

# **Small Firm – Large Firm experiences in managing NPD projects**

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## **Abstract**

**Purpose** - The purpose of this research paper is to present a modified framework for the Waves of Change of New Product Development (McGrath, 1996).

**Methodology** - The authors conducted a qualitative study of NPD in four electronic firms (two small indigenous / two large multinational). They held in-depth interviews with employees, including the founding entrepreneur in each of the small firms.

**Findings** - Analysis of strategic, organisational and development factors shows that firms face different challenges during their NPD process - some related to size. Also, as firms grow, NPD learning may be lost.

**Research limitations** - The research findings are stated as a result of four cases studies – two in large firms and two in small firms. Further research will establish the generalisability of these findings.

**Practical implications** - The electronics industry is renowned for its aggressive competitive environment where successful entrepreneurs continuously innovate product and process development. The framework presented will be of use to entrepreneurs who focus on NPD.

**Originality** - A modified version of McGrath's framework, showing separate categories for small and large firms, is presented. These modifications recognize that there are differences between New Product Development (NPD) in small and NPD in large firms.

**Keywords** New Product Development, Electronics, Small Firms, Large Firms, Growth Strategies

**Paper type** Research Paper

## **Introduction**

This paper examines the position of two small and two large firms within a framework adapted from McGrath (1996). Literature reviewed focuses on the differences between the management of New Product Development (NPD) projects in small and large firms discussing three factors identified by Montoya-Weiss and Calantone (1994): Strategic, Organisational and Development Process. Research methodology is presented, followed by a description of each of the four firms involved in the study. The authors' discussion places each firm within this framework and highlights differences between small and large firms. Consequently, they can learn from each other in relation to managing New Product Development. In particular, concepts from the large firms such as process focus and empowerment are seen as applicable to small firms carrying out NPD. In conclusion, a revised model that takes account of the differences between small and large firms as recognised during the research project is developed and discussed.

## **Background**

In general the literature related to New Product Development (NPD) has focused on large firms. Empirical evidence is lacking for product development in small firms (March-Chordà et al., 2002). According to Montoya-Weiss and Calantone (1994) a wide variety of methodologies and study types have been used in the research of NPD making it difficult to directly compare the results of different studies. In their meta-analysis they define variables in four categories that have been identified as determinants of new product performance:

- Strategic Factors
- Organisational Factors
- Development Process Factors
- Market Environment Factors.

The framework (McGrath, 1996) utilized in this study addresses the first three of these categories that are internal influences on NPD. Market Environment Factors, while being acknowledged as critical to the development of new products, is beyond the scope of this study as it focuses on factors relating to the external influence on the NPD process.

### *Strategic Factors*

Meyers and Roberts (1986) found that small technology based firms tended to adopt one key growth-sustaining technology and avoided high levels of diversification. Additionally a study of

product development in the Japanese electrical machinery industry (Wakasugi and Koyata, 1997) found that, while the number of new products developed and the number of patent applications increased with firm size, there was no evidence of economies of scale in relation to NPD. In other words, small firms can be as efficient in their product development activities as large firms.

Linking product development to corporate strategy has long been advocated, (Adler *et al.*, 1989). Berg *et al.* (2002) propose a Quality Maturity Model for Research and Development based on the well established Capability Maturity Model used in software development. As firms move through stages in Berg's model the development of new products is managed at a higher or more strategic level within the firm.

### *Organisational Factors*

Much has been published about the importance of organizational structure for NPD in large firms, in particular in the areas of leadership and management support, (see, for example, Griffin, 1997; Datar *et al.*, 1997; Cooper, 1993). However, there is a lack of empirical studies into the most suitable structures, level and type of leadership in NPD projects in small firms (March-Chordà *et al.*, 2002).

Research discussing small firm structure and organizational issues, generally focuses on external relations addressing issues such as industrial services, subcontracting relationships, licensing, networking, collaborative R&D (Rothwell and Dodgson, 1991; Hoffman *et al.*, 1997; MacPherson, 1997). A study of small Korean Telecom firms (Bae and Chung, 2001) recommends that managers of small firms should consider technological alliances particularly when operating in a competitive environment. This finding is also supported by a study of small firms in Cyprus (Hadjimanolis, 2000) that found that external networking capabilities have a significant influence on innovativeness in small firms.

### *Development Process Factors*

A dichotomy exists between how to implement structured tools and processes to the design process while maintaining flexibility and innovation. According to Tushman and O'Reilly (1997), successful organisations are those that can manage to do both simultaneously. They conclude that organisations sustain their competitive advantage by operating in multiple modes simultaneously. Firms need to be able to manage for short term efficiency by emphasising stability and control; as well as for long term innovation by taking risks and learning by doing. Ambidextrous organisations are those that can manage in both modes.

Traditionally small firms are seen as being flexible and innovative while large firms are expected to have structured processes (Wakasugi and Koyata, 1997). Tushman and O'Reilly's ambidextrous organisations need to exhibit characteristics of both small and large firms. Yap and Souder (1994) in a study of small entrepreneurial high-technology firms in the US, found that firms who divested a high level of responsibility to an authoritative project manager were more likely to succeed.

NPD processes can be described as being first-, second-, or third-generation, (Cooper, 1994). First-generation processes, developed by NASA in the 1960's, were engineering-driven. These first-generation processes broke each element of developing a new product into a discrete phase that must be completed before the next phase could begin. Marketing was not considered as part of the process. Second-generation processes became cross-functional, manufacturing and marketing were now included. Additionally, phases no longer had to be sequential – work could be concurrent. The earlier, or up-front, activities in NPD were stressed. The third-generation processes address some of the limitations of the second-generation allowing for more flexibility in the process, less rigid decision points, more fluidity between phases and a greater focus on the priority of projects. Evidence would suggest that most large firms operate second-generation processes (Cooper, 1999).

#### *The Three Waves of Change of Product Development*

The manner in which firms manage the three categories of NPD variables described above has evolved over time and continues to do so. McGrath (1996) has identified three waves of change that are summarised in Table I. The first wave began in the United States of America in the mid seventies when companies began to realise that the development of new products was something that could and should be controlled. Controllable elements in the NPD process were identified. Emphasis was placed on the co-ordination of the different functions involved. Responsibility for the process remained in the hands of the product developers. This first *wave of change* was characterised by the implementation of procedures defining the tasks involved in controlling the elements of new products.

Take in TABLE I

The mid-eighties saw the emergence of second wave of change. The concept of product lines began to emerge with the introduction of cross-functional teams. The locus and span of control changed so that the development of new products became the responsibility of managers and executives who worked with these teams. In order to stream-line and speed up the process these teams were empowered with decision-making responsibilities. The emergence of Total Quality

Management (TQM) changed the paradigm for the management of new products. A process for the management of new product projects replaced New Product Development procedures; a more holistic view was adopted.

Again, in the U.S.A., the third wave of change commenced in the mid-nineties. The competitive environment required that organisations leverage off their existing products and the concept of product platforms emerged. NPD became more closely linked with strategic success of the enterprise. Responsibility for the process moved up to Chief Executive Officers (CEO) or Managing Directors (MD).

The above model parallels firms moving up the Quality Maturity Model for Research and Development proposed by Berg (2002). The force driving the development of new products is the strategic vision of company leaders. Not surprisingly the scope has also broadened so that the focus is now on the development of new product platforms intended to spawn a whole generation of new products. The development of new products and new product platforms should now be a critical component of a company's long-term strategic vision.

According to McGrath's three waves of product development, firms who are growing move from controlling and coordinating the NPD process at the operational level, i.e. by developers, to driving NPD through leadership from the highest level within the firm, i.e. CEO/MD. This is also reflected in the evolution from Cooper's first- to third-generation process (1994).

### *Conclusions from the Literature*

McGrath's model has been based on the experiences of large firms and is useful as a template for the development of NPD processes within such firms. The literature presented on the management of NPD processes shows that NPD management at small firms is different from that at large firms prompting the question: To what extent does McGrath's model apply to small firms? The rest of this paper will address this question and in doing so will add to the knowledge about the development of new products in small firms.

### **Research Methodology**

In the Irish context, the development of small firms in the electronics sector is a critical factor in economic growth. For their continuing development, it is important for these small firms to maintain successful New Product Development programs. In Ireland, many large multinationals have set up during the past 30 years. Traditionally entrepreneurs who set up small firms would look to the larger organizations for learning opportunities. In fact, many entrepreneurs who set

up small firms had themselves previously worked in large firms. This suggests that small firms can learn from large firms. Thus the motivation for this paper. This research considers two questions:

- Can the small company learn from the large company?
- Conversely, can the large company learn from the small?

The data presented in this paper was collected during in-depth interviews over an 18-month period. In total 47 interviews were conducted, covering 4 locations, 3 countries, and all levels in the organisations from Corporate Vice Presidents to New Product Coordinators. The interviewee profiles and statistics are summarised in Table II.

Take in TABLE II

Respondents were asked a series of open questions relating to their management of NPD projects. On completion of each interview respondents validated the accuracy of their responses. The cases presented provide a summary of the findings at each firm. Analysis was carried out using recognised qualitative research methods.

### **Case 1: Small Firm 1**

Small Firm 1 employs 90 people and designs and manufactures electronics systems. The firm was founded by two Irish engineers almost 20 years ago and, during the early 1990's, was acquired by a larger European company. Since then several different management structures have been applied to the product development department. Despite its small size the company develops a wide range of products requiring a broad mix of engineering skills. Operating within a niche market has the advantage that new product deadlines are not as crucial as they might be. However, late delivery of new products is still a problem for this firm.

#### *Strategic Factors*

Small Firm 1 has two major product lines, L1 and L2. Their L1 products are driven by EU product standards, as the standards evolve and are updated the systems offered by Small Firm 1 must also be renewed. With L1 products *'there is not really a platform but they have some modules that are re-used'*<sup>1</sup>. The L2 products are not closely tied to any standard and are modular in format. Small Firm 1 uses core modules in its L2 systems, and many developments are based

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<sup>1</sup> Italics indicate a quote from an interview.

on these core modules. The L2 business is based on the development of custom systems, in other words it is a job-shop, the notion of product platforms does not easily apply.

No clear goal or success factors emerged during interviews with staff at Small Firm 1. Management were more likely to suggest revenue – *‘the most critical measure is commercial success. .... Revenue is what we look at’*. While development engineers suggested customer satisfaction – *‘a product that works accurately to customer requirements – on time – and few problems – customer satisfaction’*. However, no shared, measurable goal for the NPD was reported.

There is central control over what new product projects start at Small Firm 1, but the development of new products is seen as the sole responsibility of the Development department. Like many firms in the electronics sector, Small Firm 1 has been through some rationalizing which has resulted in the reduction of some R&D capacity.

#### *Organisational Factors*

There are several elements to NPD at Small Firm 1. Different groups of engineers look after the L1 and L2 product lines. Development of a new product in either of these areas involves a wide range of engineering skills primarily including analog design, digital design, mechanical design, firmware, software and power electronics. The R&D department is divided into hardware and software development – the hardware groups, L1 and L2, are responsible for all development other than software.

Despite its small size, communication between functional departments at Small Firm 1 is a problem. Evidence indicates that the commercial / development interface works well, but despite this, the commercial people claim that they *‘have had major problems with spec changes not being communicated to sales and marketing’* while the developers say that *‘they get very little feedback from marketing’*. The production/development interface is perhaps more problematic and the tendency is to blame the other group for problems that arise. The issues surrounding NPD at Small Firm 1 have more to do with control and co-ordination than leadership and empowerment. Ownership of the product development process resides at the functional manager level.

### *Development Process Factors*

Most NPD projects at Small Firm 1 require input from both the software and the hardware groups. Typically hardware development must be finished before software testing can begin and the software development group can find themselves very short of time if there is a delay in releasing the hardware. However there are some projects that are not dependant on hardware development, on these projects the software group is trying to improve delivery times by focusing on the requirements engineering process and by minimising change during the development cycle.

The Managing Director of Small Firm 1 admits that their on-time delivery of NPD projects is not good. They produce schedules for the development of new products but they are not adhered to. One of the problems is that schedules are not accurate in the first place – *‘there is a reluctance to face up to how long things actually take’*. This is compounded by changing design specifications.

Small Firm 1 has tried using a formal approach to managing NPD projects. On a relatively recent project they appointed a full time project manager. However this was not successful – *‘it was unclear about who was going to do what’*. Many of the engineers at Small Firm 1 have also tried using MS Project but have only reported limited success – they find that they have spent too much time managing the schedule and not enough effort on the project.

### **Case 2: Small Firm 2**

The second small firm in this study employs only 9 people. The firm has been operating for 11 years and underwent a fundamental restructuring almost 3 years ago and moved from developing, manufacturing and selling its own products to its present strategy of developing prototypes and licensing technology to third parties. The focus within this firm is on generating revenue from the technologies that it has developed rather than developing new technologies and products. The technology underpinning this strategy is innovative and well protected by patents.

### *Strategic Factors*

While this firm was developing their own products, NPD projects were large and typically work was carried out in-house. They experienced difficulties meeting schedules and defining customer’s requirements. The situation was described as being *‘a nightmare’*.



Since restructuring, NPD projects are generally customer led and short, in the region of 2 –3 months. These projects deliver functioning prototypes rather than fully developed products. Customers have a high level of involvement in defining and scheduling projects. Direct and regular communications occur between development engineers within the company and the technical staff of their customers.

Small Firm 2 has '*developed and patented several advanced technologies*'; to an extent these are treated as platform technologies. However, the current strategy of developing customer projects does not lend itself to managing new products within the framework of product platforms. The one success factor mentioned by all those interviewed at Small Firm 2 was to meet specifications and satisfy customers. The current strategy of working on customer specific projects while successful is only temporary - the long-term objective of Small Firm 2 being to generate enough revenue to recommence developing their own products.

#### *Organisational Factors*

Small Firm 2 is small enough to act as a cohesive project team; communication is very good within the firm. All employees interviewed were aware of and understood the current strategy of generating revenue through short, customer driven projects – '*its better now, you can see where you are going*'. There is a good commercial/technical relationship in the firm (there is no manufacturing/production facility) and good communication and co-operation was evident. The Managing Director at Small Firm 2 appears to have taken control of the strategic direction of the company, in particular the product development activity.

#### *Development Process Factors*

To date this firm has had a high degree of success in completing R&D projects on time – '*on the last few projects we haven't missed dates – it hasn't been an issue*'. The firm holds weekly management meetings and the MD formally meets with all staff for one-to-one meetings bi-monthly. There is a definite sense that the staff at Small Firm 2 are working well as a team and are happy with the direction that the company is taking.

An additional feature of Small Firm 2 is their use of external consultants. Both technical and marketing consultants are employed on a regular basis by the firm. An external consultant who is employed at a local university has developed a significant amount of their technology. The relationship between this consultant and Small Firm 2 is very close.

Small Firm 2 are currently revising their product development procedure to reflect their new way of operating, all those interviewed were aware that there is a process and that it is being updated.

### **Case 3: Large Firm 1**

This case study examines the new product development process of a leading manufacturer of precision high performance components. This firm designs, manufactures, and markets a broad line of microelectronic components that address a wide range of customer applications. In 2002 sales levels plateaued following a number of years of unprecedented growth. Management are concerned that the structures and systems now in place are not efficient in supporting the need for more new products within a shorter time frame.

#### *Strategic Factors*

The Irish site was set up in 1976 as a manufacturing location to access the European market. R&D capability soon followed. In 1996, with an increasing globalisation of markets, the corporate strategy was to move to product platforms across all business sites. This required a worldwide change in organization structure.

#### *Organisational Factors*

Prior to 1996 each R&D department designed products that were manufactured at their local site. In 1996, in line with many US corporations entering the third wave of NPD, the firm restructured their activities from six autonomous sites located on three different continents into 12 product lines or business units, a structure which remains in place today. The new business units operate across 21 R&D sites but a large proportion of design is located in one site for each product line. Each business unit is almost autonomous with all R&D functionality within each unit, and resources within each group are *'not available for sharing'*. Two functions have been kept separate from the Product Line structure. These are a design evaluation and an applications engineering group. Within these functions staff still report to product lines but they are located together. The primary reason for this is the cost of the equipment used by these functions, financially it would not make sense to replicate these functions in each product lines. In addition to the product line groups, different functional groups, referred to as faculties, have also been established, the reason for the faculties is to primarily retain the engineering knowledge from the manufacturing processes that are now sub-contracted. There is, however, anecdotal evidence that a specialist faculty that serves all product lines at the site works better than the faculty that has divided its resources and now reports into the product line. The products that are developed by

the business units can be manufactured at any manufacturing site worldwide including sub-contract manufacturers.

Currently there are over 120 new products under development of which seventy are totally different parts. This firm categorizes their new products and are defined as Breakthrough, Platform or Derivative projects. This has no impact however on how projects are managed with the exception of one Product Line Manager who questions why the same procedures are being followed for all project types.

Developers are highly empowered to make decisions. This company launches new products that can either be for a specific customer application or for a general market. Engineers have regular contact with the end customers where products are customer-driven.

#### *Development Process Factors*

The product development process is clearly documented and divided with defined phases and milestones. In the previous ten years the firm has successfully implemented many TQM initiatives in their manufacturing organisation. But within Research and Development, developers speak of the requirement to '*police*' the process.

Technical skills are very highly rated. Project management is not seen to be a 'technical' issue, and there is '*no strong project management culture*' within the firm. There are however, pockets of project management. Different management styles have emerged in different Business Units. Some groups are using project management and have even appointed full time project managers. The restructuring into Product Lines has also had the effect of limiting the flow of knowledge between engineers. Information is more likely to flow within a product line group than between them. For example at product review meetings, unless the lead engineer puts effort into ensuring that there will be a good attendance, numbers can be low. Most of the engineers still claimed that there was no problem in directly approaching another engineer with a technical issue, but the new structure has limited the flow of knowledge within the company.

#### **Case 4: Large Firm 2**

The second large firm case study examines the new product development processes at two European design locations of a leading multinational manufacturer of electronic consumer products. This firm in the past had a technology driven strategy and is now incorporating a customer driven strategy to compliment their technology. Recently, similar to Large Firm 1, sales levels have plateaued as markets have become near saturated following a number of years of unprecedented growth.

### *Strategic Factors*

For Large Firm 2, technology is a driver and it is important for the firm to recognise how to utilise the technology and to develop products that fill the gap new technology creates. In order to leverage the technology, roadmaps are developed for each product family. These technology roadmaps are utilized at a corporate level across sites. Within the technology roadmaps, projects are set up to design and develop individual products locally for local markets.

A project manager runs each new product development project. The project team is usually drawn from many areas of expertise and includes the project manager, marketing person, customer representative, Research & Development project manager and other technical people as required. They add other experts to the team as needed and by the end of the first milestone it would be expected that all technical people are involved in the development process. The definition and scope for the team includes all aspects of development from concept to after sales. An industrial designer is usually seconded to a project. The marketing organisation is global, and the product developers may not always have direct access to consumers. The developers find this a weakness as the *'marketing specification replaces the customer'*.

### *Development Process Factors*

The process used for product development projects at this firm is clearly documented. It contains defined phases and milestones. There is strong awareness of processes and there is an evident ownership of these processes. They are reviewed bi-monthly and updated as required. Using the process as a guideline, *'experienced people determine whether a shortcut is viable or not'*, therefore, design teams follow, to varying degrees, the documented process. They manage this well, they follow the process where it is appropriate. This helps meet the Critical Success Factors (CSFs) but they also know when it is constraining them reaching their goals. This emphasizes the importance to inculcate CSFs in all project team members: if they know what they have to achieve, they can use processes to guide rather than constrain.

Each team member has a project plan which feeds into the overall project plan including lessons learned on the previous project. When changes are made, the impact of these changes is readily observable. The overall project plan shows the biggest risks on the critical path. It is bottom-to-top planning and the project manager can then decide whether the project can be completed within the available timeframe. A strong culture of teamwork and innovation is evident. The team uses informal but effective consensus decision-making processes. Many of those

interviewed mentioned a strong respect for other project team members. Development time for product varies, but from early phase to market launch could be up to three years.

## **Discussion**

The matrix presented in Table III summarises the position of each of the four firms studied on McGrath's waves of products development.

Take in TABLE III

The challenge for both large firms is to get more products to market faster in an increasingly competitive environment. The qualitative data identified that the key weakness for Large Firm 1 is the inability to predict the time it will take to develop a new product. The data for Large Firm 2 identified that their key weakness is managing the changing requirements coming from the market place during the development cycle.

Small Firm 1 want to make more efficient use of their limited resources in order to bring products to market in a more predictable manner. Small Firm 2 are satisfied with their new strategy but have identified the need to formalize their current process.

### *Strategic Factors*

Both the large firms have employed a product platform strategy that is 3<sup>rd</sup> wave whereas both small firms have employed product strategies based on a core technology that is 1<sup>st</sup> wave. This latter point would agree with Meyer and Roberts (1986) who found that the most successful small firms adopted one key growth sustaining technology and avoided high levels of diversification. It is also interesting to note that while the concept of product platforms was not appropriate to the small firms due to the limited number of products; they did however manage in terms of core technologies. As these firms grow, a product platform strategy which is 3<sup>rd</sup> wave will become more appropriate, but at present the 1<sup>st</sup> wave core technology strategy meets the needs of the small firms.

Both large firms have re-organized into 3<sup>rd</sup> wave Strategic Business Units, based on product platforms, which are in essence creating small 1<sup>st</sup> wave firms within large firms based on core technologies. This strategy allows for the creation of an ambidextrous organisation that exhibits characteristics of both small (flexibility) and large firms (controllability). Thus while 3<sup>rd</sup> wave

strategy works for the large firm, it is not appropriate for the small firm with limited product offerings.

### *Organisational Factors*

Large Firm 1 can be considered to be operating in 3<sup>rd</sup> Wave mode with Vice Presidents for R&D leading each small business unit. Small Firm 2 is also operating in 3<sup>rd</sup> Wave mode with the Managing Director actively leading R&D activities. Small Firm 1 and Large Firm 2 operate in 2<sup>nd</sup> Wave mode with middle management responsible for R&D. The advantage Large Firm 1 and Small Firm 2 see in having the highest level of management involved in R&D is the benefit of the day-to-day communication of strategic issues.

While one would expect that communication would not be as problematic in small firms as in large firms, both Large Firm 2 and Small Firm 1 (2<sup>nd</sup> Wave) found communication to be a problem particularly in relation to communication of change coming from the marketplace. This is possibly because of the additional layers of management. In Large Firm 1 and Small Firm 2 the structure and culture facilitates regular communication between developers and customers. In the absence of structured communication channels, engineers in Large Firm 2 and Small Firm 1 reported communicating directly with customers in order to acquire the necessary information to develop new products. Thus 3<sup>rd</sup> wave strategy has an advantage for all firms, regardless of company size, in that where top management are directly involved with the R&D process, communication with the customer and within the organization facilitates the development processes. However, while in large firms a Vice-President may have responsibility for NPD, in smaller firms the top management tend to have multiple functional responsibilities. A study in the UK (Woodcock *et al.*, 2000) found that managers of Small Firms consistently de-prioritise work on NPD when faced with other short-term pressures. Unless the MD/entrepreneur in the small firm recognises this dichotomy, this NPD is in danger of being deprioritised.

### *Development Process Factors*

Despite the fact that Large Firm 1 and 2 are approaching the third wave in that they have a strategic view, manage cross projects and cross processes, they have lost some of the skills from the first wave. For Large Firm 1 the issue is fundamentally related to project management. While they have well defined processes and procedures the actual implementation of project tasks is not adequately controlled. Large Firm 2 has project management skills that Large Firm 1

could adapt. However, Large Firm 2 has issues with managing changing customer requirements. Large Firm 2 could learn from Large Firm 1 who are closer to the customer.

Both small firms could be classified as still surfing the 'first wave' of change, however Small Firm 2 appears to be doing a better job. The ability of Small Firm 2 to deliver NPD projects on time is probably related to the facts that they are customer driven, using a proven technology and all their projects relatively short (2-3 months).

All the firms in the study with the exception of Small Firm 2 identified the need to improve the control of their processes. The lesson for all firms is that they need to maintain the learning from the first wave of New Product Development as they evolve to the third wave.

### **Revised Small Firms Model**

During this research project, the authors have seen that while McGrath's framework (1996) is indeed an appropriate definition of factors matched with three waves of product development, it is not appropriate to assume that all companies, regardless of their size, should follow this model. In fact we have discovered supporting evidence to develop a modified model which includes a third dimension – company size. This is presented in Table IV.

Take in Table IV

If we look at the **strategic factors**, the framework presented by McGrath is appropriate for the large firms, as they are large enough to consider product platforms and involve the full enterprise. In the small firms however, their product lines are very limited, and it is not appropriate for them to move beyond the second wave. Therefore, they should base NPD on derivatives of a core technology. Because of company size, NPD is usually considered by the MD/entrepreneur, even at first wave of development.

Observing the **organizational factors**, we notice that the senior management involvement occurs earlier in the small firms. During the first wave, in small companies, the Managing Director, who, in most cases, is the entrepreneur, is much closer to the development process. During the second wave, a CEO is likely to be involved. Organizational factors for large firms remain as presented by McGrath (1996). However in small firms the challenge is for the MD/entrepreneur to balance multiple functions.

In both small and large companies there should be a strategic view taken of NPD. However, due to their limited number of products, cross-project, cross-process and organised learning is not appropriate for small firms. A further addition to the model for the large company is that first wave learning should be retained to maintain success in NPD.

## **Conclusions**

All firms, large and small, face a similar challenge of bringing new products to market faster. The evidence of this study suggests that firms can be positioned on different waves for different factors. For example Small Firm 2 spanned all three waves across the three factors analysed. It may not always be appropriate for a firm to be on the same wave across all factors. For example, the product platform strategy of a third wave firm is not always appropriate for a small firm with limited product offerings. However, small firms manage in terms of core technologies that are a precursor to product platforms.

As the research indicates that the third wave is not necessarily the wave that small firms should strive to achieve, the authors have presented a revised model for small firms based on their findings. Large Firm 1 and 2 have taken a third wave route of strategic business units that emulate small firms within a larger enterprise. The smaller firms, particularly Small Firm 2, benefited from a shared vision from the Chief Executive Officer.

All firms need to entrench the learnings from wave 1 as they move from wave to wave. Small firms are often in a better position to do this as some of the basics, such as process control, are still getting a lot of attention. Although large firms have become more strategic about NPD this learning is already lost.

Therefore in conclusion, can the small firm learn from the large firm? Yes, but the context is important. Concepts from the large firms such as process focus and empowerment are applicable. Concepts such as product platforms are not applicable. And can the large firm learn from the small? Yes, particularly in relation to communication channels with the customer and all employees sharing a strategic vision.

But most importantly, there is evidence that small firms should avoid the errors of the large companies in losing the learning gained during the first wave. We interpret this as requiring them to entrench the learnings from each wave of change as the company grows and moves from wave to wave. As they grow, the Managing Director /entrepreneur should ensure that, unlike many large firms, learning gained through the New Product Development process is retained within the organisation.



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	<b>1st Wave</b>	<b>2nd Wave</b>	<b>3rd Wave</b>
<b>Strategic</b>	Elements	Products	Platforms
<b>Factors</b>	Function	Cross-Function	Enterprise
<b>Organisational</b>	Developers	Managers	CEO/MD
<b>Factors</b>	Co-ordination	Empowerment	Leadership
<b>Development</b>	Control of Process	TQM	Strategic View
<b>Process Factors</b>	Tasks	Projects	Cross-Project
	Procedure	Process	Cross-Process

*Table I - Three Waves of New Product Development*

<b>Small Firm 1</b>	<b>Small Firm 2</b>	<b>Large Firm 1</b>	<b>Large Firm 2</b>
90 employees	9 employees	1,600 employees	1,200 employees
<u>Interviewees x 9</u>	<u>Interviewees x 5</u>	<u>Interviewees x 13</u>	<u>Interviewees x20</u>
Managing Director x1	Managing Director x 1	Vice President x 1	Product Line Managers x 5
Development Manager x 1	Engineering Manager x1	Team Leaders x 4	Developers x 15
Marketing Manager x1	Marketing Manager x1	Developers x 7	
Developers x 4	Development Engineers x1	New Product Co-	
Technician x 1	External Consultant x1	Coordinator x 1	
2 Product Lines	1 Product Line	9 Product Lines	2 Product Lines
1 Business Site	1 Business Site	1 Business Site	2 Business Sites

*Table II – Interviewee Profile and Statistics*

	<b>Small Firm 1</b>	<b>Small Firm 2</b>	<b>Large Firm 1</b>	<b>Large Firm 2</b>
<b>Strategic Factors</b>	Core technologies or elements	Core technologies or elements	Product Platforms	Product Platforms
	Operating within functions	Operating as a team/enterprise	Enterprise wide SBUs	Enterprise wide SBUs
	1 <sup>st</sup> Wave	1 <sup>st</sup> Wave	3 <sup>rd</sup> Wave	3 <sup>rd</sup> Wave
<b>Organisational Factors</b>	Process controlled by managers	MD coordinates NPD	VPs for each SBU	VPs for each SBU
	Process co-ordinated by managers	Leadership from MD	Leadership from Product Line Directors	Empowerment of developers
	2 <sup>nd</sup> Wave	3 <sup>rd</sup> Wave	3 <sup>rd</sup> Wave	2 <sup>nd</sup> – 3 <sup>rd</sup> Wave
<b>Development Process Factors</b>	Problems with control of process	Strategic View of NPD	Strategic view but problems with control of processes	Strategic view but problems with control of processes
	Normally tasks but have managed some projects	Managing at a Project level	Resources not shared across projects	Resources are shared across projects
	Still working on procedures	Thinking in terms of process	Same process enforced for all platforms	Same process enforced for all platforms
	Problems with 1 <sup>st</sup> wave	1 <sup>st</sup> – 2 <sup>nd</sup> wave	3 <sup>rd</sup> Wave but have lost the 1 <sup>st</sup> wave learning	3 <sup>rd</sup> Wave but have lost the 1 <sup>st</sup> wave learning

*Table III – Positioning each company on the Waves of NPD*

		<b>1st Wave</b>	<b>2nd Wave</b>	<b>3rd Wave</b>
<b>Strategic Factors</b>	<b>Small</b>	Elements Function & Enterprise	Products Function& Enterprise	Derivatives Of Core Technology
	<b>Large</b>	Elements Function	Products Cross-Function	Platforms Enterprise
<b>Organisational Factors</b>	<b>Small</b>	Developers/Managers Co-ordination	Managers/CEO/MD Empowerment	CEO/MD Leadership
	<b>Large</b>	Developers Co-ordination	Managers Empowerment	CEO/MD Leadership from VP/CTO
<b>Development Process Factors</b>	<b>Small</b>	Control of Process Tasks Procedure	TQM Projects Process	Strategic View Projects Process
	<b>Large</b>	Control of Process Tasks Procedure	TQM Projects Process	Strategic View Cross-Project Cross-Process
<b>Learning</b>		Retain Learning from 1 <sup>st</sup> Wave		

*Table IV – Three Waves of Product Development in Large and Small Companies:*