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INTERDEPENDENCE AND COMMUNICATION BETWEEN TECHNICALLY TRAINED MANAGERS AND MARKETING MANAGERS DURING INNOVATION PROJECTS

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Interdependence between Technically Trained Managers and Marketing Managers in new product development (NPD) teams is inherent, though few studies have investigated its effects within such teams. Here, interdependence is disaggregated into two underlying dimensions — the dependence of the Technically Trained Manager on the Marketing Manager, and the dependence of the Marketing Manager on the Technically Trained Manager during the project. Our model is tested using data from 184 Technically Trained Managers from Australian companies involved in NPD. The results suggest that interdependence is an important contextual variable during NPD projects. Senior managers should communicate its importance to NPD team members because of its positive effects within the NPD team. Where the Technically Trained Manager and Marketing Manager recognise their interdependence, they engage in more frequent, and more bidirectional communication. This is important because more effective communication between these two managers positively influences the quality and effectiveness of their working relationships, which in turn can increase NPD project success.

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Keywords: Interdependence; communication; conflict; relationship effectiveness; NPD project success.

Introduction

Interdependence between managers in new product development (NPD) project teams is inherent, and this current study examines the effects of interdependence between Technically Trained Managers (hereafter TTM) and Marketing Managers (hereafter MM) within such teams. The TTMs we examine in our study consist primarily of R&D Managers (40.2% of the sample), Engineering Managers (20.1%), Manufacturing Managers (31.5%), and 8.2% are other TTMs. We focus on TTM/MM relationships because these managers are among the most important decision makers during NPD, with a major influence on NPD projects from inception to launch (cf. Wind, 1981, 1982). During an NPD project, the TTM may for example rely on the MM for marketing research on customer preferences. Similarly, the MM may rely on the TTM for information on current and emerging technologies which may be incorporated into potential new products.

Many NPD activities require joint effort between TTMs and MMs because such tasks are at the boundary between management, technology, and the market place, and the operational domains of TTMs and MMs span these areas (cf. Wang, 1997). Importantly, the effectiveness of TTM/Marketing cooperation during the corporate conceptual development, product conceptual development, and implementation phases of NPD projects increases the likelihood of market success (Wang, 1997).

This current study examines the effects of *interdependence* between TTMs and MMs on two distinct forms of communication behaviour — *communication frequency*, and *bidirectionality*. The logic behind examining these constructs is that interdependence between NPD team members is likely to influence managerial communication behaviours within the project team. Specifically, to use forms of communication which improve the quality and effectiveness of their working relationships.

In turn we use these communication variables to predict our two dependent variables: the level of *interpersonal conflict* in the TTM/MM dyad, and the *perceived effectiveness of their working relationship*. We do this because NPD project success is known to be contingent on the quality and effectiveness of working relationships between these managers. There is strong evidence that the more effectively TTMs and MMs work together during NPD, the greater the likelihood of developing a successful new product (cf. Maltz *et al.*, 2001; Shaw and Shaw, 1998; Souder, 1981, 1988). Souder (1981, 1988) found that where "harmony" existed between NPD team members, 81.1% of NPD projects were a complete or partial success, compared with only 31.6% when there was "severe disharmony."

These early studies stimulated important work identifying factors influencing the quality and effectiveness of these working relationships during NPD. In this research, these relationship outcomes are proxied by two variables — the level of *interpersonal conflict* between the TTM and the MM, and the *perceived effectiveness of their working relationship*.

Broadly, this current paper adds to the innovation literature by improving our understanding of how to better manage the efforts of TTMs and MMs during NPD projects. More specifically, the article makes three contributions. First, the "interdependence" construct is relatively unexplored in the innovation literature, and our study adds to our understanding of its effects within NPD teams. Importantly, we disaggregate interdependence into: (i) the *perceived dependence of the MM on the TTM*, and (ii) the *perceived dependence of the TTM on the MM*. Existing studies examining interdependence in exchange relations have tended to use aggregated measures of each exchange partner's dependence, such as "relative dependence" (e.g., Sivadas and Dwyer, 2000), or "total interdependence" (e.g., Dawes and Massey, 2006). By disaggregating the interdependence construct into the levels of perceived dependence between these managers, we can assess the differential effects of these two constructs.

Second, while there is some vulnerability associated with being dependent on a peer manager during NPD, we demonstrate that the net effect of interdependence on project outcomes is positive. Our results suggest that greater interdependence is associated with an increased use of effective communication behaviours such as bidirectional communication. Therefore, it is in the interests of senior managers to emphasise this interdependence between TTMs and MMs during NPD projects.

Last, we make a theoretical contribution by demonstrating the salience and complementarity of two theoretical frameworks, the "information processing perspective" and "resource dependence theory" both of which are reviewed in the following section.

The rest of this article is organised as follows: first we discuss our theoretical frameworks, present the conceptual model, and develop our hypotheses. We then discuss our methodology and present the results and discuss their implications. We conclude by reviewing the theoretical and managerial contributions of this article, identify some limitations of our study, and directions for future research.

Theoretical Frameworks

There is no single overarching theoretical framework that can be used to examine TTM/MM working relationships. Depending on the nature of the study, various theoretical frameworks may be germane. In this current study, we draw on three

complementary theoretical frameworks to specify our model. The first framework is "resource dependence theory" (e.g., Pfeffer and Salancik, 1978), because our focus is primarily on interactions and relationships between individuals. We use resource dependence theory rather than related theories such as "structural contingency theory" (cf. Donaldson, 1996), because the latter lacks action-level analysis (Pennings, 1992), and this is the level of analysis at which working relationships are enacted within NPD teams.

Resource dependence theory is relevant to our research because it concerns individuals' access to and control of resources, and the outcomes of that control. Resource acquisition is an important priority for managers within NPD teams, and because securing required resources can be problematic, individual managers must attempt to negotiate successful exchanges with other NPD team members. The use of resource dependence theory therefore justifies our inclusion of "interdependence" in our conceptual model. Importantly, securing these resources requires NPD team members to use various forms of communication to achieve their ends (cf. Dawes and Massey, 2006), hence our inclusion of the two communication variables in our model.

Much existing research into the management of NPD projects uses the "information processing perspective" as a theoretical framework (cf. Atuahene-Gima and Evangelista, 2000), and it is the second theoretical underpinning to our study. Its fundamental premise is that NPD teams are intra-firm information processing systems, whose function is to reduce uncertainty, to make sense of a complex environment and tasks, and execute these effectively, leading to the development of successful new products (cf. Moenaert and Souder, 1990). Importantly for our model specification, communication is a key means by which TTMs and MMs reduce that uncertainty during NPD projects (Moenaert *et al.*, 1994). Reducing ambiguity through effective communication is an important facet of NPD projects, particularly during the "fuzzy front end" of the project (Brun, 2008). Similarly, as Kok *et al.* (2003) note, market oriented product development is predicated not only on a firm's capabilities (e.g., accumulated knowledge, skills, systems, methods, values, and norms), but also their information processing activities (e.g., acquisition, distribution, interpretation, evaluation, and utilisation of information).

We also draw on a third theoretical framework — the "interaction approach" which examines the nature and pattern of interactions between personnel in different departments, and the outcomes of those interactions (e.g., Moenaert *et al.*, 1994; Ruekert and Walker, 1987). Managers with behavioural repertoires consistent with the interaction approach seek to increase interpersonal communication via meetings, cross-functional information flow, and documented information exchange (cf. Kahn, 1996; Kahn and Mentzer, 1998).

Both the information processing perspective and the interaction approach justify our inclusion of the two communication variables — *communication frequency* and *bidirectional communication*, and two relationship outcome variables — *interpersonal conflict*, and *perceived relationship effectiveness*.

Conceptual Model

As noted previously, few studies have empirically examined the effects of interdependence during NPD projects. Literature examining other types of exchange relations however (e.g., buyer–seller relationships), suggest that its effects are likely to be positive. If an exchange partner perceives they are interdependent on another party, they will be less likely to act opportunistically, be more accommodating and open to influence, be willing to make adaptations, and more likely to trust the other party (Smith and Barclay, 1999).

Our conceptual model therefore links the levels of the *TTMs dependence on the MM*, and the *MMs dependence on the TTM* to two different communication variables. First, *communication frequency* — which represents the intensity of information flow through media such as electronic mail, memos, and face-to-face meetings (Morgan and Piercy, 1998). Second, *bidirectional communication* — is the extent to which communication between the two managers is a two-way process (Fisher *et al.*, 1997).

Our logic in linking interdependence to these two communication variables is that when managers recognise their dependence on other managers, this can lead to what Thompson (1967:55) called "coordination by mutual adjustment." Specifically, recognition of mutual dependence is likely to prompt managers to proactively use various forms of communication to improve the quality and effectiveness of their working relationship. Consistent with resource dependence theory, this is done to secure or control required resources, to improve managers' personal and work-related outcomes from the project. Moreover, good TTM/MM communication, and the sharing of domain specific knowledge (e.g., knowledge about technology, the market, or users) via effective communication, improves innovation performance (Rundquist, 2012).

These communication variables are then linked to two relationship outcome variables — the level of *interpersonal conflict* between TTMs and MMs, and the *perceived effectiveness of their working relationship*. The logic behind these links is that managerial communication is one means through which departmental managers can build and maintain effective working relationships in organisational contexts such as NPD teams. Importantly, we know from the extant literature that the quality of these working relationships during NPD projects has important

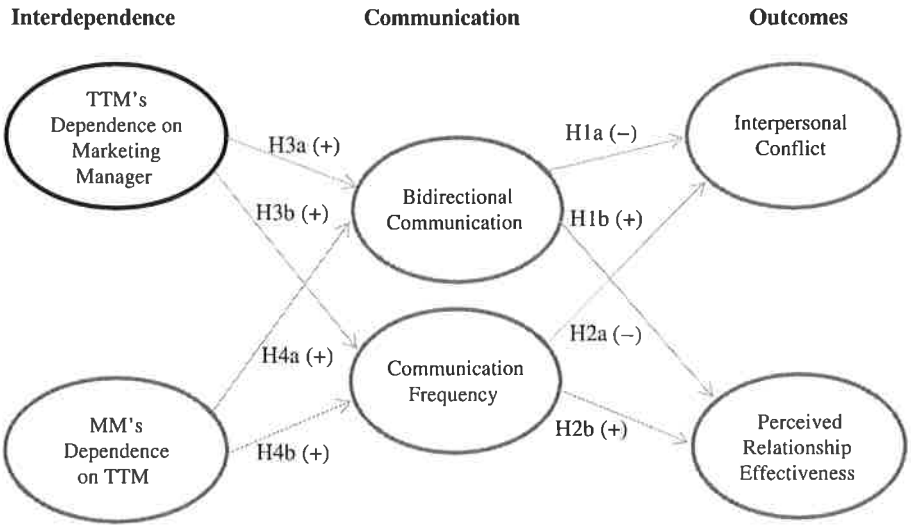

Fig. 1. Conceptual model.

effects on these "psycho-social" outcomes, i.e., the level of conflict between the two managers, and how effectively they believe they work together with the other manager. Moreover, these psycho-social outcomes have been linked to task outcomes (e.g., accomplishment of departmental and joint goals) as early as the landmark article by Ruekert and Walker (1987) on Marketing's working relationships with other departments, and are also known to be important determinants of NPD project success (cf. Souder, 1981, 1988). See Fig. 1.

Hypotheses Development

Effects of bidirectional communication

Bidirectional communication is relatively unexplored in the innovation literature, although attention on this construct is justified, as empirical evidence suggests that frequent communication alone is insufficient to achieve cross-functional coordination (e.g., Kahn, 1996; Kahn and Mentzer, 1998; Dawes and Massey, 2005).

Interpersonal conflict

An important aspect of bidirectional communication is that it is a highly collaborative form of interaction, one likely to lead to positive outcomes within NPD teams. Its strength derives from Gouldner's (1960) norm of reciprocity, and the

notion that communication from one party is likely to be reciprocated, creating a bidirectional communication flow. This is because norms of reciprocity are deeply ingrained in most social systems (Gouldner, 1960).

Empirical evidence suggests that bidirectional communication leads to positive organisational outcomes. Fisher *et al.* (1997) for example found that it was associated with greater perceived relationship effectiveness, a low conflict state. Similarly, Mohr *et al.* (1996) examined communication in inter-firm relationships and conceptualised bidirectional communication (and communication frequency) as underlying dimensions of a second-order factor — *collaborative communication.* Their results revealed this second order factor had a strong positive influence on respondents' satisfaction with the relationship, again, a low conflict state. Similarly, Jablin (1979) found bidirectional communication improves supervisor–subordinate relationships. Thus, a highly collaborative form of interaction such as bidirectional communication should be associated with positive outcomes such as lower conflict. Recent research on bidirectionality in working relationships (e.g., Fisher *et al.*, 1997; Johlke *et al.*, 2000) suggests that because of its two-way nature, bidirectional communication facilitates dialogue which helps to clarify issues and resolve conflicts. On the basis of the theory and evidence available to us, we therefore hypothesise:

H1a: *The greater the bidirectional communication between the TTM and the MM during NPD projects, the lower the interpersonal conflict.*

Perceived relationship effectiveness

As noted above, bidirectional communication allows managers to clarify issues and resolve conflicts via increased dialogue. One consequence of this is that managers using high levels of bidirectional communication are likely to perceive their working relationship with that peer manager to be more effective. Empirical research supports this view, as Fisher *et al.* (1997) found a positive relationship between bidirectional communication and perceived relationship effectiveness in Marketing/Engineering working relationships. This finding should be generalisable to the TTM/MM working relationships examined in this current study, because Engineers are what Kyriazis *et al.* (2012) refer to as "technically trained managers," the categorisation we use in this current research. Accordingly we hypothesise:

H1b: *The greater the bidirectional communication between the TTM and the MM during NPD projects, the greater the perceived effectiveness of the relationship.*

Effects of communication frequency

Interpersonal conflict

The interaction approach suggests that communication frequency can lead to both positive and negative outcomes, so no clear predictions can be made from this theory alone. This lack of clear prediction is also reflected in the empirical evidence, as studies linking communication frequency to interpersonal conflict yield mixed results. In his study of disharmony between R&D and Marketing, Souder (1981) for example found that greater interaction was associated with better cross-functional coordination — a positive outcome. Similarly, Menon *et al.* (1996) found that communication frequency was associated with greater mutual understanding and better rapport. Consistent with this, Morgan and Piercy (1998) argue that frequent communication is likely to facilitate greater understanding and more effective coordination of actions between departmental managers, and should therefore be negatively associated with interdepartmental conflict.

In contrast, Maltz and Kohli (1996) found that while low levels of communication frequency might be beneficial, beyond a certain threshold, more frequent communication between peer managers may be perceived as low quality, and dysfunctional. Consistent with this, Ruekert and Walker (1987) found that higher interaction flows between R&D and Marketing were associated with greater conflict. This result was corroborated by Dawes and Massey (2005) who found a strong negative relationship between communication frequency and interpersonal conflict in the MM/Sales Manager dyad.

Despite the lack of clear predictions from theory, and inconsistent empirical evidence, we posit that more frequent communication between TTMs and MMs should reduce conflict. We argue this because these managers work in very different conceptual and operational domains. Thus, there will be a need for frequent communication to clarify issues, identify each party's priorities, and resolve differences in each other's viewpoints, i.e., reduce conflict between the TTM and MM. We therefore hypothesise:

H2a: *The greater the communication frequency between the TTM and the MM during NPD projects, the lower the conflict.*

Perceived relationship effectiveness

As per our arguments regarding the positive effects of communication frequency in reducing conflict, frequent communication should also positively influence a manager's perception of how effective their relationship is with a peer manager. Extant research on the effects of communication frequency (e.g., Ruekert and

Walker, 1987) suggests that greater communication within a managerial dyad can improve coordination, and one's understanding of a peer's information requirements. Thus, managers who communicate more frequently are more likely to perceive their relationship to be effective. We therefore hypothesise:

H2b: *The greater the communication frequency between the TTM and the MM during NPD projects, the greater the perceived effectiveness of the relationship.*

Effects of technically trained manager/marketing manager interdependence

Communication frequency and bidirectionality

Firms can divide their activities in various ways, however regardless of the organisational structure adopted, the resulting departments or organisational units are to some extent interdependent (McCann and Galbraith, 1981). This is particularly so during NPD as interdependent managers rely on each other for inputs and support to carry out their tasks, and in turn, provide inputs and support for others in the NPD team.

In their landmark study, Ruekert and Walker (1987) argued that interdependence is a key internal variable affecting Marketing's interaction with other departments. Importantly, as the interdependence between managers increases, greater interaction and communication flows are required. This is because task interdependence requires managers to communicate, to coordinate the activities of their departments, and negotiate better personal, departmental, and organisational outcomes. Conversely, where there is little or no interdependence between any two managers, there will be little or no need for those managers to communicate.

Early work in this area supports this view, specifically, that high task interdependence results in more frequent communication, helping, and information sharing than when tasks are undertaken individually (Crawford and Haaland, 1972; Johnson, 1973). More recent work has found that positive interpersonal interactions develop most strongly in task-interdependent groups, which suggests that such groups tend to develop constructive ways to interact, to survive as a team (Wageman, 1995).

An important implication of these studies is that greater interdependence should be associated with an increased use of bidirectional communication and communication frequency. This is because interdependent managers recognise their interdependence, and their need to develop and foster ongoing relationships with other departmental managers.

These arguments are consistent with a resource-based view of the firm (cf. Wernerfelt, 1984). In short, because managers do not have all the monetary, information, or human resources necessary to do their jobs, they must seek out

these resources from people in other departments. Hence, highly interdependent managers will need to rely on other managers to secure those resources not only for immediate use, but to also draw upon these in future projects.

Evidence supporting this was provided by Goebel *et al.* (2006), who found that greater resource dependence between MMs and Purchasing Managers was associated with greater use by MMs of communication designed to influence peer managers. Specifically, there was greater use of "reasoning", and "ingratiation" when communicating with the interdependent manager. Moreover, Liden and Mitchell (1988) argue that increased ingratiatory communication within firms may also occur as a result of task interdependence.

Last, whilst the level of analysis is different, evidence in the marketing channels literature suggests that greater interdependence is associated with increased communication in order to influence another manager (e.g., Frazier and Rody, 1991; Gundlach and Cadotte, 1994). One explanation for this is that highly interdependent exchange partners recognise their need for cooperation. Therefore, consistent with the relational exchange paradigm (e.g., Dwyer *et al.*, 1987), these partners will tend to behave cooperatively, rather than competitively, e.g., use effective forms of communication with a peer manager in the NPD team.

Drawing on the literature summarised above, we posit that where the TTM and the MM perceive their interdependence to be high, this will be associated with an increased use of both bidirectional communication and communication frequency.

H3a: *The greater the TTMs dependence on the MM during NPD projects, the greater the bidirectional communication between the TTM and the MM.*

H3b: *The greater the TTMs dependence on the MM during NPD projects, the greater the communication frequency between the TTM and the MM.*

H4a: *The greater the MMs dependence on the TTM during NPD projects, the greater the bidirectional communication between the TTM and the MM.*

H4b: *The greater the MMs dependence on the TTM during NPD projects, the greater the communication frequency between the TTM and the MM.*

Research Design

Data collection

Data was collected from TTMs working in Australian firms, acting as key informants on their working relationship with the MM during a specific NPD project.

The survey used a pre-tested, mailed, self-administered questionnaire. All firms were qualified by ensuring that the respondent's firm did conduct NPD, that there was a single identifiable manager/decision maker responsible for R&D, and also a counterpart manager responsible for Marketing. These firms were contacted by telephone, and those not conducting NPD were removed from the sampling frame. In total 334 managers agreed to participate, and after two waves of mail-outs and follow up telephone calls 184 usable responses were received (response rate = 55%).

Sample characteristics

These 184 firms comprised mostly goods producers (96.2%), with the remainder (3.8%) being software producers. Consumer marketers accounted for 47.0%, business-to-business marketers 23.5%, and 29.5% sold into both markets. As noted previously the breakdown of TTMs in our study is as follows: 40.2% are R&D Managers, 20.1% Engineering Managers, 31.5% Manufacturing Managers, and 8.2% are other types of TTM. Tests of non-response bias revealed no statistically significant differences between the early and late respondents.

Operational measures

Three reflective multi-item scales were used (*bidirectional communication*; *interpersonal conflict*; and *perceived relationship effectiveness*), and 3 formative multi-item scales (*TTM's dependence on the MM*; *MM's dependence on the TTM*, and *communication frequency*). All variables were measured using 7-point scales. The operational measures used in this study are provided in the Appendix.

Principal components analysis revealed that the reflective multi-item measures are unidimensional. Partial least squares (PLS) was used to assess the measures (Ringle *et al.*, 2005), and all items except one bidirectional communication item had adequate standardised factor loadings, suggesting that they are acceptable measures of the latent variables.

Convergent validity was established in two ways, first the *t*-statistics for each item are statistically significant (Anderson and Gerbing, 1988), and second, the average variance extracted (AVE) for each reflective construct exceeds 0.50 (Fornell and Larcker, 1981).

We also used two sets of criteria to establish discriminant validity. First, the squared correlation for any pair of constructs should be less than the AVE for each of those individual constructs (Fornell and Larcker, 1981). In all cases this criterion was met. Second, the pattern of loadings and cross-loadings revealed that no item loaded more heavily on another construct than on the one it purported to

Table 1. Measurement properties of the reflective multi-item measures.

Item	Standardised factor loadings	
Bidirectional Communication*		**AVE = 0.71; Composite Reliability = 0.88**
Item 1	0.70	
Item 3	0.90	
Item 4	0.91	
Interpersonal Conflict		**AVE = 0.55; Composite Reliability = 0.83**
Item 1	0.83	
Item 2	0.77	
Item 3	0.66	
Item 4	0.69	
Perceived Relationship Effectiveness		**AVE = 0.82; Composite Reliability = 0.96**
Item 1	0.93	
Item 2	0.90	
Item 3	0.84	
Item 4	0.90	
Item 5	0.94	

* Item 2 from bidirectional communication deleted due to low standardised factor loading.

measure (cf. Chin, 1998). As all items passed this test, again discriminant validity was established.

Reliability analysis reveals that the composite reliabilities for our scales were 0.83 or above suggesting good internal consistency in our measures (see Table 1 for standardised factor loadings, composite reliabilities, and AVEs).

Results

PLS was used to estimate the structural model (Ringle *et al.*, 2005). PLS is appropriate because it allows for the specification of both reflective and formative measurement models, it has no requirement for univariate or multivariate normality, and is excellent for analysing relatively small datasets (Chin, 1998).

Descriptive statistics

The results reflect the views of TTMs reporting on their working relationship with a focal MM during an NPD project. In terms of perceived dependence, TTMs rated their dependence on the MM as fairly low (mean = 3.28, s.d. = 1.25). In contrast, they rated the MM's dependence on them much higher (mean = 4.73, s.d. = 1.29), see Table 2. Hence, while TTMs perceive their dependence on the MM to be asymmetric, overall, TTMs recognise that there is a fairly high level of

Table 2. Means, standard deviations, and latent variable correlations.

		Correlations				
Construct	Mean (SD)	1	2	3	4	5
1. TTMs Dependence on MMs	3.28 (1.25)					
2. MMs Dependence on TTMs	4.73 (1.29)	0.30**				
3. Communication Frequency	2.51 (0.66)	0.31**	0.12			
4. Bidirectional Communication	4.96 (1.18)	0.25**	0.23	0.51**		
5. Interpersonal Conflict	2.75 (1.17)	−0.09	−0.11	−0.15*	−0.39**	
6. Relationship Effectiveness	5.15 (1.32)	0.27**	0.21**	0.32**	0.57**	−0.64**

* $p \leq 0.05$; ** $p \leq 0.01$ (2-tailed tests).

interdependence between them during NPD projects. This implies that the TTM and MM need to use forms of communication which increase the quality and effectiveness of their working relationship and thus, the likely success of the NPD project.

The results reveal a fairly low level of communication frequency (mean = 2.51, s.d. = 0.66), but high levels of the reciprocal form of communication — bidirectional communication (mean = 4.96, s.d. = 1.18). Also, despite significant differences in the vocational training, backgrounds, and responsibilities of the TTMs and MMs, and the resulting likelihood that they would not work effectively together (cf. Dougherty's 1992 work on departmental "thought worlds"), their working relationship is encouragingly healthy. Specifically, interpersonal conflict is low (mean = 2.75, s.d. = 1.17), and the perceived effectiveness of the working relationship is quite high (mean = 5.15, s.d. = 1.32).

PLS path modelling results

As the results of the structural modelling show (see Table 3), bidirectional communication has powerful effects during NPD projects. It has a strong negative relationship with interpersonal conflict ($\beta = -0.49, p < 0.001$), thus supporting H1a, and a very strong positive relationship with perceived relationship effectiveness ($\beta = 0.64, p < 0.001$), supporting H1b. The results for communication frequency however are mixed, as it has no effect on interpersonal conflict ($\beta = -0.06, p > 0.05$), thus we reject H2a. However, it does have a small positive effect on perceived relationship effectiveness ($\beta = 0.15, p < 0.01$), supporting H2b.

Turning now to interdependence, when the TTM perceives their dependence on the MM to be high, this is associated with greater bidirectional communication ($\beta = 0.28, p < 0.001$), and communication frequency between those managers

Table 3. PLS model testing results.

Linkage in the model	Hyp. no.	Std. beta	t-stat
Bidirectional Comm. → Conflict	H1a (−)	−0.49	7.4759***
Bidirectional Comm. → Relationship Effectiveness	H1b (+)	0.64	12.9127***
Communication Freq. → Conflict	H2a (−)	−0.06	0.7341
Communication Freq. → Relationship Effectiveness	H2b (+)	0.15	2.4412**
TTMs Dep. on MM → Bidirectional Comm.	H3a (+)	0.28	3.5529***
TTMs Dep. on MM → Communication Freq.	H3b (+)	0.29	2.8193**
MMs Dep. on TTM → Bidirectional Comm.	H4a (+)	0.17	1.9230*
MMs Dep. on TTM → Communication Freq.	H4b (+)	0.17	1.4061†
Bidirectional communication $R^2 = 0.13$			
Communication frequency $R^2 = 0.13$			
Interpersonal conflict $R^2 = 0.26$			
Perceived relationship effectiveness $R^2 = 0.50$			

†$p \leq 0.10$; * $p \leq 0.05$; ** $p \leq 0.01$; ***$p \leq 0.001$ (1-tailed tests).

($\beta = 0.29, p < 0.01$), thus supporting H3a and H3b. Last, where the MM is perceived to be more dependent on the TTM, this is associated with greater bidirectional communication ($\beta = 0.17, p < 0.05$), supporting H4a, and greater communication frequency ($\beta = 0.17, p < 0.10$), supporting H4b, though the latter result only approaches statistical significance.

Discussion

Theoretical implications

Recall that this study drew upon three theoretical frameworks: interaction theory, the information processing perspective, and resource dependence theory. Our study supports the salience of the latter two theories, but less so, the interaction approach. Specifically, our findings demonstrate that more frequent interaction, as advocated by the interaction approach, has limited value. More frequent communication does not reduce conflict between TTMs and MMs during NPD projects. Also, while the path coefficient linking communication frequency to perceived relationship effectiveness is statistically significant, the effect is relatively modest. This finding supports the view expressed in Dawes and Massey (2005) that applying the logic of the interaction approach may lead managers into a "mere frequency" fallacy, specifically, the assumption that more frequent communication is necessarily better than less frequent communication in peer manager working relationships. Our results suggest that the effects of high frequency communication are modest at best, while other studies suggest that its

effects can actually be negative (e.g., Dawes and Massey, 2005; Maltz and Kohli, 1996; Ruekert and Walker, 1987).

In contrast, our results provide good support for the salience of both the information processing perspective, and resource dependence theory. As discussed earlier, the information processing perspective considers NPD teams as intra-firm information processing systems, which reduce uncertainty, make sense of complex environments and tasks, allow managers to undertake these tasks effectively, and thus improve the likelihood of such teams developing successful new products (Moenaert and Souder, 1990). Our findings suggest that bidirectional communication has powerful task and psycho-social effects. In terms of task effects, bidirectional communication is a potent means through which managers can plan and execute their tasks during NPD projects. With respect to psycho-social effects, bidirectional communication between TTMs and MMs strongly reduces conflict between these two managers. Moreover, by far the strongest effect we found in our model was the link between bidirectional communication and perceived relationship effectiveness. Thus, this collaborative, reciprocal form of communication operates in a way that is consistent with the information processing perspective on NPD teams.

We also find support for resource dependence theory as a theoretical lens through which to view NPD teams. Given that such teams consist of interdependent managers who are seeking power and influence to secure and control resources, our results vindicate our use of interdependence as one of our focal constructs. Specifically, all four hypotheses linking perceived interdependence between these managers and the two communication dimensions are supported. Thus, the more these managers perceive themselves to be interdependent, the more likely they are to increase both the frequency and bidirectionality of their communications with those interdependent peer managers. Managers, therefore, appear to recognise that when working in NPD teams they cannot achieve successful project outcomes alone. Rather, they must find and use effective forms of communication to secure the expertise and inputs of other specialist departmental managers in order to deliver a successful new product.

Managerial implications

Firms with NPD programmes can benefit from our findings. They suggest that senior management should highlight to TTMs and MMs their high levels of interdependence during innovation projects. This strategy is likely to help increase the success of NPD teams because, the *realpolitik* of most organisations is that when senior management explicitly identify specific initiatives and priorities, and are seen to actively encourage and support them, middle managers are more likely

to "buy in" to those initiatives. This is important because the evidence presented here suggests that the more these two managers recognise or acknowledge their interdependence, the more likely it is that they will self-organise and volitionally use productive communication behaviours to improve their working relationships with other NPD team members, and in turn, improve NPD project success rates. This is consistent with the findings of Rundquist (2012) who notes that firms in which senior managers create cultures which facilitate communication and integration of domain specific knowledge (i.e., relating to technology, operations, or markets), are likely to improve their innovation performance.

This then raises the question: given that these two forms of communication increase under conditions of interdependence, how effective are they during NPD projects? The results reveal that bidirectional communication has by far the biggest influence on the quality and effectiveness of the TTM/MM dyad during NPD. Bidirectional communication not only strongly reduces interpersonal conflict, but has even stronger positive effects on the perceived effectiveness of their working relationship. Thus, senior management should consider introducing systems which require these two managers to exchange information on a regular basis.

In contrast, communication frequency has only a modest effect on perceived relationship effectiveness, and no effect on interpersonal conflict. Senior managers should therefore not attempt to merely increase the frequency of communication between TTMs and MMs. Instead, they should attempt to increase the sharing of information. Consistent with reciprocal action theory (cf. Gouldner, 1960), this could help build effective ongoing communication links between these two managers.

Conclusions, Limitations, and Directions for Future Research

This study reveals that despite the potential for managerial vulnerability during NPD projects, caused by poor performance by a peer manager, the net effects of interdependence appear to be positive. Consistent with the precepts of "internal marketing" (cf. Gummesson, 1987), managers within NPD teams should view peer managers within the team as either customers or service providers within an internal market, i.e., the NPD team. The logic behind this is that the better peer managers within a team deliver their own domain-specific inputs, the better the team will function, and the more likely it will be to develop successful new products.

In addition, this study shows that not all forms of intra-firm communication are equally effective. Managers should therefore attempt to not simply communicate more frequently, thus falling into Dawes and Massey's (2005) "mere frequency"

fallacy, they should seek to establish more two-way communication flows within the NPD team.

A limitation of this study is that it uses cross-sectional data to investigate issues that have a temporal component. Future research could adopt a longitudinal design, to better explore the dynamics of NPD team relationship development and maintenance. In addition, the views here are those of the TTM only, and future research could use matched dyadic data from both the TTM and the MM within the same firm.

Appendix. Operational Measures

Construct	Items
Technically Trained Managers dependence on Marketing Manager	Seven-point scale anchored: 1 "Completely Disagree" and 7 "Completely Agree." Concerning this project, in order for you to accomplish your goals and responsibilities, how dependent were you on the Marketing Manager with respect to: (1) Obtaining resources (e.g., personnel, equipment, information); (2) Obtaining support (e.g., advice, technical assistance); (3) Obtaining outputs (e.g., plans, reports, strategies).
Marketing Managers dependence on Technically Trained Manager	Seven-point scale anchored: 1 "Completely Disagree" and 7 "Completely Agree." Concerning this project, in order for you to accomplish your goals and responsibilities, how dependent was the Marketing Manager on you with respect to: (1) Obtaining resources (e.g., personnel, equipment, information); (2) Obtaining support (e.g., advice, technical assistance); (3) Obtaining outputs (e.g., plans, reports, strategies).
Communication Frequency	Seven-point scale anchored: 1 "Never" and 7 "Very Frequently." Respondents were asked how frequently they communicated with the other manager during the project using the following methods: (1) Electronic mail; (2) Voice mail; (3) In scheduled one-to-one meetings (face to face); (4) In impromptu face-to-face conversations (e.g., in the hall); (5) In scheduled one-to-one phone conversations; (6) In impromptu one-to-one phone conversations; (7) Informal face-to-face conversations in a non-work setting (e.g., after work drinks, barbeques etc.); (8) Teleconferencing; (9) Hand written memos; (10) Reports; (11) Fax machine.
Bidirectional Communication	Seven-point scale anchored: 1 "Completely Disagree" and 7 "Completely Agree." (1) The Marketing Manager always responded to my communication; (2) The Marketing Manager provided me with a lot of feedback†; (3) There was much two-way

Appendix. (*Continued*)

Construct	Items
	communication between the Marketing Manager and myself; (4) We exchanged e-mail frequently.
Interpersonal Conflict	Seven-point scale anchored: 1 "Completely Disagree" and 7 "Completely Agree." (1) When the two of us got together in group meetings, tensions between us frequently ran high; (2) I generally disliked having to work with him/her; (3) There were no disagreements between myself and the Marketing Manager over the running of this project[r]; (4) Throughout the project there was little interpersonal conflict between myself and the Marketing Manager[r].
Perceived Relationship Effectiveness	Seven-point scale anchored by 1 "Completely Disagree" and 7 "Completely Agree". (1) Throughout this project, I was very satisfied with our working relationship; (2) During this project, the Marketing Manager fully carried out his/her responsibilities and commitments to me; (3) I think the time and effort that I spent developing and maintaining this working relationship was very worthwhile; (4) During this project, the Marketing Manager responded well to feedback and advice from myself; (5) Overall, our working relationship was very successful.

[†]Item deleted due to low standardised factor loading.
[r]Denotes reverse scaled item.

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