

Accelerating new product development : an empirical test of a hierarchy of implementation

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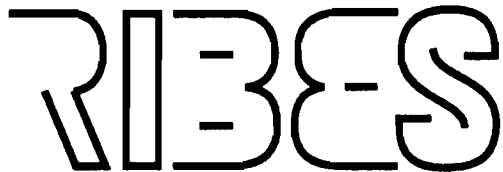
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**Accelerating New Product Development:
An empirical test of a hierarchy of implementation**

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WP 94-01**



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ABSTRACT

Over the past few years there has been an emphasis on methods a firm can use to speed up its new product development process. Millson, Raj, and Wilemon [1992] have proposed a hierarchy to the implementation of these methods. They argue that companies which accelerate in accord with this hierarchy will experience better results. In this paper this hierarchy is tested, both for its effect on faster new product development and financial performance. The results of the empirical study show that companies that accelerate in accord with the hierarchy do manage to develop their new products faster, and do have a better financial performance. Companies that accelerate their new product development but do not pay special attention to the order of implementation of the acceleration methods do turn out new products faster too. However, they do not experience an improvement in their financial performance.

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Accelerating New Product Development

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Ed J. Nijssen, Arthur R.L. Arbouw and Harry R. Commandeur

1. Introduction

In recent years there have been some major developments in the firm's operating environment. Among these developments are the increasing level of (international) competition, increasing speed of obsolescence of technologies, an increasing cost-level of developing new products and faster changing consumer demands [Capon & Glazer, 1987; Craig & Hart, 1992; Gupta & Wilemon, 1990]. As a result of these developments there has been an increasing emphasis on the importance of faster developing new products and market driven innovations. Firms which succeed in developing new products faster than their competitors can obtain several first-mover advantages [Gupta, Brockhoff & Weisenfeld, 1992; Smith & Reinertsen, 1991]. However, even to be a successful later entrant requires relatively fast NPD capabilities. A company should get its products out in time in order to be able to capitalize on its effort to meet customer needs before they change. Recent studies by McKinsey and A.D. Little show that introducing a new product six months late will have a negative effect on the cumulative profit of 17% to 35% over a period of five year. The timely introduction of a product in a high growth market however, even when 50% over budget, cuts profit potential only 4% [Karagozoglou & Brown, 1993]. In line with this, Gupta et al [1992] report that German managers who had to make trade-offs in the NPD process preferred to exceed their budget instead of risking a delay in the release of the product. Of course such evidence is, just like most success stories reported on, circumstantial by nature [Griffin, 1993]. Nevertheless, it does point to the fact that today time is a major competitive factor [Stalk, 1988; Stalk & Hout, 1990].

In order to accelerate NPD several methods have been suggested. Among them are the elimination of delays, organizing NPD around multi-functional teams, using computer

models instead of extensive empirical market research to make market predictions, and even skipping stages. Although the aim of the use of all these methods is to accelerate the NPD process in some way, the actual purpose is to improve NPD and company performance. Just moving new products to the market rapidly is no advantage if these products do not have an adequate customer fit [Cooper, 1980; Narver & Slater, 1990; Nevens, Summe & Ural, 1990]. Speeding up NPD should add to the sustainable competitive advantage of the company and thus to its overall performance. However, before a company can accelerate its NPD process, it should first prepare its organization. Speeding up without first simplifying the organization and NPD-tasks could even be counterproductive. Most authors agree on this [Ernst, 1987; Millson, Raj & Wilemon, 1992; Takeuchi & Nonaka, 1986; Vesey, 1992]. But, on the extent to which clear guidelines for implementation are possible opinions differ.

Although convinced that the creation of an organizational environment where change and innovation come naturally is a premise to successful acceleration practice, Vesey [1992] states that there will be no "single bullet" approach. Millson *et al* [1992], however, put forward a specified hierarchical model and argue that companies which follow its directives will be more successful in speeding up their NPD. The objective of this paper is to test the hierarchical model of Millson, Raj and Wilemon (MRW-hierarchy) and to draw conclusions on how to best accelerate a company's NPD. In the first section of this paper we discuss the contents of the MRW-hierarchy and its underlying rationale. Four hypotheses are formulated. In the second section we describe the empirical research conducted in order to test the hypotheses. The third section contains the findings. In the fourth, and final section, we draw conclusions and develop managerial implications and implications for future research.

2. The MRW-hierarchy of implementation

The New Product Development (NPD) process can be described as the process aimed at developing a new product, consisting of strategy formulation, organization, concept generation, concept and marketing plan evaluation, and commercialization of a new

product [Crawford, 1991]. Over time, this process has gained importance due to a quickening pace of technological developments, shorter product life cycles etc.. There is a serious pressure to reduce lead times and to get to the market first [Bower & Hout, 1988; Gupta, Brockhooff & Weisenfeld, 1992; Rosenau, 1988; Rothwell, 1992; Vesey, 1992]. This has boosted the attention for methods which can be applied to speed up the NPD process [Batson, 1987; Nayak, 1990; Nonaka, 1990]. The aim of using these methods is to decrease the time-to-market of the new product. Time-to-market can be defined as the total development time from the generation of the product idea to its manufacturing release. Today, being able to beat the competition in bringing out new products is considered an important distinctive competence that will give a company a serious competitive advantage, and will benefit company performance [Day & Wensley, 1988; Nevens, Summe & Utal, 1990]. This has to do with first mover advantages which can be obtained. A number of sources of first-mover advantages can be found: technological leadership, preemption of assets, economical advantages and buyer switching costs [Liebermann & Montgomery, 1988].

In order to accelerate its NPD process a company can apply several methods. In their article on major approaches for accelerating NPD, Millson *et al* [1992] distinguish five clusters of methods, based on an extensive analysis of the literature and discussions with two industry groups of NPD-managers and R&D directors respectively. The clusters were formed based on the similarity in their individual characteristics. The clusters include: simplify, eliminate steps, parallel processing, eliminate delays and speed-up.

Simplify:

NPD simplification concerns any action that makes processes, communication and interfaces easier to perform and manage. Apart from functional parts and certain tasks, also the organization as a whole can be simplified. For example, a flatter organization reduces the levels of reporting and time needed to get decisions approved; integrating process and product R&D can help to coordinate the total design process and thus facilitate the acceleration of NPD; and the use of more standard components or increasing part commonality across product models may help lowering manufacturing costs and time. In simplifying NPD multi-functional teams can play an important role. Teams ensure a constant flow of information across functions and minimize the problem

of ignoring interdependencies at boundaries [Thamhain, 1990]. Therefore, teams will make it easier to manage NPD projects.

Eliminate steps:

The objective of eliminating steps is to shorten or eliminate unnecessary NPD operations. It concerns distinguishing between tasks that could be done and tasks that must be done. Only the latter have to be retained. The elimination of steps can be applied to many facets of NPD. It includes skipping stages of approval in marketing or R&D, making use of lead users, and the reduction of parts in the product in order to limit the number of drawings, associated drawing inspections and approvals, manufacturing time etcetc.. However, in eliminating steps one must be careful. Often it will imply taking higher risks (e.g. skipping a test market).

Parallel processing:

Simultaneous NPD operations involves performing at least two tasks at the same time. It requires a thorough analysis of all tasks, their interrelationships and their time-frame. Although parallel processing may be implemented all along the NPD process, empirical studies show it is better not used before the probability of failure and overall project risk has been reduced significantly.

In that case, valuable resources will be wasted. To make sure good marketable products are developed, establishing an early link to customers is important. NPD activities can be simultaneous and independently performed, but also simultaneous and dependently --in multi-disciplinary teams--performed. The latter is called overlapping NPD.

Eliminate delays:

Eliminate delays can be defined as reviewing all tasks for unused time or slack between and within activities, and the removal of this unused time or slack. It may lead to a serious reduction of throughput time. Examples of the elimination of delays are the reduction of time loss between the generation of a product idea and the formation of a project team [Smith & Reinertsen, 1991], applying "Just In Time" principles to NPD [Schmenner, 1988], and removing time loss caused by waiting for inspections and approvals. However, one has to be careful not to eliminate all slack, as slack does

provide implicit review time and can lead to new creative ideas.

Speed-up:

Speeding up operations is the most direct way of accelerating NPD. It essentially requires that current activities are simply performed faster. Rosenau [1988] calls this compressing of activities. The implementation of new speed-up technologies must be accompanied by personnel training and the allocation of resources to make these technologies effective and efficient. Furthermore, without simplifying first, speeding up can be a disaster [Ernst, 1987].

Millson *et al* propose that the implementation of these clusters of acceleration methods should be done exactly in the order presented, and preferably all the way (see figure 1). Only such an implementation will, to their opinion, generate the best results and allow to obtain the greatest effectiveness. Their conceptual basis for this is that the ease of implementation diminishes going from simplification to speeding up, and that this particular sequence will have the least amount of wasted effort at later stages. They argue that products, tasks and organizations can be easily simplified as long as interfaces with other elements are considered. The eliminating of steps is a natural by-product of product and process simplification and is thus a logical step next to simplification.

Parallel processing is difficult to implement before nonessential tasks are removed and thus should be done only after the first two steps. The fourth step in the hierarchy is to eliminate delays. The elimination of delays is easier if the tasks are integrated in a simple way. Therefore, it should be done after simplification, the elimination of steps, and parallel processing. The final step is speeding up operations, for one can not run before one can walk. Accelerating without a proper organizational base can be counterproductive.

Figure 1 about here

Although the general outline of the hierarchy matches the idea that first the right organization should be created before actually speeding up the NPD process [Ernst, 1987; Takeuchi & Nonaka, 1986; Vesey, 1992], the hierarchy may be challenged. Firstly, there is the sequence of implementation. For instance, one wonders whether the stages of parallel processing and the elimination of delays should not be reversed, as parallel processing seems a much more advanced way of accelerating than the simple act of removing delays. Secondly, the stages themselves may be challenged too. This has to do with the fact that the five clusters of methods are to some extent interdependent, as Millson *et al.* also note themselves. Maybe, as the elimination of steps is a natural by-product of simplification [Millson, Rai & Wilemon, 1992, p.65] both stages are very much the same. Thirdly, the hierarchy seems to suggest that there is no need and no possibility to go back to earlier stages, once a certain level of implementation has been reached. Similar to classical hierarchical models in consumer behavior one might wonder if this is enough to cover reality adequately. However, one can also look upon the hierarchy as to simply suggest to shift the emphasis placed on the different acceleration methods in a specific direction over time, in order to generate the best results. Adopting the latter point of view eliminates the issue of possible interrelatedness between the clusters and the worry about whether the hierarchy is a oneway system or not. It brings us back to the question, whether implementing the methods of acceleration in accord with the proposed hierarchy pays off.

We formulate the following two hypotheses, in line with the argument made by Millson *et al.*:

Hypothesis 1:

Companies which accelerate their NPD process in accord with the MRW-hierarchy develop new products faster than those which do not.

Hypothesis 2:

Companies which accelerate their NPD process in accord with the MRW-hierarchy have a more favourable financial performance than those which do not.

To be able to establish the actual value of the MRW-hierarchy we decided to compare it to a straight forward approach in accelerating NPD. Companies focusing on the acceleration of NPD without paying attention to the order of implementation of the various methods will probably still experience their NPD to turn out new products faster (Just picture a company which skips stages in the NPD process). However, just moving new products to the market rapidly is no advantage if these products do not have an adequate customer fit or if they are of a poor quality. Consequently, the products' financial result may suffer and thus prevent a significant positive rise in overall financial performance. This leads us to formulate two additional hypotheses for companies which simply implement a large number of acceleration methods and/or emphasize them to a large extent without controlling for the order of implementation:

Hypothesis 3:

Companies which use a simple straight forward approach to accelerate their NPD process develop new products faster than those which do not.

Hypothesis 4:

Companies which use a simple straight forward approach to accelerate their NPD process do not have a more favourable financial performance than those which do not.

3. The empirical study

In order to be able to test the four hypotheses a sample of 263 firms was taken from the Dutch ABC-register of companies. All companies were industrial manufacturers, involved in electronics, metals and materials, chemicals and pharmaceuticals. A mailed questionnaire was used. It was addressed to the CEO of the firm. The accompanying letter requested the CEO to either participate him/herself or to pass the questionnaire on to the individual most qualified to participate in the study. This procedure resulted in 41 usable responses (although still containing some missing values per variable) yielding a response rate of about 16%. This is average for a mailed questionnaire in the Netherlands. Most questionnaires were filled out by CEO's (75%). Chi square tests

performed to compare respondents to non-respondents on industry and company size showed a small, but not significant bias towards bigger companies. Due to the limited sample size the empirical results reported next in this paper must be considered to be of an exploratory nature.

In the questionnaire respondents were asked to answer all questions (except those concerning the company level) for the last NPD project which had taken place, representative for the type of projects generally executed by the company. This was done to prevent respondents from getting confused. Despite a company's possible general policy towards accelerating its NPD the number and type of acceleration methods employed may depend on the specific NPD project. The different variables were operationalized in the following ways:

Independent variables

Unfortunately Millson *et al* [1992] are not very specific about the methods which constitute the five clusters of acceleration methods they distinguish. Therefore, we decided to use single-item questions to measure the use (0 = no use, 1 = use) and degree of use of the different clusters of methods (1 = very limited emphasis, 6 = very extensive emphasis). An exception was the cluster "parallel processing". For this cluster the methods parallel processing (i.e. simultaneous but independently performed activities) and overlap of activities (i.e. simultaneous but dependently --in multi-disciplinary teams-- performed activities) were distinguished.

A single value for this cluster was obtained by calculating the average of the score/answer to these two questions (Cronbach α 0.73). To determine the emphasis the companies placed on straight forward acceleration (i.e. without paying attention to the order of implementation) the variable *EMPHASIS* was created as the unweighted mean of the degree of emphasis given by a company to all five individual clusters of acceleration methods. To determine the companies' score on the *MRW-HIERARCHY* of accelerating a special procedure was followed (see Appendix for an extensive discussion). Firstly, we developed a way to transform the scores on the use of the five individual clusters of acceleration methods into a 5 point scale representing the degree of fit with the MRW-hierarchy (1 = no fit with the MRW-hierarchy, 5 = a very good

fit with the MRW-hierarchy). Secondly, we had 10 students score the different cases using this procedure, as to objectively determine the companies' scores on the newly developed scale. Thirdly, the reliability of the scale was investigated. The average pairwise correlation between the judgements of the students were about 0.85. A factor analysis treating the students' judgements as separate variables resulted in the extraction of one factor with factor loadings exceeding 0.84. The additionally calculated Cronbach α amounted 0.98. Given these results it was decided to compute the variable *MRW-HIERARCHY* as the mean of the judgements of the students.

Dependent variables

Although the aim of the use of all acceleration methods is to accelerate the NPD process in some way, the actual purpose is of course to contribute to the performance of the product and the company, or to enhance its strategic possibilities. Therefore, in order to evaluate the performance of the speeding up methods, several performance measures were distinguished and used, referring to (a) the acceleration of the NPD process accomplished, (b) performance at the product level, (c) performance at the company level, and (d) the extent to which the more speedily introduction to the market of the product opened up new market opportunities for the company. The acceleration of the NPD process was measured by the extent of acceleration established (*DEGREE OF SPEED*: 1 = 0-10% faster; 5 = more than 50% faster). The performance measure at the product level was the profitability of the new product compared to the anticipated profit level of the product (*PRODUCT PROFIT*: -3 = much lower than expected, +3 much higher than expected).

At the company level last years overall financial performance and last years gross-profit percentage were asked (*COMPANY PERFORMANCE* and *COMPANY GROSS-PROFIT* respectively: 1 = belonging to lowest 20% of companies in the industry; 5 = belonging to highest 20% of companies in the industry) [13]. To establish additional strategic possibilities created by the new product, the degree to which it had opened up new product/market-opportunities was asked (*PM-OPPORTUNITIES*: 0 = no new possibilities, 5 = very many new possibilities) [c. Cooper & Kleinschmidt, 1987].

4. The results

In order to test hypotheses 1 and 3 about the positive relationship between the degree of emphasis placed on accelerating, and the level of speeding up the NPD process simple (one tailed) correlation analyses were performed. The results are shown in table 1.

Table 1 about here

The results show that both *EMPHASIS* and *MRW-HIERARCHY* are significantly correlated with the *DEGREE-SPEED* variable. It implies that there is support for the fact that companies which implement more acceleration methods or emphasize them to a larger extent, do manage to speed up their NPD more. These companies thus turn out new products faster than those companies which place less emphasis on accelerating their NPD. This finding leads us to accept both hypothesis 1 and 3. At the same time we see that the simple straight forward approach to accelerating NPD, *EMPHASIS*, has a larger impact on *DEGREE-SPEED* than the hierarchical approach. This is reflected in the higher correlation coefficient and the better probability value.

Hypotheses 2 and 4 concern the relationship between the approach to accelerating and financial performance. Again correlation analyses were performed. The results are presented in table 2. It turns out that the *MRW-HIERARCHY* is significantly correlated with three out of four of the performance measures.

At the company level both *COMPANY PERFORMANCE* and *COMPANY GROSS-PROFIT* have a high correlation-coefficient and are highly significant. At the product level *PRODUCT PROFIT* has a high significant correlation coefficient too. This shows that there is a strong positive relationship between the hierarchy of implementation of acceleration methods, and product and company level performance. Only *PM-OPPORTUNITIES* has no significant value. This indicates that no additional opportunities are

created by getting the new product to the market more speedily using the *MRW-HIERARCHY*. However, the overall result can be considered in support of hypothesis 2. For the straight forward approach of accelerating, *EMPHASIS*, no significant values are encountered. *EMPHASIS* is not significantly correlated with any of the performance measures used. This is in support of hypothesis 4. Comparing the outcome for *EMPHASIS* and *MRW-HIERARCHY* more in detail the difference for *PM-OPPORTUNITIES* stands out. Despite the fact that this variable is not significant for both approaches, the probability values seem to imply a much larger effect in the case of *EMPHASIS*.

Table 2 about here

5. Conclusions and implications

The significant positive correlations between both approaches to accelerating NPD and *DEGREE-SPEED* point out that companies that are more involved in accelerating NPD are able to develop their new products faster than those companies which are less involved. Although the straight forward approach seems to have the highest impact on the speed accomplished, the correlation analyses with regard to performance show this is done to the neglect of costs and/or customer fit. The significant positive impact of *MRW-HIERARCHY* on performance and the lack of significant values for *EMPHASIS* are in favour of the MRW-hierarchy and its specific order of implementation. Apparently, accelerating in accord with the hierarchy prevents a company from making important mistakes which put its financial results under pressure. These findings are in line with our hypotheses and thus our expectations.

So, implementing the acceleration methods more carefully helps to safeguard the company's financial performance. The high positive correlation coefficients for the financial performance measures for the MRW-hierarchy even suggest this effect to be a strong one. However, the non-significant value of *PM-OPPORTUNITIES* points out that no extra product/market-opportunities are generated by those companies which get

to the market more speedily using the MRW-hierarchy. The speed lost while accelerating more carefully, first creating an organizational base, jeopardizes the strategic opportunities which the company stands to gain from a more speedily introduction. With the probability level of the straight forward approach to accelerating being almost 0.10 we may argue that in order to obtain the strategic advantage by accelerating its NPD, a company should accomplish a very high level of speed in developing new products. A degree of speed the MRW-hierarchy does not seem able to provide. However, Cordero [1991] notes the effect of accelerating may depend on the type of innovation. Some approaches to acceleration may fit some types of innovations better than others. This may also apply to the MRW-hierarchy. As Cordero argues that a concurrent approach is more appropriate for situations that call for a structure capable of processing many concurrent product solutions like in the case of incremental product innovation, and that a faster phased approach is more appropriate for situations where this is not the case (i.e. minor product changes, and breakthrough innovations) we may expect our data to include a fair amount of the latter type of innovations.

Furthermore, the missing values for *DEGREE-SPEED* and *PRODUCT PROFIT* are worth noting. They point to the fact that the CEO's had difficulty answering the questions for the product level. Apparently, CEO's have limited insight into the performance of a single product. These constructs are therefore better measured at a lower level in the organization.

From these results follow some important managerial implications. First of all, it does seem possible to formulate guidelines for accelerating NPD beyond the general suggestion to simplify the company's process and organization, before speeding things up. Implementing the different acceleration methods in the sequence as suggested by the MRW-hierarchy appears worthwhile. It leads to a faster NPD process and a better financial performance at both the product and company level. The latter is important, as turning out new products in less time will probably only be a tool to help create a competitive advantage, or to help sustain it. In doing so, accelerating NPD will contribute to the company's overall performance.

However, in order to make sure that the actions of accelerating are well planned and

do pay off, management has to benchmark its performance, know why it is implementing certain methods, and monitor and evaluate the results carefully. The evaluation should be done with regards to the NPD process, the product level and the company level. Just looking at the process or product level may lead to drawing conclusions and taking action too early; looking only at company performance may result in drawing conclusions and taking action too late. Most important, the evaluation should include the contribution of the acceleration practice to the company's customer value and the company's competitive advantage. Only then the real value of implementing the acceleration methods can be established. Currently, some interesting work on measuring the effects of improving NPD is being done by Griffin [1993]. She is engaged in a long term research project set out to (1) encourage companies to use some set of measurement tools to produce a baseline of current performance before implementing changes in the NPD process, and (2) provide managers with a set of measures that they can use to compare themselves with others and compare their own performance before and after making changes to the NPD process. So, Griffin too, is calling to benchmark and monitor the effects of changes made in NPD in order to be able to take the right actions. Furthermore, although Millson *et al* state that it is best to implement all of the NPD acceleration approaches to achieve the greatest effectiveness, and the fact that we do find a clear cut impact of speeding up on company performance we must consider that there are other variables which constitute company success. Given the results obtained at the company level we suggest to accelerate depending on the company's strategy (including the type of innovations mostly involved in) and its competitive environment. If a company is part of an industry where technological change is slow and competition is low, there may be *less* need to accelerate, especially as speeding up is not without risk and failure. The use of acceleration methods involves both costs and profits. These aspects should be calculated for and balanced [Crawford, 1992].

Although the relationship between the hierarchy and performance (both speed and financial performance) is a positive one we must be careful on interpreting the cause and effect, for our research is of a cross sectional nature. It may be so that not the specific approach to implementation of the acceleration methods has lead to a poor

performance, but that the poor performance has led to a specific way of implementation.

It is well possible that poor performing companies have a natural tendency to "step on the gas" where NPD is concerned. To establish this longitudinal research is needed. The same is true for future research which wants to try and establish the relationship between the actual path of implementation of the hierarchy and performance, for our research only tested the hierarchy by studying the relationship between companies' acceleration methods emphasized (i.e. acceleration-profiles) and performance. In fact, researchers should try to establish a more elaborated model of speeding up. In this model NPD speed and additional product/market opportunities for the product itself and the company should be incorporated as intermediate variables. This may improve our understanding of the true strategic value of speeding up. Furthermore, future research should make use of objective data (or use multiple respondents), a larger number of cases (including consumer goods), and multiple item scales to measure the different clusters of acceleration methods. Another potential area for doing research is that of alternative hierarchies. Although our data do show the MRW-hierarchy to be a good guideline for implementation it is not said that it is the only one. In fact, as has been argued different (generic) strategies may call for different levels of implementation and may even request the implementation of different approaches of acceleration altogether. Pioneers may benefit more from speeding up the first stages of the NPD process whereas followers probably benefit more from accelerating the middle and final stages. Pioneers are the ones generating and marketing new ideas. Followers act on existing ideas. One way to identify new possible structures of the hierarchy is to take up an inductive research approach [Nijssen, Rombouts & Commandeur, 1993]. This will include deriving more homogeneous clusters of acceleration methods and looking for the implementation-patterns of the more and less successful companies, controlling for their strategy. It will lead to a better understanding of the value of hierarchical structures of implementation for accelerating NPD. The final area for future research we like to identify is one put forward by Crawford [1992]. He states that accelerating may generate profits but is also associated with costs. Additional insight is needed into the specific cost- and profitability-drivers which exist. What are the best internal and external circumstances under which to implement which acceleration methods, and to

what extent should they be implemented? Clearly, NPD is an area with a lot of potential for future research. Where accelerating the NPD process is concerned, especially more empirical testing is needed to establish the true value of speed [Griffin, 1993].

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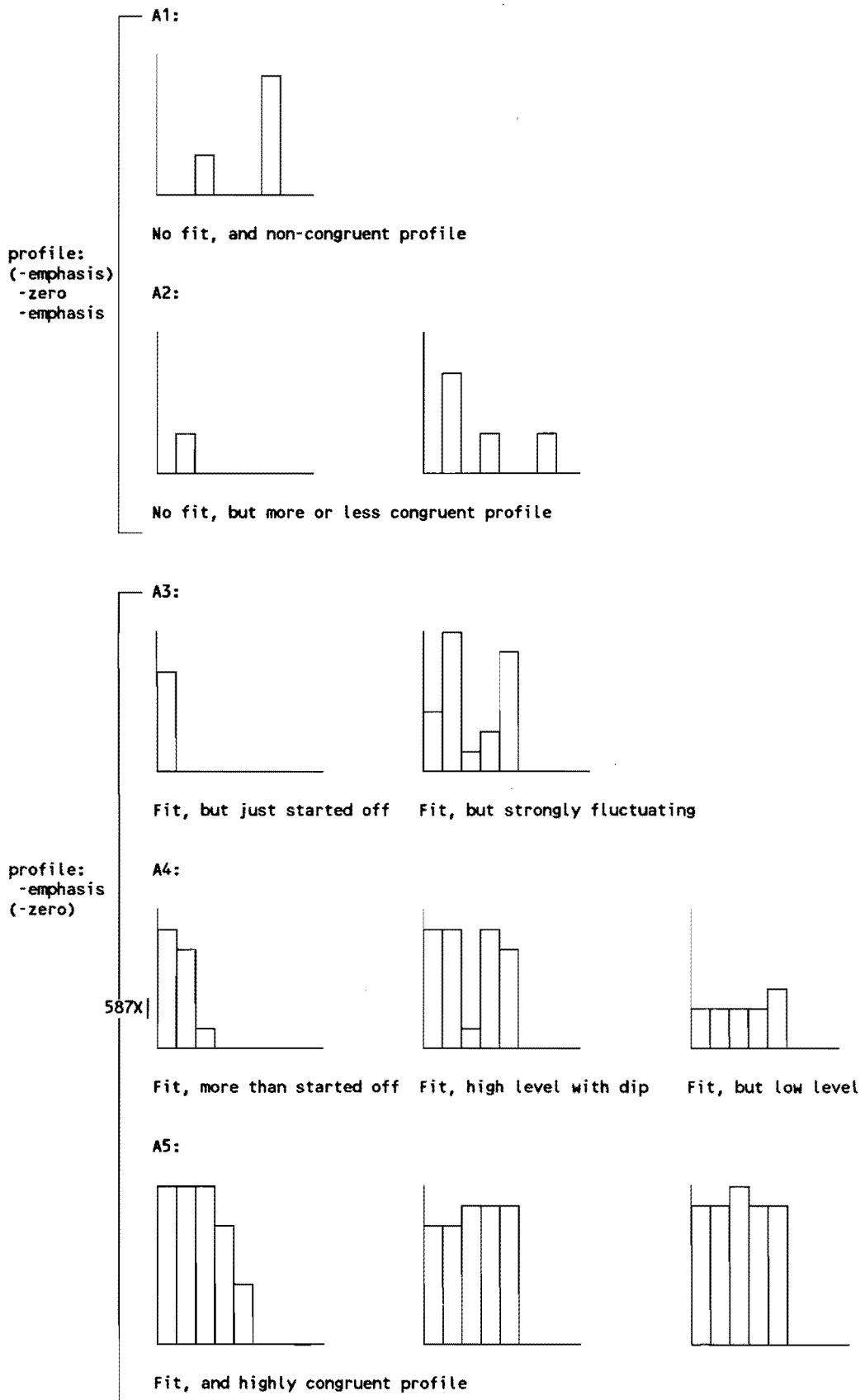
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Appendix: Procedure of Transformation

Formulating the transformation procedure:

To collapse the scores on the five clusters of acceleration methods into one 5-point scale representing the degree of accelerating in accord with the hierarchy we developed a classification scheme. For this purpose we first differentiated between companies which did and which did not accelerate in accord with the hierarchy. To our point of view, companies which accelerate in accord with the hierarchy will emphasize a certain stage before moving to another stage. This implies that no dip in emphasis of acceleration methods back to zero is allowed, if followed by another acceleration method being emphasized. So, we can not accept an acceleration profile of the sort: emphasis -> zero/no emphasis -> emphasis. If such a profile occurs the maximum score on the hierarchy scale shall be 2 on the 5 point scale used. Next the two subgroups (fit/no fit) were split up further in: 1 = no fit, and non-congruent profile; 2 = no fit, but more or less congruent profile; and 3 = fit, but just started of *or* strongly fluctuating profile; 4 = fit, more than just started of *or* low overall level *or* high level with dip profile; 5 = fit, highly congruent profile. The following pictures (see figure A1 to A5) are examples of the different profiles. The numbers refer to the different values of the 5 point scale used.

Figures A1 to A5: Scheme of transformation



Checking the reliability:

Next, we had ten students classify the cases/companies using this scheme (see figures A1 to A5) and a written instruction explaining about the MRW-hierarchy. Based on the judgements of these students the reliability of the scale developed was investigated. The average pairwise correlation between the judgements of the students were about 0.85, and an additional check using factor analysis (treating the judgements of the students as separate variables) and Cronbach α resulted in the extraction of one factor with factor loadings exceeding 0.84, and an α of 0.98. Given these results it was decided to compute the variable *MRW-HIERARCHY* as the mean of the judgement of the students.

Figure 1: The MRW-hierarchy of speeding up NPD.

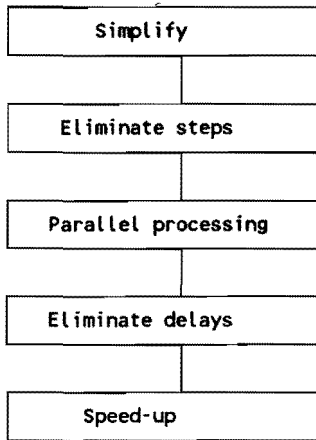


Table 1: The correlation of the straight forward and hierarchical approach to accelerating, with faster NPD

	<i>EMPHASIS</i>		<i>MRW-HIERARCHY</i>	
	corr.coefficient (r)		corr.coefficient (r)	
<i>DEGREE SPEED</i>	0.38	P<0.02	0.22	P<0.10 (n=34)

Table 2: The correlation of the straight forward and hierarchical approach to accelerating, with financial performance

	<i>EMPHASIS</i>		<i>MRW-HIERARCHY</i>		
	corr.coefficient (r)	P	corr.coefficient (r)	P	(n)
<i>PRODUCT PROFIT</i>	0.17	P<0.17	0.29	P<0.04	(n=38)
<i>COMPANY GROSS-PROFIT</i>	0.19	P<0.11	0.36	P<0.01	(n=41)
<i>COMPANY PERFORMANCE</i>	0.15	P<0.17	0.29	P<0.04	(n=41)
<i>PM-OPPORTUNITIES</i>	0.19	P<0.11	0.02	P<0.46	(n=41)

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