

The Impact Of Communication Behaviours On New Product Development Speed And Organisational Learning

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The purpose of this research is to understand how communication behaviours influence new product development (NPD) speed and organisational learning. Through the use of structural equation modelling, this research tests a model examining the effects of communication behaviours (i.e. communication quality, bi-directional communication, and communication frequency) on NPD speed and organisational learning, and also the effect of organisational learning on NPD speed. The results indicate that communication behaviours had no direct effect on NPD speed; however, each communication behaviour had a significant positive effect on organisational learning, particularly communication quality. Moreover, the results indicate a strong direct relationship between organisational learning and NPD speed. These findings suggest that to increase NPD speed, importance needs to be placed on improving organisational learning within the firm. In addition, our findings suggest that three useful means to improve organisational learning involve improving the quality of communication exchanged between managers within the firm, increasing bidirectional communication, and communication frequency between managers responsible for NPD.

Field of Research: Marketing

1. Introduction

This research investigates the factors influencing the speed of new product development projects in Australian companies (henceforth “NPD speed”). Although a number of studies have identified various factors affecting NPD speed (e.g. McDonough and Barczak, 1991; McDonough, 1993), or developed models examining NPD speed (e.g. Lynn and Akgun, 2003), there is little consensus as to the variables examined in these models. Importantly, the effect of various communication behaviours on NPD speed has received little attention in the literature. Consequently, this research attempts to examine the effects of various managerial communication behaviours on NPD speed, and also on organisational learning, to gain a better understanding of the relationships

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amongst these variables. In addition, the effects of organisational learning on NPD speed are investigated. A large-scale survey methodology, and quantitative methods were used to test the hypothesised model. The following section establishes the academic and managerial importance of the topic, states the specific objectives of the research, and details the contribution of this research to the literature.

1.1 The Importance of New Product Development

Over the last 30 years there has been a significant academic and managerial focus on NPD, which stems from the importance of NPD as a source of competitive advantage for firms, and as an essential factor for firms' survival (Cormican and O'Sullivan, 2004). NPD provides firms the opportunity to improve their competitive position and strengthen their competitive advantage. For example, firms that develop new products that consumers are willing to buy will experience an increase in sales and market share (Brown and Eisenhardt, 1995). For many firms NPD is also an essential factor for survival as it allows an organisation to diversify, adapt, and reinvent itself to match the changing conditions of the market (Brown and Eisenhardt, 1995).

Despite the acknowledged importance of NPD to firms, NPD failure rates are high and have been consistently high for decades. According to industry statistics, for example, around 70% of new products fail within the first two years (Mcintyre, 2002) and only one in four development projects result in a successful product (Cooper and Kleinschmidt, 1990). These alarming NPD failure rates have prompted researchers to gain a better understanding of the factors affecting NPD success (e.g. Ayers, Dahlstrom, and Skinner, 1997; Cooper, 1979; Lynn and Akgun, 2003). Accordingly, NPD has been extensively examined in the academic literature and there continues to be a focused stream of research concerned with NPD and investigations of the factors that lead to NPD success.

1.2 The Relevance of NPD Speed

In spite of the growing body of research on the factors that lead to NPD success, studies of NPD speed are scarce in the literature (Kessler and Chakrabarti, 1996). NPD speed is important because as markets continue to evolve and dramatically change, environmental conditions such as technological advances, new customer needs, and new competition are creating shorter product life cycles (Rosenau, 1990). Therefore, it is becoming necessary for organisations to not merely introduce products to the marketplace, but to introduce those products to the market at a faster pace (Griffin, 1997; McDonough, 1993). The faster an organisation can introduce its products into the marketplace, the greater the organisation's chances in exploiting the benefits of first-mover advantages such as market leadership opportunities and greater market share (Zahra and Ellor, 1993; Wind and Mahajan, 1997). However, despite the importance of NPD speed there has been limited research attention in theoretical development, model building, and empirical testing of the determinants and effects of NPD speed (Kessler and Chakrabarti, 1996).

Amongst the few studies in the marketing literature some have examined the antecedents and outcomes of NPD speed. These include a study of the effect of leadership style on NPD speed (e.g. McDonough and Barczak, 1991; McDonough, 1993) and the effect of NPD speed on an organisation's internal performance (e.g. Lukas, Menon, and Bell, 2002). However, currently absent from the NPD speed literature is an analysis of the direct and indirect effects of various communication behaviours (i.e., communication quality, bi-directional communication, and communication frequency) and organisational learning on NPD speed. A key objective of this study is therefore to empirically test the effects of these communication behaviours on NPD speed and the effect of organisational learning on NPD speed. NPD speed is defined here as the time difference between idea conception and new product implementation (Ali, Krapfel, and Labahn, 1995).

1.3 Organisational Learning during NPD

The second dependent variable examined in this current research is organisational learning. Organisational learning is defined as the ability of an organisation to create, acquire, and transfer knowledge, as well as modify the organisation's behaviour to reflect the new knowledge learnt (Garvin, 1993). Organisational learning has received attention within businesses as an important strategy to maintain and improve competitive advantage, particularly during NPD. Chan and Scott-Ladd (2004) suggest that the rapid increase in globalisation has perpetuated greater uncertainty and competition in the business environment. Moreover, this increase in competition is causing shorter product lifecycles and greater importance is being placed on introducing products to the market at a faster rate. Consequently, increasing organisational learning is becoming an important strategy for firms to manage inherent environmental uncertainties, to increase NPD speed, and thereby improve a firm's advantage.

Given the importance of the organisational learning construct, numerous researchers have articulated the need for more research to be conducted in this area. In particular, to develop measures of the organisational learning construct and conduct empirical tests of its antecedents and consequences (see Dawes, Lee, and Midgley, In Press). This current research responds to the need for empirical research into organisational learning during NPD.

1.4 Research Objectives and Contribution

In light of the paucity of empirical research into NPD speed, the objectives of this research are to test a conceptual model of the effects of various communication behaviours on NPD speed and organisational learning. Also, to empirically test the link between organisational learning and NPD speed.

This research is theoretically important because it increases our understanding of how communication behaviours can influence NPD speed and organisational learning within firms. We also provide empirical evidence of the positive link between organisational learning and NPD speed. This research is also managerially important as it can help

managers responsible for NPD increase the speed of their NPD projects, thereby bringing their products to the market quicker than would otherwise be the case.

2. Conceptual Framework

The following section reviews the literature relevant to the study of NPD speed and organisational learning in order to identify the theoretical frameworks that will be adopted for this research. The conceptual model is presented below in Figure 1.

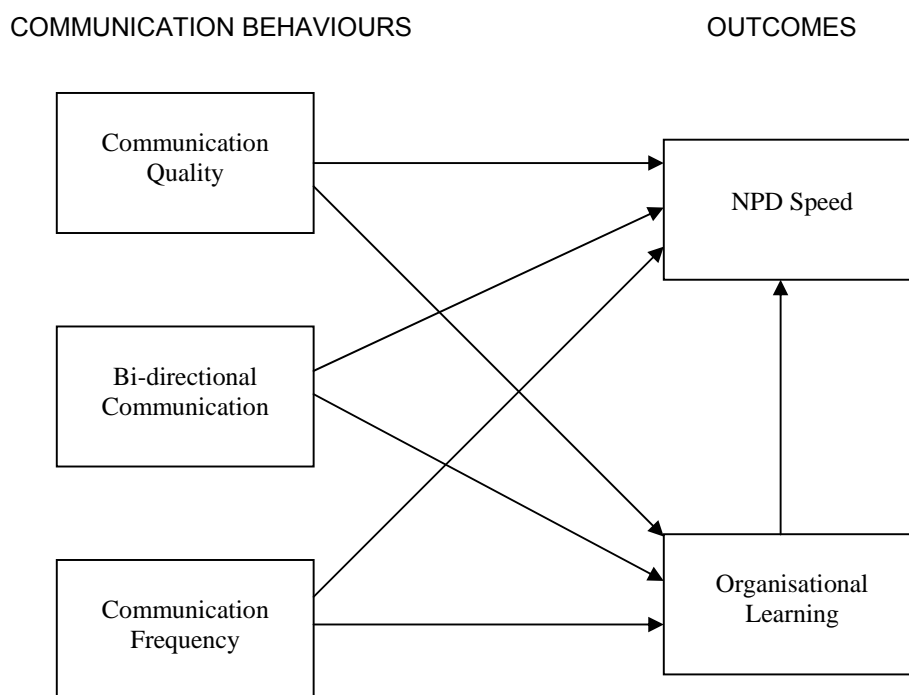


Figure 1: Conceptual Model

2.1 Endogenous Variables

2.1.1 NPD Speed

NPD speed has been conceptualised in three different ways. The first involves comparing the time difference between the actual project completion time with the planned project time. The second involves comparing the time differences of one project with another project. The third conceptualisation of speed involves the time difference between product conception and introduction into the marketplace (Ali, Krapfel, and Labahn, 1995). This research adopts the third definition because unlike the first two

conceptual definitions, the third definition of speed is the most widely accepted in the marketing literature (e.g. Griffin, 1997; Ittner and Larcker, 1997).

Research into NPD speed has followed two specific approaches (cf. Brown and Eisenhardt, 1995). The first approach is an economics-oriented focus in which research is conducted at a macro-level, and focuses on a broad overview of factors affecting NPD speed. The second approach involves adopting an organisations-oriented focus. This research focus investigates the micro-level issues within an organisation. For example, research conducted by Cooper and Kleinschmidt (1987) and Damanpour (1991) used this approach and examined the effects of an organisation's structure and internal processes on product development. This research focus, unlike the macro-level approach, allows managerial implications to be readily adopted by organisations to achieve NPD speed (Kessler and Chakrabarti, 1996; Brown and Eisenhardt, 1995) and consequently is adopted in this current research. A further justification for adopting a project-level of analysis in this research is because it is the most relevant level of analysis to examine NPD speed, since "projects are accelerated, not individuals or organizations" (Kessler and Chakrabarti, 1996. p.1149).

2.1.2 Organisational Learning

Organisational learning can be viewed from four principal schools of thought. These include an economic view, a developmental view, a managerial view, and a process view (Bell, Whitwell, and Lukas, 2002). An economic view considers that learning takes place with the accumulation of continuous production. In contrast, a departmental view consists of a higher-order learning where learning is achieved through a series of sequential steps. Similarly, a managerial view of organisational learning also consists of a higher-order learning, however, the speed at which learning is achieved is determined by the nature and extent of organisational change. Finally, a process view incorporates various learning constructs (e.g. information acquisition, dissemination, and utilisation) which are common to all organisations. Importantly, organisational learning is driven by individual-level phenomena, such as one's cognitive and behavioural capabilities, and personal idiosyncrasies (Dawes, Lee, and Midgley, In Press). For the purpose of this research, a process view of organisational learning will therefore be used because we are primarily concerned with the effects of various communication behaviours in driving the information, acquisition, dissemination, and utilisation represented by the organisational learning construct.

2.2 Exogenous Variables

2.2.1 Communication Behaviours

It has been widely recognised that communication behaviours can be linked to a number of positive business outcomes, such as greater NPD success (see e.g. Cooper, 1984; Dougherty, 1987). Much of the prior research on communication behaviours has investigated only one communication dimension i.e., communication frequency. However, it is becoming increasingly clear that measuring communication frequency

does not provide a thorough understanding of communication behaviours within an organisation (cf. Fisher, Maltz, and Jaworski, 1997). Consequently, this research attempts to gain a better understanding of communication behaviours by investigating three dimensions – communication quality, bi-directional communication, and communication frequency.

In this study we define communication quality as the perceived relevance and usefulness of information supplied for the task at hand (Moenaert, De Meyer, Souder, and Deschoolmeester, 1992). Bi-directionality is the extent to which communication is a two-way process (Mohr, Fisher, and Nevin, 1996; Mohr and Nevin, 1990), i.e., the extent to which feedback exists in the communication between NPD team members. Finally, communication frequency is defined as the number of times information is transmitted by one manager to another during the NPD project (cf. Van de Ven and Ferry, 1980).

3. Conceptual Model & Hypotheses Development

3.1 The Effects of Communication Quality

Studies by Menon, Bharadwaj, Adidam, and Edison (1999) and Maltz and Kohli (1996) suggest

that high quality communication stimulates greater creativity among functional teams because there are higher degrees of trust between functional areas within the firm. This has specific implications for NPD, since product development requires the coordination of functional areas, the quality of information communicated during the NPD process is crucial for the firm to achieve NPD speed. Accordingly, we hypothesise:

- H1. The greater the communication quality within the NPD process, the greater the NPD speed.

Turning now to the effect of communication quality on organisational learning, it can be argued that the higher the quality of communication disseminated within the organisation, the less likely employees will experience uncertainty and misunderstandings. Research by Argyris and Schon (1981) support this hypothesis, suggesting that one of the key requirements for organisational learning is the availability of high quality information to be freely communicated across the organisation. Further support for this hypothesis is provided by Moenaert and Caeldries (1996) who suggested that as the quality of communication improves within the firm, the greater the learning within the organisation. Therefore, we hypothesise:

- H2. The greater the communication quality, the greater the organisational learning.

3.2 The Effects of Bi-directional Communication

Research by Fisher, Maltz, and Jaworski (1997) suggest that language misunderstandings can occur between different functional areas, as there are dissimilarities in their goals and strategies during NPD projects. Research conducted by Fisher (1978) shows similar findings suggesting that in order to minimise confusion and misinterpretations among functional areas, two-way communication channels (i.e., bi-directionality) need to be present during product development. Wheelwright and Clark (1992) suggest that bi-directionality enhances the flow of communication between functional areas as it allows opportunities to clarify any misunderstandings. Consequently, it promotes greater interaction among functional areas during NPD projects (Cooper, 1984) and improves the ability of the firm to increase the speed of their NPD projects. Accordingly, we hypothesise:

- H3. The greater the bi-directional communication within the NPD process, the greater the NPD speed.

In terms of the effect of bi-directional communication on organisational learning, it seems reasonable to speculate that the more people interact via feedback and two-way communications, the more likely misunderstandings can be minimised, and instructions and information can be disseminated correctly (Wheelwright and Clark, 1992). Research by Moenaert and Caeldries (1996) supports this hypothesis suggesting that by encouraging the sharing of information, where information is communicated openly between information source and information receiver, the organisation is able to improve learning within the firm. It can therefore be suggested that bi-directional communication will have a positive effect on organisational learning. Therefore, we hypothesise:

- H4. The greater the bi-directional communication, the greater the organisational learning.

3.3 The Effects of Communication Frequency

A number of studies suggest that people involved in the NPD process have differences in world views and language dissimilarities that can create divergence in the NPD process in terms of goals and preferred solutions (see Fisher, Maltz, and Jaworski, 1997; Griffin and Hauser, 1996). Maltz and Kohli (1996) suggest that increasing the communication frequency between those involved in the NPD process can further instigate conflict and degrade the quality of information during NPD. Consequently, the increased conflict generated from more frequent communication can impede the development of new products, and subsequently reduce the speed of NPD. Accordingly, we hypothesise:

- H5. The greater the communication frequency within the NPD process, the lower the NPD speed.

Turning now to the effects of communication frequency on organisational learning, it can be suggested that although frequent communication can cause conflict between those involved in the NPD process, frequent communication can also stimulate dialogue and encourage the exchange of ideas and knowledge within the organisation. Research by Sinkula, Baker, and Noordewier (1997) provides some support for this hypothesis. Further support for this hypothesis is provided by Sinkula (1994) and Slater and Narver (1995) who suggest that information generation and dissemination (i.e. typical organisational learning constructs from a process view) through communication provides a mechanism through which learning can occur. Therefore, we hypothesise:

- H6. The greater the communication frequency, the greater the organisational learning.

3.4 The Effects of Organisational Learning

McKee (1992) suggests that organisational learning drives innovation. As new knowledge and information is learnt from the internal and external environments of the organisation, employees obtain greater insights into both environments, and subsequently the use of this new knowledge creates more ideas in the NPD process. More specifically, Stata (1989) suggests that when organisations invest in the promotion of learning within the NPD process, the improvement in ideas is likely to increase the pace of product development. This relationship is further supported by Guns (1996) who suggests that one potential benefit of organisational learning is a reduction in NPD cycle time. Accordingly, we draw our last hypothesis:

- H7. The greater the organisational learning within the NPD project, the greater the NPD speed.

4. Methodology

4.1 Sampling

The sample for this research consists of Marketing Managers in Australian firms, who were chosen to complete the questionnaire because they are typically involved in NPD and were therefore used as key informants on the NPD project. The sampling frame was obtained from a commercial mailing list and the list was screened to eliminate firms that were unlikely to be involved in product development. In order for managers to qualify as respondents for this research, they had to satisfy three criteria. The first criterion was that the respondent's firm must conduct NPD. Secondly, the respondent must have been involved in a NPD project within the last 12 months. The third criterion was that the firm should have a separate person assigned as the Research and Development (R&D) Manager and as the Marketing Manager. Subsequently, the questionnaires were sent to 308 firms, however, an initial contact by telephone revealed that 29 firms either did not satisfy the criteria and/or they did not want to participate in the research. Consequently, the sample included 279 respondents. Further contacts by

telephone to the respondents also revealed that a further 50 firms either did not satisfy the three criteria and/or they did not want to participate in the research. Consequently, the total sample for this research included 229 respondents. From the sample of 229 respondents, 92 respondents filled in the questionnaire, resulting in an overall response rate for this research of 40.17%. The data for this study was collected from Marketing Managers, in Australian firms, using a pretested, mailed, and self-administered questionnaire.

4.2 Measurement

In total five multi-item measures were used in this research, two formative measures (communication frequency, organisational learning) and three reflective measures (bi-directional communication, communication quality, and NPD speed). Measures were selected from the literature based on face validity, and the items having standardised loadings greater than 0.7. Items with a standardised loading of 0.7 or greater were chosen because loadings lower than this will yield an average variance extracted below the recommended 0.5 level (Fornell and Larcker, 1981) and thus convergent and discriminant validity may be compromised. See Table 1: Assessment of Measurement for details of the measurement properties, and the Appendix for the full set of items used.

PLS Graph Version 3 was used to analyse the measurement and structural models. PLS was used for a number of reasons, including its ability to model formative measurement models (i.e. communication frequency and organisational learning), its ability to accommodate small sample sizes (e.g. $n = 92$), and because we make no assumptions about univariate or multivariate normality (Chin, 1998; Diamantopolous and Winklhofer, 2001; and Fornell and Bookstein, 1981).

Table 1: Assessment of Measurement

Construct	Indicator	Standardised Factor	Composite	Average
Variance		Loadings	Reliability	
Extracted				
Communication	1	0.7527	0.897	0.635
Quality	2	0.8524		
	3	0.7857		
	4	0.8268		
	5	0.7630		
Bi-directional Communication	1	0.8585	0.913	0.777
	2	0.9005		
	3	0.8855		
Communication Frequency ^a	1	0.1803	N.A.	N.A.
	2	0.5156		
	3	0.4170		
	4	0.6318		
	5	0.1297		
	6	0.5934		
	7	0.3895		
	8	0.0848		
	9	0.3042		
	10	0.6513		
Organisational Learning ^a	1	0.6632	N.A.	N.A.
	2	0.8573		
	3	0.7599		
	4	0.7672		
	5	0.6762		
	6	0.6015		
	7	0.4746		
	8	0.5977		
NPD Speed	1	0.7932	0.885	0.720
	2	0.8606		
	3	0.8897		

^a denotes a formative measure

4.3 Measure Development and Validation

To establish unidimensionality for each of the reflective multi-item measures, principal components analysis (PCA) was used. PCA results indicated that the items were more correlated with its related construct, than any other model construct. Consequently, the PCA results satisfy Hattie (1985) and McDonald's (1981) recommendations in establishing unidimensionality.

The majority of measures were adequate indicators of the latent variables. However, one exception involved an item from bi-directional communication, in which the original factor loading was less than 0.7. Consequently, following Hair, Anderson, Tatham, and Black (1998) and Robinson, Shaver, and Wrightsman's (1991) general rule of thumb to remove any items that have an outer model loading less than 0.7, this item was removed as an indicator in order to improve construct validity.

Convergent validity was achieved as the average variance extracted (AVE) of the three reflective measures was greater than 0.5 (See Table 1) (Bagozzi and Yi, 2005). For instance, Bi-directional communication at 0.777, communication quality at 0.635, and NPD speed at 0.720. Scale reliability was established as the composite reliability for each scale being above 0.7. For example, the composite reliability for bi-directional communication was 0.913, communication quality was 0.897, and NPD speed was 0.885.

Fornell and Larcker's (1981) criterion to establish discriminant validity requires that the square of the correlation between any pair of constructs needs to be less than the AVEs of each individual construct. As indicated by Table 2, the reflective measures used in this study satisfy Fornell and Larcker's (1981) requirements for discriminant validity.

Table 2: Discriminant Validity Results

Pairs of constructs	AVE (1 st)	AVE (2 nd)	Correlation between constructs	(corr ²)	Discriminant validity established?
CQ/BC	0.635	0.777	0.562	0.316	Y
NS/BC	0.720	0.777	0.192	0.037	Y
CQ/NS	0.635	0.720	0.178	0.032	Y

5. Results

5.1 Descriptive Statistics and Correlations

The items were measured using seven-point Likert scales ranging from 1 "strongly disagree" to 7 "strongly agree". The descriptive statistics in Table 3 below indicate that both communication quality and bi-directional communication have high means (5.29 and 5.63, respectively). These results are encouraging because they indicate that both

communication quality and bi-directional communication are quite high during the NPD projects in this study. In addition, the mean for organisational learning is reasonably high at 4.83, indicating that organisational learning is fairly high in our sample of firms. Furthermore, the results reveal a low mean for NPD speed (i.e. 3.88) which suggests that in general, the speed of NPD in most firms is quite low however, the high standard deviation (i.e. 1.49) suggests that there is considerable variation in the speed of NPD.

Table 3: Means, Standard Deviations, and Correlations of Latent Variables

Variables	Scale Mean	S.D	1	2	3	4	5
1. Communication Quality	5.29	0.93	-				
2. Bi-directional Communication	5.63	0.93	.54**	-			
3. Communication Frequency	3.98	0.98	.44**	.46**	-		
4. NPD Speed	3.88	1.49	.28**	.19	.04	-	
5. Organisational Learning	4.83	1.02	.70**	.65**	.45**	.30**	-

** Correlation is significant at the 0.01 level (2-tailed).

5.2 Results of the Structural Modelling

The R^2 value for NPD speed was 0.164, which suggests that the model explains only 16.4% of the variance in this endogenous variable. Whilst we only explain a fairly small amount of variance in this dependent variable, this is not unexpected, as many variables other than those included in this current study can affect NPD speed. In contrast, the R^2 value for organisational learning was 0.682 suggesting that the model explains 68.2% of the variance in this endogenous variable. This suggests that the communication behaviours tested in our model are important drivers of organisational learning. In summary, our results suggest that communication behaviours have a strong effect on organisational learning but not on NPD speed.

Table 4: PLS Structural Model Results

Linkages in the Model	Hypothesis Number	Hypothesis Sign	Std. Beta (t-value)
Comm Quality → NPD speed	H1	+	0.0490 (0.2840)
Comm Quality → Org Learning	H2	+	0.4310 (4.2958)***
Bi-directional Comm → NPD speed	H3	+	-0.1300 (0.7718)
Bi-directional Comm → Org Learning	H4	+	0.3280 (3.1142)***
Comm Freq → NPD speed	H5	-	-0.0750 (0.3088)
Comm Freq → Org Learning	H6	+	0.2400 (2.5421)**
Org Learning → NPD speed	H7	+	0.4860 (2.5599)**
Model Statistics			
R ² for NPD speed	= 0.164		
R ² for Organisational Learning	= 0.682		
*	Significant at ≤ 0.05 level (one-tailed test)		
**	Significant at ≤ 0.01 level (one-tailed test)		
***	Significant at ≤ 0.001 level (one-tailed test)		

As shown in Table 4 above, the results revealed that communication quality (beta = 0.431, t-value = 4.2958, $p \leq 0.001$), bi-directional communication (beta = 0.328, t-value = 3.1142, $p \leq 0.001$), and communication frequency (beta = 0.240, t-value = 2.5421, $p \leq 0.01$) had a significant relationship with organisational learning. These results indicate good support for the hypotheses relating to the effects of communication behaviours on organisational learning. Specifically, an increase in communication quality would result in a substantial increase in organisational learning (H2). Similarly, with respect to H4, it was found that an increase in bi-directional communication leads to a large increase in organisational learning. Moreover, an increase in communication frequency resulted in a smaller, but significant increase in organisational learning (H6).

In contrast, bi-directional communication (beta = -0.130, t-value = 0.7718, $p \geq 0.05$), communication frequency (beta = -0.0750, t-value = 0.3088, $p \geq 0.05$), and communication quality (beta = 0.049, t-value = 0.2840, $p \geq 0.05$) had no relationship with NPD speed (see Table 4). In light of these results, the hypotheses relating to communication quality (H1), bi-directional communication (H3), and communication frequency (H5) were not supported.

Furthermore, results indicate that organisational learning had a strong positive relationship with NPD speed (beta = 0.486, t-value = 2.5599, $p \leq 0.01$) (see Table 4), the strongest effect observed in our structural model testing. This result indicates strong support for H7, suggesting that an increase in an organisational learning leads to greater NPD speed being achieved by the firm.

6. Discussion

This research aimed to empirically test a model concerning the effects of communication behaviours (i.e. communication quality, bi-directional communication, and communication frequency) on NPD speed and organisational learning. Along with these relationships, the effect of organisational learning on NPD speed was also examined.

Overall, the model performed very well in predicting organisational learning, as this construct had a high R^2 , and all of the associated hypotheses were supported. This contrasts with the other endogenous variable NPD speed. None of the hypotheses relating to this particular endogenous variable were not supported.

Communication quality had the strongest positive effect on organisational learning, followed by bi-directional communication and communication frequency. This suggests that the higher the quality of information disseminated within the NPD team, the greater the organisational learning. Also, support for the hypotheses concerning the positive effects of bi-directional communication and communication frequency on organisational learning, suggest that two-way dialogue and frequent communication facilitates greater interaction, and consequently fosters greater learning within the firm.

In addition, the results reveal that organisational learning has a strong effect on NPD speed. This suggests that the more an organisation promotes learning through high quality interaction and feedback between decision-makers, the more likely the firm will increase the speed of their NPD projects. Furthermore, the results suggest that an increase in the three forms of communication examined in this research can increase organisational learning, which subsequently can lead to faster NPD.

In light of the above discussion, the results of this research have significant implications for managers and those involved in the NPD process. Firstly, in order to promote learning with the firm, managers need to understand that the quality of communication and information disseminated is crucial in enhancing employees learning capacity. Secondly, high communication quality needs to be further supported with bi-directional communication and frequent communication. More specifically, there needs to be two-way interaction and regular dialogue between employees to enhance learning opportunities. If employees are regularly in contact and the quality of communication is high, confusion can be minimised and consequently knowledge can be enhanced (Wheelwright and Clark, 1992).

In order to increase the speed of NPD projects, managers need to understand that by promoting high quality communication, bi-directional communication, and establishing frequent communication, firms experience greater learning within the firm, which consequently, increases the speed at which new products are developed.

7. Conclusions

This research achieved two objectives. Firstly, it empirically tested the relationships between communication behaviours and NPD speed, and organisational learning, and the effect of organisational learning on NPD speed. Secondly, this research contributes to the growing need for research on organisational learning. Using sound theory development and rigorous testing, future research needs to focus on better understanding both NPD speed and organisational learning.

Limitations within this research included a relatively small sample size, and concentrating only on the effects of communication behaviours on NPD speed and organisational learning. Consequently, future research could utilise a larger sample size and investigate other factors which have a direct effect on NPD speed and organisational learning, such as interpersonal trust and conflict between NPD team members.

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Appendix

Operational Measures

Construct	Items	Adapted From
Communication Quality De (5 items) Meyer, Souder, and Deschoolmeester	7-point Likert-scale (1 = strongly disagree, 7 = strongly agree). MMs were asked the degree to which communication quality occurred within their NPD project: (1) The information provided by those involved in the NPD project was useful for the NPD project; (2) I was very satisfied with the content of the information provided by those involved in the NPD project for the NPD project; (3) The information provided by those involved in the NPD project was highly relevant to the NPD project; (4) The information provided by those involved in the NPD project was highly credible; and (5) The form and presentation of the information for the NPD project was very satisfactory .	Moenaert, (1992)
Bi-directional Communication Maltz, and (4 items) (1997)	7-point Likert-scale (1 = strongly disagree, 7 = strongly agree). MMs were asked the degree to which bi-directional communication occurred within their NPD project: (1) We respond to each others communication during the NPD project; (2) We provide each other with a lot of feedback during the NPD project; (3) During the NPD project we frequently exchange email ^b ; and (4) There is a lot of two-way communication between those involved in the NPD project.	Fisher, Jaworski
Communication Frequency ^a and Piercy (10 items)	7-point Likert-scale (1 = strongly disagree, 7 = strongly agree). MMs were asked how frequently they communicated during the NPD project by: (1) Written memos; (2) Written reports; (3) Fax machines; (4) Scheduled one-to-one meetings; (5) Impromptu face to face meetings; (6) Scheduled one-to-one phone conversations; (7) Impromptu phone conversations; (8) Voice mail; (9) Teleconferencing; and (10) E-mail.	Morgan (1998)
Organisational Learning ^a Hult and Ferrell (8 items) (1997)	7-point Likert-scale (1 = strongly disagree, 7 = strongly agree). MMs were asked the degree to which organisational occurred within their NPD project: (1) In the NPD team, cross-functional teamwork is the common way of working rather than an exception to the norm;	

(2) There is a commonality of purpose in the NPD team processes; (3) All activities that take place in the NPD process are clearly defined; (4) The NPD team understand where all activities fit-in in the NPD process; (5) The basic values of the NPD process in our firm include learning as a key to improvement; (6) The collective wisdom involved in the NPD process is that once we quit learning, we endanger future NPD projects; (7) Our NPD team has specific mechanisms for sharing lessons learned in the NPD process from project to project; and (8) There is a good deal of organisational conversation within the NPD team which keeps alive the lessons learned from previous NPD projects.

NPD Speed
Rodriguez (2006)
(3 items)

7-point Likert-scale (1 = strongly disagree, 7 = strongly agree). MMs were asked the degree to which speed occurred within the NPD project: (1) We launched our product on or ahead of schedule; (2) During the NPD project we performed the project faster relative to how it could have been performed; and (3) During the NPD project we performed the project faster relative to what was considered customary for the industry. Carbonell and

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- a Denotes a formative measure
 - b Item deleted from measurement model due to low standardised factor loading