

GROUPS OF GERMAN DOMESTIC APPLIANCE MANUFACTURERS ACCORDING TO NEW PRODUCT DEVELOPMENT PRACTICES

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Abstract

Finding the best way to develop new products has been always a hot topic for practitioners and academics. However, so far only a few of these kinds of studies have concentrated on a single industry. In this paper, we group German domestic appliance manufacturers with regards to their new product development (NPD) practices to discover their attitude to NPD effort. By conducting a survey we found that three different groups of manufacturers can be distinguished, i.e. *big leaders*, *good SME's*, *SME's doing little*, who differ in level of NPD performance. Overall, our results show that high engagement in the NPD practices under investigation pays and some specific practices are better than others in the domestic appliance industry.

Keywords: new product, new product management (NPD), product development, domestic appliances

Research problem and concept

Classification is an important task in every field of science. If we use classification in the case of companies where classifying variables are NPD practices, then we will have groups of companies who have different attitudes to new product management. Furthermore, if we associate these groups of firms with new product results, then we will end up with different attitudes to management of new products, which give a different level of NPD performance. This kind of classification has been already applied in the area of NPD (see, for example Cooper, 1985). Also our study addresses the issue of such classification to draw implications for academics and practitioners.

The scope of this study can be characterised by geography, industry, areas (or categories) of new product management and level of NPD management (i.e. project

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vs. firm level). The study concentrates on German domestic appliance manufacturers for two reasons. Firstly, we provide information of NPD activity of European firms as the NPD literature is over-represented by Canadian and U.S. studies (Montoya-Weiss, Calatone, 1994). Secondly, we concentrate on a single industry to eliminate a possible inter-industry effect on NPD (Barczak, 1995; Cooper, Kleinschmidt, 1993). Domestic appliance manufacturers are chosen as product life cycles are relatively short (from two to five years) in this industry, and domestic appliances are improved continually. Furthermore, the study focuses on the following areas of new product management: strategy, process, organisation, entrepreneurial climate, company's commitment, and external links. Researchers have often used new product practices of the first five categories when investigating NPD issues (see, for example Barczak, 1995; Cooper, Edgett, Kleinschmidt, 2004a, 2004b; Griffin, 1997; Page, 1993) because of their importance in practice. The last category, external links, was researched much less but some authors stress that there has been not enough (e.g. Montoya-Weiss, Calatone, 1994). Lastly, in this study we focus on new product practices on a firm-level, so in this way we respond to the dominance of project-based studies in this field (Barczak, 1995; Cooper, Kleinschmidt, 1995; Montoya-Weiss, Calatone, 1994).

The purpose of this study, therefore, is to group German domestic appliance manufacturers by using NPD practices – which come from categories of new product management given in the study scope – to discover their attitude to NPD effort. Also we want to associate these attitudes with new product results to find ways of developing new products by firms of high and low performance.

Research method

Data gathering method

A sampling frame for the survey consisted of all German manufacturers of household appliances who were identified on the basis of two NACE codes: 29710 – manufacturers of electrical domestic appliances, 29720 – manufacturers of non-electrical domestic appliances. We developed a list of the manufacturers using the Hoppenstedt database, where all NACE codes of a firm were taken into account. For each firm we identified either a new product manager or managing director (using the Hoppenstedt database, telephone or electronic mail) to whom initial postcards were sent to invite them to take part in the survey. The original list of the manufacturers amounted to 265 units and, through all the initial contacts with firms, it was reduced to 250 units for several reasons (e.g. a firm did not exist or did not develop new products or not manufacture domestic appliances).

Questionnaires were mailed with a personalised cover letter and a stamped addressed envelope to all 250 firms. Two weeks later a reminder postcard was sent to each firm who did not return the questionnaire. Altogether fifty-six valuable questionnaires were received and the response rate achieved was 22,4 percent.

The questionnaire was tested before sending it to the manufacturers on a sub-sample of seventeen respondents. Six of these respondents returned the questionnaire and all stated that they did not have any problems with filling it in.

Measuring variables

The questionnaire was developed to measure the extent to which firms were using NPD practices, their NPD performance, and several general characteristics of the firms. For clarity a brief definition was provided for each practice considered.

To measure the extent, to which a firm was applying a specific NPD practice, a six-point ordinal scale was used. The scale had labels: 1 – “not at all” and 6 – “to a very great extent”. With regard to new product strategy the survey was concentrated on new product goals, strategic focus and timing strategies. To measure new product objectives respondents were asked to show on the six-point scale the extent to which they defined goals (or objectives) of the NPD program (Cooper, Kleinschmidt, 1995; Kahn, Barczak, Nicholas, Ledwith, Perks, 2012). To measure strategic focus respondents were asked to state on the six point scale: one, the extent to which they were concentrating on the market when developing new products and two, the extent to which they were concentrating on technology (Brockhoff, Chakrabarti, 1988; Gerstenfeld, 1976; Roper, 1997). Then in case of timing strategies three options were used: first-to-market, fast follower and delayed entrant (Barczak, 1995; Schnaars, 1986). Here respondents were asked to indicate on the six-point scale the extent to which they were using each of the timing strategies.

Considering NPD process the following activities were distinguished by analysing the following studies (Crawford, Di Benedetto, 2008; Dąbrowski, 2009; 2012; Kotler, 2005): opportunity identification, concept generation and development, concept testing, concept screening, development of product prototype, customer prototype testing, marketing plan development, market testing and product introduction. To measure these activities respondents were asked to indicate on the six-point scale the degree to which their firm was engaged in each of these activities.

To distinguish various structures a criterion *the degree of projectization* (Crawford, Di Benedetto, 2008) was used and the three following structures were proposed (Moore, Pessemier, 1993): functional organisation, project matrix and venture organisation. Also a new product committee and a product champion were taken into account. Hence to find the structures used for NPD, respondents were asked to show on the six-point scale the extent to which their firm was using each of the five organisational solutions.

To characterise the entrepreneurial climate in a firm three techniques were proposed (Albach, 1993; Cooper, Kleinschmidt, 1995; Crawford, Di Benedetto, 2008): *idea suggestion schemes*, *free time* and *skunk works*. To determine a usage for each of these techniques, respondents were asked to state on the six-point scale the degree to which their company was using each of them.

With respect to company's commitment to NPD two measures were introduced: senior management commitment (Cooper et al., 2004a; Maidique, Zirger,

1984) and availability of human, financial and technological resources (Cooper, Kleinschmidt, 1995). The existence of each of these two situations in a firm was measured again on the six-point scale and respondents were asked to state the extent to which each of these situations was present in their firm.

We identified a set of external links performed by a firm when developing new products by conducting interviews with industry experts. As a consequence of this the following five linkages were included in our questionnaire: outsourcing new product designs (e.g. CAD construction); outsourcing prototyping or tooling (e.g. buying rapid prototyping or rapid tooling services); outsourcing finishing, surface-technology, assembly; co-operating with scientific and R&D institutions (e.g. universities, Fraunhofer Society); engagement in international programs which promoted innovations (e.g. Eureka, 5FP). Again, respondents were asked to show on the six-point scale the degree to which their firm was involved in each of the links.

To measure NPD performance four variables were selected from the list provided by Griffin and Page (1993). Respondents were asked to estimate the following ratios. One, the percent of sales provided by products less than three years old (Barczak, 1995; Cooper et al., 2004a). Two, the rate of successful new products to total number of product introduced (Cooper et al., 2004a). Three, the overall success of the NPD program (Barczak, 1995; Cooper, 1985) measured on a six-point ordinal scale with labels: 1 – “completely dissatisfied”; 6 – “completely satisfied”. Four, the number of new products introduced to the market in the last three years. However, after gathering data, it appeared that the latter measure was not showing real differences between firms – probably due to the heterogeneity of our sample (manufacturers of electrical and non-electrical domestic appliances) – and it was excluded from further analysis.

Finally, we measured three general characteristics of a firm like number of employees, annual turnover and year of establishment. For each variable we developed an ordinal scale with suitable intervals of the variable.

Data analysis

The whole process of data analysis was divided into two steps according to Bazarnik, Grabinski and Wojdacki (1992). Firstly, we reduced the set of NPD practices by eliminating highly correlated variables, and secondly the companies were grouped on the basis of the variables left in the set.

In the first step, we reduced the set of NPD practices from thirty to twenty-four variables by applying a cluster analysis. We used Kendall's τ coefficient to determine correlation between variables to build a distance matrix – with a measure of distance $(1 - \tau)$. Next, Ward's method was used for grouping the variables. The number of clusters was determined in a way proposed by Mojena (1977) and the process of classification was stopped when $(h_{e+1}/2) > 0.62$ for $a = 1$. The latter way gives clusters of very similar variables so only several clusters included more than one variable. For clusters with more than one variable, we found representatives

applying a centroid method. Thus twenty-four NPD practices were further used for grouping companies.

In the second step the companies were clustered, where distances between objects were calculated by the use of a formula proposed by Walesiak (1996), and a complete linkage method served to determine groups of companies. Then, the process of classification was stopped when $h_{e+1} > 0.457$ for $a = 2$ (Mojena, 1977). In this way three clusters of the domestic appliance manufacturers were found.

To describe clusters according to NPD practices, we transformed the six-point scale, used to measure the extent to which each NPD practice existed, to a two-point scale. Responses 1, 2 and 3 were combined into a new category called “to a small extent”, and responses 4, 5 and 6 were combined into a category called “to a large extent”. These two categories were used to determine a usage of each NPD practice for each group and outcomes are given in Table 1.

Moreover, suitable central tendency measures (median or mean) were calculated for the NPD performance measures for each group (p. 1 – 3, Table 2). Then, for each group a single synthetic performance measure was found by combining the central tendency measures, where the formula proposed by Walesiak (1996) was used. The values of the synthetic measure are given in point 4 of Table 2, and lower values mean higher performance because they express a “distance” from the so called “pattern-object” (i.e. an object which has the highest values of a variable among all objects).

Lastly, we calculated a median for each of the general characteristics of a firm for every group. The values of medians are shown in Table 2, points 5 – 7.

Results and discussion

The groups are described below and each of them has been given a symbolic name based upon its individual characteristics.

Table 1. New product development practices used by groups

GROUPS NAMES	GROUPS					
	I*		II**		III***	
	To a small extent	To a large extent	To a small extent	To a large extent	To a small extent	To a large extent
Defined goals (or objectives) for the NPD program	0.0%	100.0%	36.8%	63.2%	44.4%	55.6%
First-to-market	25.0%	75.0%	31.6%	68.4%	100.0%	0.0%
Fast follower	71.4%	28.6%	52.6%	47.4%	55.6%	44.4%
Delayed entrant	85.7%	14.3%	78.9%	21.1%	77.8%	22.2%
Concentrating mainly on market	14.3%	85.7%	36.8%	63.2%	0.0%	100.0%

continued Tab. 1

Concentrating mainly on technology	50.0%	50.0%	31.6%	68.4%	44.4%	55.6%
Opportunity identification	10.7%	89.3%	36.8%	63.2%	22.2%	77.8%
Concept generation and development	0.0%	100.0%	31.6%	68.4%	77.8%	22.2%
Concept testing	21.4%	78.6%	78.9%	21.1%	66.7%	33.3%
Concept screening	25.0%	75.0%	78.9%	21.1%	66.7%	33.3%
Development of product prototype	7.1%	92.9%	15.8%	84.2%	77.8%	22.2%
Customer prototype testing	25.0%	75.0%	31.6%	68.4%	77.8%	22.2%
Marketing plan development	21.4%	78.6%	84.2%	15.8%	66.7%	33.3%
Market testing	75.0%	25.0%	89.5%	10.5%	77.8%	22.2%
Market introduction	8.0%	92.0%	60.0%	40.0%	66.7%	33.3%
New product committee	21.4%	78.6%	42.1%	57.9%	77.8%	22.2%
Functional matrix	46.4%	53.6%	89.5%	10.5%	77.8%	22.2%
Project matrix	17.9%	82.1%	73.7%	26.3%	100.0%	0.0%
Venture	64.3%	35.7%	78.9%	21.1%	100.0%	0.0%
Product champion	50.0%	50.0%	47.4%	52.6%	77.8%	22.2%
Idea suggestion scheme	28.6%	71.4%	73.7%	26.3%	44.4%	55.6%
Free time	71.4%	28.6%	89.5%	10.5%	66.7%	33.3%
Skunk works	64.3%	35.7%	63.2%	36.8%	88.9%	11.1%
Senior management commitment	3.6%	96.4%	0.0%	100.0%	44.4%	55.6%
Adequate resources	17.9%	82.1%	21.0%	79.0%	55.6%	44.4%
Outsourcing new product design	64.3%	35.7%	84.2%	15.8%	100.0%	0.0%
Outsourcing prototyping or tooling	39.3%	60.7%	73.7%	26.3%	88.9%	11.1%
Outsourcing finishing, surface technology, assembly	75.0%	25.0%	57.9%	42.1%	100.0%	0.0%
Co-operation with R&D institutions	46.4%	53.6%	73.7%	26.3%	88.9%	11.1%
Involvement in international programs	81.5%	18.5%	89.5%	10.5%	100.0%	0.0%

* N = 28 except market introduction (N = 25) and involvement in international programs (N = 27).

** N = 19 except market introduction (N = 15).

*** N = 9 except concentrating mainly on market (N = 8).

Source: own work

Table 2. New product performance and general characteristics of groups

CHARACTERISTICS	GROUP		
	I	II	III
NPD PERFORMANCE MEASURES			
1 Percent of sales from products less than 3 years old	40.2%	28.6%	29.9%
2 A rate of successful new products	74.2%	58.9%	56.6%
3 Overall level of NPD program satisfaction	4.5	4	3
4 Value of synthetic NPD performance	0.00	0.64	0.80
GENERAL CHARACTERISTICS			
5 Time of firm's establishment (in years)	Before 1945	1945–1969	1970–1989
6 Number of employees	250–499	50–99	50–99
7 Turnover (millions of Euro)	40–99	19 or less	19 or less

Source: own work

Group I – Big leaders

This group includes big firms who are highly engaged in NPD and achieve the highest new product performance among all three groups. According to Table 1 their new product practices can be described as follows. Firstly, their NPD strategy has the following characteristics: all of these firms define goals for their NPD program to a large extent, usually they apply first-to-market strategy, and most of them focus mainly on market and a half on technology. Secondly, these firms apply to a large degree all the new product process activities except market testing. The latter activity is used to a small extent probably due to some disadvantages of it like, for example, risk of revealing a new product to competitors or the long time of its performance. Overall, these firms favour the systematic new product process and follow it. Thirdly, when organising for NPD most of these firms use to a large degree new product committees, project matrixes, and functional structures. But usage of project matrixes (with project teams) was much more common than functional structures, as 82.1 percent of companies stated that they were using project matrixes and 53.6 percent functional structures to a large extent. It can be surprised that the firms reported to use to a large degree both, project matrixes and functional structures, because only one of these solutions can be used for a NPD project. But the survey referred to a firm level, not to a project level, so the firms could use different structural solutions for different new product projects. Also Table 1 shows that a half of these firms make use of product champions. Fourthly, a majority of these firms use an idea suggestion scheme extensively to create an entrepreneurial climate. This technique is simply and easy to implement in a company and also well known. Fifthly, senior management was engaged and adequate resources were made available to a large degree in these firms, which is a reasonable situation. Lastly, firms of this group were highly involved in outsourcing prototyping or tooling (e.g. rapid prototyping

or rapid tooling services) and co-operation with R&D institutions when developing new products (e.g. universities or Fraunhofer institutes). The latter findings suggest that the companies of this group have been taking advantage of the most advanced technology available outside their firm and were passing some R&D work to external institutions.

It can be seen from Table 2 that all these practices resulted in very high NPD performance. These firms obtained a 74.2 percent successful rate of new products and the sales from products less than three years old amounted to 40.2 percent. And it is not surprising that overall level of satisfaction of the NPD program of these firms is 4.5 on a scale from 1 to 6.

General characteristics of these firms are given in Table 2 and say that this group includes the biggest and the oldest firms in comparison to other groups.

Summing up, firms in this group perform most of the NPD practices and as a consequence of this they achieve high new product results and can serve as a pattern for other companies. They are big and experienced firms with a potential to perform important NPD practices. In all, this group could be described as *big NPD leaders* among the German domestic appliances companies that were investigated.

Group II – Good SME's

In this group we have companies of small and medium size, and in the middle position according to their NPD performance. These firms are less engaged in NPD than the previous group but they still make a considerable NPD effort according to Table 1. They pay much attention to new product strategy because the four following practices were used by most of these firms to a large extent: defined goals for the NPD program, first-to-market strategy, concentrating on market, and concentrating on technology. An interesting thing is that nearly half of these companies (47.4%) apply to a large degree fast follower strategy. This suggests that these small and medium firms, apart from being a pioneer, develop *me-too* new products.

Regarding NPD process Table 1 shows that four activities were used in the main by most of these firms, i.e. opportunity identification, concept generation and development, development of product prototype, and customer prototype testing. This gives quite simply but still reasonable process which begins with identifying needs for new product, then through defining new product concept, the process goes to the development of prototype and, next, its testing by customers. The process ends with market introduction. The latter activity was reported to be used to a large extent only by 40 percent of these companies, and it may mean that some prototypes are left on a shelf or these firms do not pay much attention for this activity. However, market introduction has to be performed if a firm wants to have a new product on market.

Referring to new product organisational solutions, Table 1 shows that new product committees and product champions are the top two structures preferred by these firms. This attitude can be a good solution for small and medium firms to develop new products. Organisational structures of SME's are simpler than these of big

companies, since SME's have smaller number of functions and levels of management. So also simpler structures can be used to develop new products, like product champions, instead of project teams that are popular among big companies.

Next, the firms of this group to a small degree used all techniques to create entrepreneurial climate. This is a rather sad message since innovation requires special cultural arrangements. And in term of company's commitment we see from Table 1 that 79 percent of these firms had adequate resources available for NPD and in all cases senior management was committed to new products. Finally, the companies of this group practised all external links being investigated to a small extent, and this can be due to scarce resources of SME's.

Regarding new product results, it is rather not surprising that these manufacturers achieve lower results than *big leaders* because, as shown in Table 2, they are smaller.

Group III – SME's doing little

This group consists of these domestic appliance manufacturers who are least engaged in NPD effort, who are small and medium sized and obtain the lowest overall score of NPD performance. Table 1 shows that most of these firms perform only six NPD practices to a large degree. These practices come from four following categories: strategy, process, entrepreneurial culture, and company's commitment. Within two categories, i.e. new product structure and external links, a majority of firms apply all practices researched to a small extent.

According to Table 1, data suggests that these companies mainly pay attention to new product strategic issues when developing new products. As many as three strategic practices are used by most of these firms to a large degree. Specifically, these firms are likely to: define goals for their new product program, concentrate mainly on market, focus on technology. Hence, in terms of strategy these manufacturers behave more or less the same as the firms of the two previous groups. But their timing strategy seems to be different. All of these firms reported to use a first-to-market strategy to a lesser extent and 44.4 percent of them a fast follower strategy to a larger extent. Therefore they much more prefer to be the second on market than the first.

Next, the remaining three practices extensively performed by these firms – i.e. opportunity identification, idea suggestion scheme, and senior management commitment – come from different areas of NPD. This says that, apart from new product strategy, other areas of NPD are neglected by these firms. Partly this attitude can be explained by the size of these firms, as on average they fall in the same range of employment and turnover as the firms of the second group, but on the other hand this calls for improvement.

The above attitude to NPD issues is reflected in new product performance of this group as it takes the last place in comparison to other groups. As shown in Table 2 the overall level of satisfaction of the NPD program of these companies equates to

three on a scale from 1 to 6. However, two other performance measures, percent of sales from products less than three years old and the rate of successful new products, are still quite high, and this fact is hard to explain given the data gathered in our survey. One possible explanation could be related to the fact that it was only in this group that we had the majority of firms with a primary NACE code different than 29710 and 29720 NACE (about 60% of all firms). These codes were on the second or next place under reported activity in the Hoppenstedt database. Therefore, this could influence our outcomes.

Conclusion and implications

The focus of this study was to cluster German domestic appliance manufacturers according to similar NPD practices pursued by them. The analysis resulted in three groups with different attitude to NPD activity. Comparing the three groups we can say that, overall, a criterion of distinguishing the three approaches appeared to be a level of engagement in NPD effort. The first attitude is concerned with high involvement in NPD and resulted in the highest NPD performance. Usually this way of dealing with NPD activity is applied by big and the oldest German household manufacturers. The second attitude is a moderate NPD engagement and, consequently, gives medium NPD performance. It appeared that this kind of approach is pursued mainly by SME's who were younger than the group of high NPD engagement. The last revealed attitude to NPD effort relays on using only few NPD practices to a large extent. This attitude we call as the low NPD effort that, surprisingly, yields also a medium NPD performance if we take into account only two quantitative NPD performance variables, i.e. percent of sales from products less than three years old and a rate of successful new products. The study shows that this low involvement in NPD effort is applied by the youngest companies among researched and SME's in the main. Among these SME's we have quite high proportion of really small firms who employ less than 20 people.

Outcomes of this study allow us to draw some important implications. To draw the first one let us join together groups II and III as shown in Table X. In this way we can have one group represented an attitude of moderate or low NPD involvement. Such attitude to product innovation yields medium NPD results and is mainly applied by SME's. Then we can compare approach of high NPD engagement, represented by group I, to moderate and low NPD effort pursued by group II and group III. On a basis of this comparison we can conclude that high NPD involvement pays because product innovation performance of group I is much higher than of groups II and III. This implication is particularly apparent for big German household manufacturers (employing more than 250 people) and established before 1945 year.

The second conclusion comes from comparison of moderate to low NPD engagement. Table Y shows that in case of SME's an attitude of moderate and an attitude of low NPD engagement can be equally profitable. This implies that in case of

small and medium household manufacturers not only intensity of product innovation effort is important but also other factors. One of these factors can be a type of NPD practices used or, other words, choosing the right practices. For example let us compare new product strategy of firms of group II to firms of group III. From Table 1 we see that any manufacturers of the low NPD engagement do not apply first-to-market strategy to a large extent but 68.3 percent of the firms of the moderate NPD engagement do it. This implies that manufacturers from group III avoid risk in NPD, they rather concentrate on developing *me-e-to* products instead of trying to be a pioneer and this is in line with their small and medium size. Hence better matched NPD practices to company's potential can be also a factor of success in NPD.

Table 3. High versus moderate or low NPD effort

Groups	NPD attitude	NPD performance	General characteristics of manufacturers
I	High engagement	High	Big and the oldest firms
II and III	Moderate or low involvement	Medium	SME's and younger firms

Source: own work

Table 4. Moderate versus low NPD effort

Groups	NPD attitude	NPD performance	General characteristics of manufacturers
II	Moderate engagement	Medium	SME's established between 1945 and 1969
III	Low involvement	Medium	SME's established between 1970 and 1989

Source: own work

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GRUPY W NIEMIECKIM PRZEMYSŁE SPRZĘTU GOSPODARSTWA DOMOWEGO W ODNIESIENIU DO PRAKTYK KSZTAŁTOWANIA NOWYCH PRODUKTÓW

Znalezienie najlepszych sposobów projektowania nowych produktów było i jest ważnym tematem dla praktyków i naukowców. Jednak do tej pory tylko kilka tego rodzaju badań koncentrowało się na jednym przemyśle. W niniejszym artykule pogrupowano niemieckich producentów sprzętu gospodarstwa domowego zgodnie ze stosowanymi przez nich praktykami w zakresie wdrażania nowych produktów. Pozwoliło to na ujawnienie ich podejść w tym zakresie. Na podstawie przeprowadzonego badania i zastosowania analizy skupień okazało się, że można wyróżnić trzy następujące grupy tych producentów: *wielkich liderów*, *dobrych MSP*, *małe i średnie przedsiębiorstwa słabo zaangażowane*. Grupy te różnią się wynikami w zakresie wdrażania nowych produktów. Uzyskane rezultaty pokazują, że wysokie zaangażowanie we wdrażanie nowych produktów opłaca się oraz, że niektóre praktyki są lepsze od innych w branży sprzętu gospodarstwa domowego.