them to flourish and to find support (Cooper and Kleinschmidt 1995a). An empirical study on the relationship between the successful work of product champions contingent on company culture is missing to date.

The work of Cooper and Kleinschmidt (see Table 5), as well as that of all the other authors (see Table 6), shows that the influence of an



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innovation-enhancing culture or the influence of elements which the authors conceive as part of that culture, has, to date, hardly been analysed for its influence on the success of new products. A corresponding need to pursue research in this area is expressed in the literature (Hauschildt 1993; Wind and Mahajan 1997). The broad neglect of cultural aspects has presumably contributed to the fact that the concept of culture is ill-defined in existing NPD research and that a valid method for measuring innovation-enhancing culture has not, to this point, been developed and utilized.<sup>20</sup> Against the background of known definitions of the term culture, one must ask whether the variables mentioned in Tables 5 and 6 include cultural aspects. According to Schein, organizational culture can be defined in the follow way: "Organizational culture: a pattern of basic assumptions invented, discovered or developed by a given group as it learns to cope with its problems of external adaptation and internal integration that has worked well enough to be considered valid and, therefore, to be taught to new members as the correct way to perceive, think and feel in relation to those problems" (Schein 1985, 9).

The definition clearly demonstrates that culture embraces 'values', 'perceptions' and 'assumptions' of the members of an organization and influences their decisions or behaviour. NPD literature to date is primarily concerned with actions that could be viewed as the result of a specific culture. The possibility for workers in R&D to use a set portion of their work day for work on their own ideas may thus be viewed as the result of an organizational culture in which this freedom is considered important and is fostered accordingly. NPD studies to date do not include guidelines for measuring cultural influences which lie behind observable actions. Furthermore, it is crucial to recognize that the components of innovation-enhancing culture summarized here (see Tables 5 and 6) are not derived from a theoretical concept, but represent a loose collection of individual

variables. Typologies grounded in organization theory offer good starting points for an improved assessment of company culture (e.g. Cameron and Freeman 1991; Quinn and Rohrbaugh 1983). These typologies could be used to analyse the impact of organizational culture on the success of new products.

### *Role and Commitment of Senior Management*

The findings of Cooper and Kleinschmidt (see Table 7) already make it clear that the support of senior management and adequate resource allocation are success factors in NPD. It is not clear whether it is reasonable to differentiate between management's material and non-material support for new products. After all, support for NPD projects must be reflected through the appropriateness of resources, otherwise non-material support may soon be nothing more than lip-service. With this in mind, Cooper and Kleinschmidt's (1995a) construct building may be criticized. In their work, both these aspects are unconvincingly separated, and this, among other things, serves to demonstrate that the key variable for measuring the allocation of resources ('sufficient resources to achieve the NPD programme objectives') is contained in both constructs: 'senior management commitment' and 'resource support for new products' (see the section on 'Methodology' below).

In the work of Cooper and Kleinschmidt work (see Table 7) as well as in the work of other authors (see Table 8), it becomes apparent that the analysis of resource allocation needs to go beyond a simple analysis of the R&D budget. As such, Cooper (1982, 1984a), Balbontin *et al.* (1999) as well as Maidique and Zirger (1984) show that expenditures for market research and the introduction of new products to the market are meaningful for the success of new products. This again underlines the fact that 'market orientation of the NPD process' which has previously been identified as a success



**Table 7.** Empirical results: role and commitment of senior management (Cooper and Kleinschmidt)

Publication	Success measure	Main results
<i>NewProd I: 103 companies; 195 projects (102 successes/93 failures); written questionnaire about 77 characteristics of NPD projects; industrial products; Canada</i>		
Cooper, 1981	Successful and unsuccessful projects; reduction of independent variables into 13 factors; discriminant analysis	1. Overall project/company resource (R&D, marketing, sales, production) compatibility (+)
Cooper, 1982	Effectiveness of NPD programme; effectiveness is a combined measure of success rate, termination rate, failure rate and a subjective assessment of overall success and sales impact of new products; correlation analyses	1. Company resources (+), esp. regarding the following aspects (marketing resources): <ul style="list-style-type: none"> <li>● marketing research skills and resources</li> <li>● advertising and promotion strength</li> <li>● sales force and distribution prowess</li> </ul>
<i>Intermediate studies: 122 companies; NPD programme; written questionnaire about 66 characteristics of NPD programme; industrial products; Canada</i>		
Cooper, 1984a	3 success dimensions out of 8 single success variables: <ol style="list-style-type: none"> <li>1. High-impact programme strategy</li> <li>2. High success rate strategy</li> <li>3. High relative performance</li> </ol> 19 strategy dimensions out of 66 variables; correlation analyses	1. Market research spending (+, 1) 2. R&D spending (+, 1)
<i>Studies in the international chemical industry: 21 companies; 103 projects (68 successes/35 failures); written questionnaire about 298 characteristics of NPD projects; chemical industry; Canada, USA and Great Britain</i>		
Cooper and Kleinschmidt, 1993c	Reduction of 8 success variables into 2 success dimensions: <ol style="list-style-type: none"> <li>1. Financial index (FT)</li> <li>2. Cycle time (CT)</li> </ol> Correlation analyses with 95 NPD project characteristics	1. Top-management support (+, 2)
<i>Latest international study: 135 companies; NPD programme; written questionnaire about 48 characteristics of NPD programme; industrial products; Canada, USA and Europe</i>		
Cooper and Kleinschmidt, 1995a, 1996	2 success dimensions out of 10 single success variables: <ol style="list-style-type: none"> <li>1. Programme impact (sales)</li> <li>2. Programme profitability</li> </ol> Cluster analysis based on the 2 success dimensions: <ol style="list-style-type: none"> <li>1. Solid performer</li> <li>2. High-impact technical winners</li> <li>3. Low-impact performer</li> <li>4. Dogs</li> </ol> Reduction of independent variables into 9 constructs; analysis of variance (t-tests)	Significant characteristics of 'solid-performer' (+): <ol style="list-style-type: none"> <li>1. Senior management commitment (construct), esp. regarding the following aspects: <ul style="list-style-type: none"> <li>● senior management strongly committed to new products</li> <li>● senior management intimately involved in go/kill and spending decisions</li> <li>● senior management devoted the necessary resources to NPD</li> </ul> </li> <li>2. Senior management accountability (construct), esp. regarding the following aspects: <ul style="list-style-type: none"> <li>● new product performance measures were an explicit part of senior managers' annual objectives</li> <li>● performance measures became criteria for senior management compensation</li> <li>● new product results were measured regularly</li> </ul> </li> <li>3. Resource support (construct), esp. regarding the following aspects: <ul style="list-style-type: none"> <li>● sufficient resources to achieve the NPD programme's objectives</li> <li>● adequate R&amp;D budgets</li> <li>● adequate personnel resources and time freed up for new products</li> </ul> </li> </ol>

**Table 8.** Empirical results: role and commitment of senior management (other authors)

Publication	Level of analyses, <i>n</i>	Success measure	Main results
Baker and Green and Bean, 1986	Project, <i>n</i> = 211	Selection of successful and unsuccessful (technical and commercial) projects by respondents	1. Involvement of general management (+)
Balbontin et al., 1999	Project, <i>n</i> = 208	Selection of successful and unsuccessful projects by respondents	1. Adequate market research skills/resources (+) 2. Adequate sales and marketing skills/resources (+)
Bronnenberg and v. Engelen, 988	Project, <i>n</i> = 19	Selection of successful and unsuccessful projects by respondents	1. Company resource compatibility (+)
Balachandra, 1984	Project, <i>n</i> = 114	Selection of successful and unsuccessful (termination) projects by respondents	1. Increase in top management support (+, no termination)
Chakrabarti, 1974	Project, <i>n</i> = 45	Selection of successful and unsuccessful projects by respondents	1. Degree of top management support for the innovation (+) 2. Availability of personnel to implement the technology (+)
Gerstenfeld, 1976	Project, <i>n</i> = 22	Selection of successful and unsuccessful (commercial) projects by respondents	1. High degree of top management activity (+)
Johne and Snelson, 1988	Programme, <i>n</i> = 40	Comparison between firms according to the following criteria: 'currently growing successfully through active product innovation and to compare ... with ... firms which are less successful'.	1. Top-management support (+), esp. regarding the following aspects: <ul style="list-style-type: none"> <li>• top management sets broad objectives for organic growth</li> <li>• top management fosters understanding of the need for really new products</li> <li>• top management is intimately involved in the NPD process</li> </ul>
Kotzbauer, 1992	Project, <i>n</i> = 120	Selection of successful and unsuccessful projects by respondents; 3 success measures: <ol style="list-style-type: none"> <li>1. Market success</li> <li>2. Financial success</li> <li>3. Strategic success</li> </ol>	1. Management involvement and management support (+, 2, 3)
Maidique and Zirger, 1984	Project, <i>n</i> = 158 (118)	Selection of successful and unsuccessful projects by respondents (achievement of financial breakeven)	1. Successful innovations were more actively marketed and sold (+), esp. regarding the following aspects: <ul style="list-style-type: none"> <li>• more actively publicized and advertised</li> <li>• promoted by a larger sales force</li> <li>• coupled with a marketing effort to educate users</li> </ul> 2. Support from senior management (+)

Rubenstein et al., 1976	Project, n = 103	3 success measures: 1. Technical success 2. Overall economic success 3. Both technical and economic success	1. Level of resources available (+, 2) 2. Sufficiency of resources (+, 1) 3. Level of top management support (+, 3)
Schmalen and Wiedemann, 1999	Project, n = 40	Selection of successful and unsuccessful projects by respondents	1. Sufficient project resources (resources)
Song and Parry, 1997	Project, n = 1.400	3 success dimensions: 1. Relative profitability 2. Relative sales 3. Relative market share	1. Internal commitment (existence of individuals in the firm who were dedicated to the success of the project), esp. regarding the following aspect: • senior management support (+, 1) 2. Marketing and technical skills and resources (+, 1)
Song and Parry, 1996	Project, n = 788	4 success dimensions out of 12 single economic success variables: 1. Product profitability 2. Relative sales performance 3. Relative market share performance 4. Window of opportunity	1. Top management support (+, 1–4)
Thamhain, 1990	Firms, n = 52	5 success measures: 1. No. of innovative ideas 2. Meeting goals 3. Change orientation 4. Commitment 5. Senior management perception of innovative performance	1. Involved, interested, supportive management (+, 5) 2. Sufficient resources (+, 5)
Voss, 1985	Project, n = 18	3 success variables: 1. Installation success 2. Commercial success 3. Composite measure of success	1. Availability of resources (+), esp. regarding the following aspect: • resources committed to NP-projects
Yap and Souder, 1994	Project, n = 48	Selection of successful (financial standpoint) and unsuccessful projects by respondents	1. Encouraging early top management involvement (+) 2. Applying high quality resources (+)

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factor (see above), can only be professionally accomplished when the necessary resources are at hand.

At this point, it is worth mentioning the findings of Balachandra (1984), who states that with increased support of senior management, the probability that the project will be terminated decreases. This can be interpreted, for one thing, as 'positive', since senior management has a guiding hand in disputed NPD projects and may, as a power promoter, overcome internal resistance. This perspective presumes that the projects will eventually lead to a commercial success. At the same time, the findings may be interpreted as senior management holding on to their favourite projects at all economic costs, lending them the necessary support and protecting them from being stopped, even when it might be to the economic advantage of the company to terminate the project. This would be an undesirable misinvestment of scarce resources which, in light of opportunity cost, might be lacking elsewhere. Balachandra's (1984) findings do not offer an answer to this question, nor do the generally positive findings of other NPD works make it possible – partly because of methodological shortcomings – to draw definitive conclusions (see the section on 'Methodology' below).

Finally, Cooper and Kleinschmidt's (1995a) conclusion that accountability of senior management has a positive effect on the success of a new product should be discussed. This at least substantively convincing construct measures whether senior management defines goals for the NPD programme, regularly monitors the attainment of these goals and ties monetary incentives to their attainment (see Table 7). Incentives for management play an important guiding role, since senior management can make strategic decisions regarding corresponding resource allocation which may exercise considerable influence on the support for the development of new products, particularly in conflict with the existing core business. If incentives for management are linked to the attainment of

short-term sales or profit goals, the danger arises that substantial innovations will be neglected in favour of incremental developments (Brockhoff 1999a).<sup>21</sup>

### Strategy

First, we must define which findings will be presented in this section. Only those NPD studies that have examined the existence of a long-term NPD strategy, rather than its specific content, will be summarized here. With respect to the latter aspect of strategy, we should like to draw the readers' attention to those studies which have analysed the impact of certain technology or new product strategies on innovation success (e.g. Gatignon and Xuereb 1997).<sup>22</sup>

From Tables 9 and 10, it becomes clear that the aspect of NPD strategy in empirical NPD studies to this point has barely been examined. In the most recent work by Cooper and Kleinschmidt (1995a), the strategy of the NPD programme is measured as a construct consisting of four variables (see Table 9). First, the objectives of the NPD programme need to be defined and the meaning of their attainment for the overall goals of the organization must be clearly communicated. Furthermore, the NPD programme should have a strategic focus which gives overall direction to the individual NPD projects. Finally, the NPD programme has a long-term thrust as expressed by a substantial number of long-term projects in the entire NP portfolio. In Cooper and Kleinschmidt's (1995a) study, the construct 'new product strategy' is the second most important success factor for the NPD programme. A similar finding establishing the importance of a strategic framework relating the sum of individual NPD projects can be found in Cooper (1984a).

It is apparent that only a few other authors have analysed the strategies of NPD (see Table 10). Griffin (1997), Meyer and Roberts (1986) and Thamhain (1990) support the conclusion already discussed that the presence of a clear NPD strategy has a positive

**Table 9.** Empirical results: NPD strategy (Cooper and Kleinschmidt)

Publication	Success measure	Main results
<i>Intermediate studies: 122 companies; NPD programme; written questionnaire about 66 characteristics of NPD programme; industrial products; Canada</i>		
Cooper, 1983	Reduction of 8 success variables to 3 success dimensions: 1. Overall performance 2. Success rate 3. Impact Correlation analyses between the success dimensions and 66 variables	<ol style="list-style-type: none"> <li>Product strategy (+, 2), esp. regarding the following aspects: <ul style="list-style-type: none"> <li>set of products closely related to each other</li> <li>products with a similar end-use (function) as firm's existing products</li> <li>products that fit well into the firm's current product line</li> </ul> </li> <li>Nature and orientation of the programme (+, 1), esp. regarding the following aspects: <ul style="list-style-type: none"> <li>offensive product programme coupled with an active idea search effort</li> <li>technology orientation and firms which are proactive in acquiring new technologies</li> </ul> </li> </ol>
Cooper, 1984a	3 success dimensions out of 8 single success variables: 1. High-impact programme strategy 2. High success rate strategy 3. High relative performance 19 strategy dimensions out of 66 variables; correlation analyses	<ol style="list-style-type: none"> <li>High degree of programme focus/relatedness to other projects in the firm (+, 1, 2)</li> </ol>
<i>Latest international study: 135 companies; NPD programme; written questionnaire about 48 characteristics of NPD programme; industrial products; Canada, USA and Europe</i>		
Cooper and Kleinschmidt, 1995a, 1996	2 success dimensions out of 10 single success variables: 1. Programme impact (sales) 2. Programme profitability Cluster analysis based on the 2 success dimensions: 1. Solid performer 2. High-impact technical winners 3. Low-impact performer 4. Dogs Reduction of independent variables into 9 constructs; analysis of variance (t-tests)	<p>Significant characteristics of 'solid-performer' (+):</p> <ol style="list-style-type: none"> <li>New product strategy (construct), esp. regarding the following aspects: <ul style="list-style-type: none"> <li>goals or objectives defined for NPD programme</li> <li>role of new products in achieving company goals clear and communicated to all</li> <li>clearly defined arenas, areas of strategic focus to give direction to the NPD programme</li> <li>long-term thrust and focus of NPD programme, including long-term projects</li> </ul> </li> </ol>

**Table 10.** Empirical results: NPD strategy (other authors)

Publication	Level of analyses, n	Success measure	Main results
Griffin, 1997	Programme, n = 383	4 success dimensions out of 7 single economic success variables: 1. Overall success 2. Relative success 3. Market success 4. Financial success Classification of firms in 'best' and 'rest' based on the 4 success dimensions	Significant differences between 'Best' (+) and 'Rest' (-): 1. Having a clear strategy for the NPD programme 2. Measuring the commercial performance (reaching of objectives) of the NPD programme constantly
Maidique and Zirger, 1984	Project, n = 158 (118)	Selection of successful and unsuccessful projects by respondents (achievement of financial breakeven)	1. Successful innovations were planned more effectively and efficiently (+), esp. regarding the following aspect: • developed with a clearer market strategy
Meyer and Roberts, 1986	Product, n = 79	Sales growth rate: 'calculated by dividing annual sales by the age of the firm at each respective year of sales'	1. NPD programme with a strategic focus (+)
Perillieux, 1987	Project, n = 231	Selection of successful and unsuccessful projects (commercial) by respondents	1. Close relationship of new product to existing product range (+)
Thamhain, 1990	Firm, n = 52	5 success measures: 1. No. of innovative ideas 2. Meeting goals 3. Change orientation 4. Commitment 5. Senior management perception of innovative performance	1. Setting strategic goals and priorities (+, 5)

influence on the success of new products. At the same time, it should be noted that this aspect obviously requires more research.

## **Assessment of Previous Empirical NPD Research**

### **Content**

The most essential conclusions of almost thirty years of empirical NPD research can be summarized as follows: The presence of a formal or informal NPD process in the firm establishes the basis for success of new products. Within this process, the quality of planning before the beginning of the actual development stage is decisive for the success of the NPD project. The necessary preparatory work for the project comprises especially the initial, rough evaluation of ideas, the execution of technical and market-oriented feasibility studies and a thorough commercial evaluation of the NPD project. Furthermore, the project concept, the target market and the relative increase in benefits of the new product for the customer in comparison with a competitor's product must all be clearly described. The selection of the most promising projects before entering the development phase is especially important. NPD projects are continually evaluated throughout the course of the process using an 'on-going control' such that the projects which do not meet the previously defined goals are consequently terminated. In the successful NPD project, all process steps are aligned with the market requirements. Market information is up-dated throughout the NPD process and may be used as a basis for the decision to continue or terminate the project. One cannot definitively determine the advantages of customer integration into product development. This aspect must be clearly separated conceptually from the idea of the 'customer as a demander' which is expressed in the market orientation of NPD. There are hints which imply that the advantage of customer integration increases

when it is used in the early and the later phases of the NPD process and when the customers possess specific characteristics such as those of a 'Lead User' and have a high economic attractiveness.

An organizational requirement for the success of new product development is the creation of a dedicated project organization which ought to have certain generic characteristics. Generally, the project organization must ensure that the progress of the NPD project will not be negatively effected by daily routines and/or departmental influences. This implies that people be specifically assigned to the NPD team who have enough time to work on the project and that the project leader has access to team members from other departments. The NPD team should be cross-functional. Cross-functional project teams encourage interfunctional communication and co-operation and as a result can contribute to the resolution of possible interface problems. Consequently, cross-functional teams have both an indirect and a direct influence on the success of new products. The project leader has an important role to play. S/he must have the necessary qualifications and sufficient know-how, and be able to devote her/himself sufficiently to the project. Substantial autonomy for the NPD team has a positive influence on team performance and on the success of the NPD project. Furthermore, the team ought to have responsibility for the whole NPD process rather than just for parts of it. This fosters motivation and commitment of the team members, which, in turn, has a positive influence on the success of a new product. This can possibly be fostered by the implementation of project-specific material or non-material performance incentives.

Senior management's recognition of the value of new products, reflected in adequate material support of the NPD programme, seems to have a positive effect on the success of new products. The resource allocation must go beyond the R&D budget, since expenditures for market research and market



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launch of the new product are important for the success of new products. This reinforces the notion that market orientation of the NPD process, an aspect already identified as a success factor, can only be attained professionally if sufficient resources are available for these activities. It was observed that top management support prevents NPD projects from being terminated. Boulding *et al.* (1997) show in a theoretical model and a subsequent experiment that senior management is not likely to terminate an NPD project even when objective information is available that the NPD project will be a commercial failure. This lends support to the hypotheses that top management commitment with corresponding resource allocation may have a negative effect on NPD success. This question has to remain unanswered and should be subject to further empirical testing.

The impact of organizational culture and NPD strategy on the success of new products has not been adequately researched to date. Obviously, the personal engagement of specific people has an important influence on success. However, it remains unclear whether the championing or promoting activities come from the officially designated project leader or from other people in the organization. It appears to be helpful for the organization to undertake activities to encourage the emergence of individuality and creativity. In this context, the establishment of supporting and motivating elements, such as an active suggestion scheme for new products or the availability of corporate venture capital, seems to have a positive effect on the success of new products. As mentioned earlier, the impact of organizational culture on innovation success requires more sound empirical research based on valid measures of culture.

Some findings point to the importance of strategy. The NPD programme ought to have a strategic framework which offers orientation to the sum of single NPD projects. The NPD programme should have a long-term thrust. This includes, in particular, the pursuit of

long-term NPD projects which go beyond the completion of short- and medium-term NPD projects. Senior management should regularly review whether the aims of the entire NPD programme are being reached. Linking the attainment of these goals with monetary incentives for senior management can have a positive effect on success.

It is noteworthy that, over a period of nearly thirty years, the results of empirical NPD research have remained fairly constant. One can only speculate on the reasons for this. It is conceivable that the findings of research into the success factors of NPD have not been completely put into practice. Furthermore, it could be presumed that the random selection of companies for empirical investigation contains a normal distribution of 'good' and 'bad' companies which will constantly be different with respect to those fundamental success factors. This observation may also be interpreted as a sign of a certain stability of results. The extent to which this stability is caused by the methodological shortcomings of empirical NPD studies producing statistical artefacts will be discussed below.

### Methodology

The NPD works cited here, with a few exceptions of the more recent works, are methodologically well below the level of empirical work which characterizes other disciplines in the social sciences. A typical example of this is the work of Cooper and Kleinschmidt who, in the course of almost 30 years, have not changed the essence of their methodology. This point of criticism applies, however, to the vast majority of NPD studies. NPD studies have hardly made use of the methodological advancements in data collection and evaluation which have been achieved in the past several years. Often a battery of single items are used as either independent or dependent variables and tested for significant relationships with the help of bivariate testing procedures. This often results in a flood of confusing findings, depending on



the many variables used in the studies. Only in the past few years have some authors begun to conduct empirical research of success factors on the basis of reliable measurement for the dependent and the independent variables. Unfortunately, constructs are often not derived from theoretical considerations and the technical implementation of construct development does not follow the standard procedures suggested in the literature. In addition, studies frequently do not give reliability coefficients. Because these data are missing, it is not possible to make a judgement on the reliability of the constructs. Here one must encourage scholars to apply more rigorous statistical techniques in empirical studies and one should introduce minimum reporting standards in publications. Further, as a rule, linear relationships are tested, although non-linear effects (e.g. the effect of customer integration or senior management support on NPD success) are – from a theoretical standpoint – also plausible. Groups of successful and unsuccessful projects are frequently compared to determine success factors. The focus on project level data has the major drawback that company-specific factors, which are constant over individual projects, cannot be analysed. As mentioned before and illustrated in the tables, new product success has been measured in a variety of ways. In order to increase the comparability of results, researchers should use the same success measures. Among different success dimensions, one should stress the aspect of profitability because this is the ultimate dependent variable in management science. Finally, situational influences on the success impact of individual variables in a contingency model are seldom incorporated in the empirical studies. An important contingent factor may be the ‘degree of newness’ of the new product, especially for studies conducted at the project level, because it can be assumed that it affects the new product development process and the relevance of a specific success factor. Measures for the ‘degree of newness’ have

been developed and should be used in future empirical studies (Schlaak 1999).

Against the background of these critical considerations, it is not surprising that NPD research has been the subject of, in part, harsh criticism. The following quotation from Brown and Eisenhardt is a prominent example:

To use a colloquialism, it is often difficult to observe the ‘new product development’ forest amid myriad ‘results’ trees. The findings of many [NPD] studies read like ‘fishing expedition’ too many variables and too much factor analysis further, extensive bivariate analysis is commonplace, and this blurs possible multivariate relationships. Second, the research stream relies heavily on retrospective sense making of complex past processes, usually single informants. Individuals often are asked to quantify subjective judgements surrounding long lists of success and failure factors. The frequent use of single informants simply exacerbates these methodological problems. Thus, the research results are likely to suffer from a host of attributional and other biases . . . Most important, the research in this stream often presents results without relying on well-defined constructs. (Brown and Eisenhardt 1995, 353)

Although this declaration turns out to be too general,<sup>23</sup> when one considers the NPD work and its methodological weaknesses which we have summarized above, one cannot help but agree in principle with this criticism. At the same time, the findings of NPD research seem to be plausible so that, despite the methodological limitations, one finds it hard to question the practical relevance of the findings. We have already mentioned the stability of empirical results over time and numerous studies which can also be viewed as an indicator of relevance of previous NPD research.

In the above quote, a further fundamental criticism of NPD research becomes evident. The questioning of single respondents per company, so-called ‘key informants’, in the vast majority of NPD studies calls the validity



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of the findings of NPD studies in principle into question (Ernst 2001). This holds true not only for NPD research, but for a large part of the empirical research in the social sciences. It is well known that organizational research has its serious limitations, if empirical studies are based on the perception of single informants within the organization only. It has been shown that this can lead to a systematic measurement error, a so-called method error or informant bias, which hampers the validity of results (Bagozzi *et al.* 1991; Campbell and Fiske 1959; Kumar *et al.* 1993). A meta-analysis conducted by Cote and Buckley (1987) shows that method error can account on average for up to 25% of total variance.

In the field of NPD, it has been assumed that the informant's organizational role, i.e. his/her functional background or hierarchical status, can lead to an informant bias (Ernst and Teichert 1998). Whereas this work only represents preliminary evidence from a case study, latest large-scale empirical research on firms' NPD activities based on multiple informants and applying multitrait-multimethod analysis shows that different organizational positions of respondents lead, in fact, to a serious informant bias. The informant bias accounts on average for more than 30% of the total variance and lies for some constructs even above the trait (construct) variance (Ernst 2001). Thus, the assessment of organizational properties depends to a large extent on the interviewed respondent. If this effect is not taken into account, the validity of empirical results is highly questionable. It appears that some constructs cannot be measured with a sufficient degree of validity at all, making it impossible subsequently to test many of the hypotheses (Ernst 2001). The findings and conclusions drawn from previous NPD studies have to be viewed in the light of these results. In fact, a careful look at the results of previous NPD studies which include sufficient information about the organizational positions of the respondents reveals that the findings are very likely to be systematically biased (Ernst

2001; Ernst and Teichert 1998). For future NPD studies, the use of multiple informants and the application of adequate evaluation procedures for this type of data is required if informant effects on measurement are expected.

### Notes

- 1 With a few exceptions, this paper summarizes work on product innovations in manufacturing industries with a significant amount of R&D activities.
- 2 For a summary of results on these aspects, see e.g. Hauschildt (1993), Montoya-Weiss and Calantone (1994). For results of the 'NewProd' studies, see e.g. Cooper (1979a,b, 1980a,b, 1981, 1988, 1990, 1992) or Cooper and Kleinschmidt (1986, 1987a,b,c).
- 3 For a critical discussion of the comparability of empirical NPD work, see e.g. Hauschildt (1993), Montoya-Weiss and Calantone (1994) or Perillieux (1987).
- 4 The NPD process includes the steps from idea generation through to its market introduction. According to Brockhoff (1999a), one can therefore refer to an innovation process in the narrow sense excluding the diffusion of the innovation. Accordingly, only those NPD activities which are part of this NPD process are recorded here.
- 5 All NP-related works by Cooper and Kleinschmidt are combined in our discussion as their works must be understood in relation to one another, very often also because they are based on the same data.
- 6 The conception of phases can be found in many handbooks on NPD in many organizations. A thorough discussion of the existence of phases can be found in Hauschildt (1997).
- 7 The findings of this and other studies must always be interpreted in the light of methodological shortcomings. The authors use a construct, but offer no proof of its reliability (Cooper and Kleinschmidt 1995a, 1996). For a general discussion of methodological shortcomings of NPD studies, see the section on 'Methodology'.
- 8 This fact alone demonstrates the substantial influence of Cooper and Kleinschmidt on NPD research.
- 9 Controversial findings (e.g. Albers and Eggers 1991; Johne 1984) surround the so-called 'Loose-

- Tight Hypothesis' in which one must choose between a less formalized process in the early stages and a formalized process once the project is defined. This aspect is not to be placed in the foreground of this paper. For a comprehensive discussion of the 'Loose-Tight Hypothesis' see, e.g. Brockhoff (1999b) and Hauschildt (1997).
- 10 Beyond a project organization, other organizational solutions for managing innovations within and outside the firm exist (Hauschildt 1997).
  - 11 It can be presumed that the extent of the contribution of individual functions varies in the different phases of the NPD project. This aspect has not yet been studied.
  - 12 For more information on the characteristics of successful project leaders, consult Keim (1997).
  - 13 In this context, it is notable, that the influences of project-related incentive systems on the success of new products has not been studied yet. These incentives could have an effect on team commitment and hence NPD success.
  - 14 The intensity of communication and interaction may depend on the geographical proximity of the NPD team members (e.g. Allen and Fusfeld 1975). However, this variable does not have a significant effect on NP success (Cooper and Kleinschmidt 1995a). For this reason, it would be interesting to analyse whether the influence of geographical proximity is reduced in its significance as a result of better communication technologies. Here, one has to take the type of knowledge to be transferred into account (Rüdiger and Vanini 1998).
  - 15 For a complete comparison of the advantages and disadvantages of the different forms of project organization for the development of a new product, see e.g. Hauschildt (1997).
  - 16 This is a measure which many organizations have recently implemented (e.g. the 'Olympics of Innovation' at BSH Bosch and Siemens Hausgeräte GmbH. This shows very clearly that some success factors may be subject to changes over time.
  - 17 The promoter model has steadily expanded in recent years, leading to the identification of new promoter roles (e.g. the process promoter and the relationship promoter). For more on this topic, see especially the work of Hauschildt and Chakabarti (1988), Hauschildt and Gemünden (1999) or Walter (1998).
  - 18 Nonetheless, in the NPD literature, this aspect is often discussed in connection with cultural aspects of innovation (Johnes and Snelson 1988).
  - 19 One can directly expand on this thought in that the existence of measures which support innovation (see sections on 'NPD Process', 'Methodology' and 'Role and Commitment of Senior Management') also reduce the necessity of personal intervention of promoters and champions.
  - 20 The definition and measurement of organizational culture present complex tasks and are controversially discussed in the literature (see e.g. Deshpandé and Webster 1989; Düfler 1991; Smircich 1983).
  - 21 A comprehensive discussion of various incentives in the area of industrial R&D and an empirical analysis on their effects can be found in Leptien (1996). See also Gedenk (1994) on a similar issue.
  - 22 The small number of empirical NPD studies on this aspect may also be attributed to the fact that valid measurement scales still remain to be developed. Some preliminary work can be found, e.g. in the work of Brockhoff (1989) and Weisenfeld-Schenk (1995). Since these studies do not relate strategic issues to NP success, their results are not presented here.
  - 23 In more recent NPD studies, methodological advances can be found. This is particularly true for using well-defined constructs for measurement (e.g. Song and Parry 1997) and the questioning of multiple informants in each organization (e.g. Song *et al.* 1997; Souder *et al.* 1997). However, if multiple informants are questioned, this type of data has not been used to analyse informant effects on the empirical findings. Often, answers are simply averaged, which is highly problematic; for a detailed discussion see Ernst (2001).

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