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## ORMAL AND INFORMAL COMMUNICATION IN NEW PRODUCT DEVELOPMENT TEAMS: THE MEDIATION EFFECT OF TEAM TRUST

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### ABSTRACT

New product development (NPD) projects are costly, and fragile against failures as compared to other structures. This study has a holistic view of team factors to examine their relationship with team communication. Communication contributes to technical and practical processes such as learning, new idea development, and creativity. Trust has become prominent by affecting outcomes and processes indirectly, and changing relationships within team. This paper attempted to offer a contribution to the technology and innovation management (TIM) literature by presenting a model for researchers and project managers to understand potential interrelationships among team level factors (team autonomy, stability, member experience, and empowerment), team trust, and team formal and informal communication in NPD teams.

**Keywords:** New Product Development; Team Communication; Team Trust; Stability; Autonomy.

### Cite it like this:

Polat, V., Lynn, G., Akgün, A., & Emre, O. (2018). Formal and Informal Communication in New Product Development Teams: The Mediation Effect of Team Trust. *International Journal of Innovation*, 6(2), 95-109.  
<http://dx.doi.org/10.5585/iji.v7i2.245>

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## INTRODUCTION

Teamwork has become common for organizations. Teams benefit to organizations by increasing their productivity, learning, problem solving and creativity. Following a common purpose and having mutual accountability are vital elements to achieve specific outcomes by valuing others in a team (Deeter-Schmelz & Ramsey, 1995). These features differentiate teams from other work structures and underline team member's social relations and behaviors in team. In this context, although many factors affect behaviors and relationships, team trust plays an important role within influencing team member interpersonal and group behaviors (Golembiewski & McConkie, 1975).

Team trust has been associated with several positive attitude and behavior such as commitment, extra role behavior, problem-solving; and it urges members to perform these actions voluntarily (Goerz & Tsambaos, 1978).

Conversely, the lack of trust within teams is related with many negative factors which affect performance of organizations and behavioral outcomes of individuals in the organization. Moe and Šmite (2008) suggest that low trust causes low socialization and lack of socio-cultural fit and monitoring, causes inconsistencies and disparities in work practices, and brings doubts about the intentions of other members. Trust provides open information exchange and facilitates confidence in a team, thus seeds influence among members and makes members use discretion, take risks rather than resorting to self-protective actions.

Besides trust, organizations consider communication as one of the most important factor of success in teamwork. Suchan and Hayzak (2001) emphasize that organizations should actively manage and use communication at work, instead of take it for granted.

Communication is not related with just daily routines, it is also related with future of the team and organization. Communication contributes to technical and practical processes such as learning, new idea development, and creativity. Creative and efficient using of communication

develops relationships in a team, enables sharing and storing information and supports member growth (Henttonen & Blomqvist, 2005; Suchan & Hayzak, 2001). So, providing a climate for communication is especially important for environments which require innovativeness, creativity, and speed such as new product development (NPD) projects.

NPD projects are costly and fragile against failures as compared to other structures. NPD projects need special attention to reach speed and flexibility in fiercely competitive markets. Several studies have reported that communication is a key factor for NPD performance (McDonough III, Kahn, & Griffin, 1999). Since NPD projects should be started, developed, and accomplished in optimal conditions, communication obviously vital to achieve it throughout all processes. Thus, the importance of reciprocal exchange relationships emerges. Trust is a central factor at different stages of any relationship. It makes interdependence and interaction possible in the team, hence, team members contribute team actions such as sharing information with each other (Wickramasinghe & Widyaratne, 2012).

Trust has been used to determine "team input – team outcome relationships" in past studies (Mathieu, Maynard, Rapp, & Gilson, 2008). It is considered as "an emergent state" which refers to "cognitive, motivational and affective states of teams and functions as team context, inputs, processes, and outcomes" (Marks, Mathieu, & Zaccaro, 2001: 357).

Trust has become prominent by affecting outcomes and processes indirectly, and changing relationships within team. Considerable amount of literature on trust have reported indirect relationship with team performance (Porter & Lilly, 1996) and there is a consensus among scholars on the need to study indirect processes of affective, behavioral and cognitive variables on team effectiveness (Ilgen, Hollenbeck, Johnson, & Jundt, 2005).

Many scholars have approached the relationship between team trust and communication in the virtual team context

(Henttonen & Blomqvist, 2005; Jarvenpaa, Knoll, & Leidner, 1998; Jarvenpaa & Leidner, 1999; Sarker, Ahuja, Sarker, & Kirkeby, 2011). Since group processes and group effectiveness vary according to nature of the task (Hackman & Wageman, 2005), we believe that examining team trust and communication in NPD project teams carries new insights for scholars and practitioners. In previous studies, team factors that have been shown to influence team trust include team member experience, team autonomy and team stability (Rajagopal & Rajagopal 2006; Akgün & Lynn, 2002).

In this study, we will focus on examining whether there is an indirect effect of team trust between team factors and team communication. This study differs from past studies by using a holistic view of team factors to examine their relationship with team communication through the mediation effects of team trust at the NPD project team level.

In addition, we examined team communication in two aspects separately as formal and informal communication while most of studies have focused on a one-dimensional construct of communication.

The paper is structured as follows. First, based on relevant theories, the hypotheses are developed. Second, research methods and results are reported. The paper then discusses the implications and ends with limitations and directions for future research.

## **THEORETICAL BACKGROUND AND HYPOTHESES**

### **Team trust**

A large and growing body of literature has investigated trust, but to date there is no consensus between scholars about its definition. The majority of previous studies have reported the definition of trust which is suggested by Mayer, Davis, and Schoorman who described it as *“the willingness of a party to be vulnerable to the actions of another party based on the expectation that the other will perform a particular action important to the trustor, irrespective of the ability to monitor or control that other party”* (1995 p. 712). Trust has been examined by scholars from multiple disciplines such as sociology, economics, and psychology

(Costa, 2003), and demonstrated that trust is a multilevel concept, and may show different results in different organizational levels (Schoorman, Mayer, & Davis, 2007; Argyris, 1962; Driscoll, 1978).

Early studies mostly have discussed the concept of trust in the light of various organizational concepts that include personality differences, institutional variables, cross-cultural issues, and interpersonal relations (Jarvenpaa, Knoll, & Leidner, 1998; Argyris, 1962; Driscoll, 1978). Studies which examine trust in terms of “group” or “team” appear later (Friedlander 1970; Boss 1978).

### **Team autonomy and team trust**

Autonomy refers to *“the degree to which the task provides substantial freedom, independence, and discretion in scheduling the work and in determining the procedures to be used in carrying it out”* (Hackman & Oldham, 1980, p. 79), and reflects the degree of team member responsibility for their own work activities (Gerwin & Moffat, 1997). Due to complex structure of NPD teams, critics have been arguing a dichotomy between autonomy and control over research and innovation processes (Patanakul, Chen, & Lynn, 2012).

Although there are some exceptions regarding the contribution of autonomy, (e.g. autonomy may not be appropriate for incremental innovation in NPD teams), many scholars suggest that team autonomy is an especially important concept for new product development (NPD) teams (Gerwin & Moffat, 1997; Patanakul, Chen, & Lynn, 2012).

Besides the contribution of team autonomy on creativity, team autonomy is also related to various indicators of psychological well-being (Mierlo et al. 2007). Autonomy is one of the antecedents of trust and it supports cross-functional collaboration between team members (Jassawalla and Sashittal, 1998). People who are limited by restrictive roles can be limited at assessing the trustworthiness of individuals (McEvily, Perrone, and Zaheer, 2003).

It reduces bureaucratic constraints and enables team members to develop relationships easily. Autonomy increases team possessiveness, shared work, and cooperative negotiation so team members find an opportunity for fostering

familiarity and developing trust. Hence, we suggest that team autonomy positively affects team trust.

*H<sub>1</sub>: Team Autonomy is positively associated with Team Trust.*

### **Team stability and team trust**

Team stability refers member longevity in a team, and it is especially essential for a team comprising of members that are selected more carefully and specifically with regard to their roles as in innovation and NPD teams (Akgün & Lynn, 2002; Slotegraaf & Atuahene-Gima, 2011). In the context of team, members should have knowledge on others' past such as backgrounds, work experiences, and current position; to perceive ability, integrity, and benevolence to establish good relationships (Jarvenpaa, Knoll & Leidner, 1998).

Teams differ from working groups and they improve effectiveness when they show collective mind that is necessary to build common goals (Deeter-Schmelz & Ramsey, 1995). The collaboration of team members requires the integration of technical and operational systems (Ernst & Chrobot-mason, 2011) and integration between members. Team members not only work with their functional roles but also with their personal characteristics which shape their activities as members of the team (Senior, 1997). Members take advantage of being a stable team member by finding chances to know each other and developing strong relationships. It may help individuals to gain familiarity with others' working styles and way of thinking, and supports collaboration (Pelled, Eisenhardt, & Xin, 1999). While developing such a positive relation between each other, they feel protected by their own group and collaborate effectively (Ernst & Chrobot-mason, 2011).

*H<sub>2</sub>: Team Stability is positively associated with Team Trust*

### **Team member experience and team trust**

Forming a successful NPD team is substantially related with pairing up members who have the right combination of skills to

generate ideal harmony to work people with other people inside and outside. Teams need highly trained technical and scientific experts from different knowledge bases and diverse backgrounds to meet demands for value-creating innovation (Daniel & Davis, 2009). Teams consist of technical expertise and skills that are able to perform effectively.

Besides knowledge and skills to perform the job, nature of teamwork also requires social abilities and interpersonal skills. According to Ohland et al., (2012), team members who have the knowledge and capability performing in the related area tend to behave more socially and have higher levels of commitment in team, and they coordinate easily with one another (Hackman & Wageman, 2005). Knowledge and skills contribute to problem solving and that can be related with employment processes or social relations. Additionally, as gaining skills or practicing those mostly require social relations with other people, that helps members to develop social experiences and to use them in their relationships. So, experienced members may take the lead on how to behave and offer solutions against to the problems faced by team. On the other hand, having the knowledge and experience to support self-efficacy of the team members (Bandura, 1994) and self-efficient people feel less alienated and have fewer intentions to evaluate peers.

*H<sub>3</sub>: Team Member Experience is positively associated with Team Trust*

### **Team empowerment and team trust**

Team empowerment refers to degree of authority and power which is given to the team to direct, manage, and lead itself (Manz & Sims, 1991). Team empowerment shows that team management has confidence in teams' capabilities and reflects positive climate in team. Empowerment supports proactivity and commitment in the team and hence, leads more initiating behaviors and persistence against the (Kirkman & Rosen, 1999).

At team level, empowerment is a social structure which consists of shared cognitions and influenced by interactions with team members. Members have knowledge about the

boundaries of the task and they use their authority to determine ways which should be followed to accomplish the tasks. This clarity and certainty promotes goodwill in team and members keep risks out of uncertainty that may be faced. Besides, empowerment gives responsibility to members and this overlaps with proactive and dynamic structure of trust (Jarvenpaa, Knoll & Leidner, 1998). Members tend to care more about social relations with their friends and develop trust in such a climate.

*H<sub>4</sub>: Team Empowerment is positively associated with Team Trust.*

### **Mediating effect of team trust between team level factors and team formal and informal communication**

Increasing complexity and competitiveness of markets have shaped NPD's future and changed the requirements to reach success. For instance, Porter and Lilly (1996) suggested that NPD requires information sharing and integration, and it should find the ideal product for market, but it does not require speed to complete and produce products. But today's market structure push organizations to innovate for ideal product and do so quickly (Lynn, Skov, & Abel 1999). This makes the management of NPD projects more complex and important to survive in fierce competition.

Every project and problem has unique characteristics in uncertain and challenging environment, and requires different approaches for solution. Team requires technical expertise and skills with problem-solving abilities but there is not a guarantee for high performance without collective team performance. Mutual positive attitudes can have important impact on members' intentions and behaviors toward team work. Therefore, to be a good team, members must have psychological safety (Edmondson, 2012).

Trust provides a basis for any relation (Duncan & Moriarty, 1998). A person may have respect for a person who is not liked by the other, and maintain a minimum relationship out of necessity. It is hard to like or respect to a person who is not trusted. Potential harm lies behind mistrust. The lack of trust keeps people from any basic relationship. A work team is a good example to observe this issue. People

present their skills and work together for a common success. However, not only benefits are shared, but fails are also common. In the strict sense, nobody is a winner in a losing team. Therefore, members have to build a good relationship and make effort for success together. But as mentioned above, insecure members intend to avoid themselves from untrusted members. Ceasing communication with them is the first and key step of being far from a person (Sanford, Hunt, & Bracey, 1976). Without any communication, you would not build or conduct a relationship.

Communication is the means of human interaction that link people together and form a relationship (Duncan & Moriarty, 1998). Previous studies have reported that communication is conceptualized as formal (Park & Lee, 2013; Price, 1997) and informal (Fish, Kraut, Root, & Rice, 1993).

Formal communication refers to communication style which are planned, organized and allowed by management, and has rules, standards, and processes (Price, 1997). Information follows the hierarchy in organization and usually flows through formal chart of management.

Team member use e-mails, meetings, or official correspondences to communicate and share knowledge. Although there are formal regulations and requirements with this communication style, members follow their personal characteristics and intentions to fill content of the message. In lack of trust, members may delay communication, or reduce quality of communication by giving insufficient knowledge and misinforming. So, team trust supports to healthier and more reliable formal communication in teams.

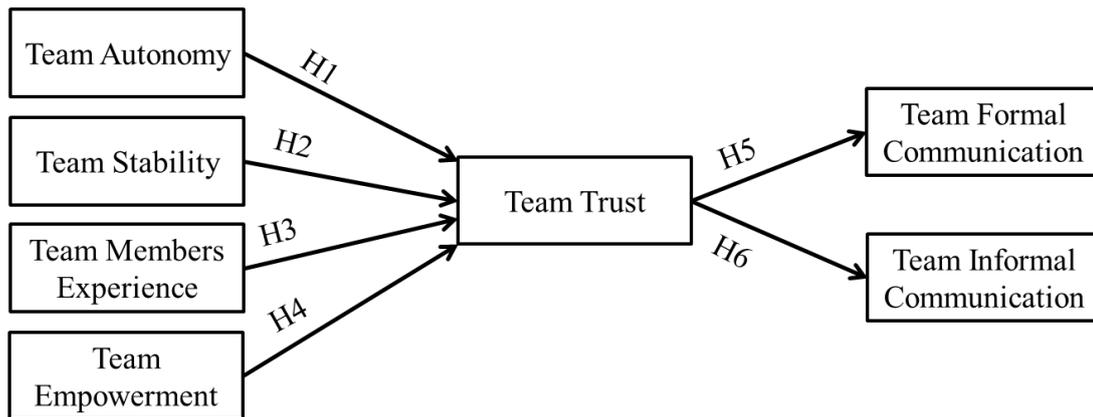
Informal communication states that face-to-face conversations in non-work settings such as after work meeting, lunches, parties, etc. (Park & Lee, 2013). Some early studies have linked informal communication to technological and multi-media tools (Fish, Kraut, Root, & Rice, 1993). These new technological tools were recently developing, and they were replacing face-to-face communication. However, these technological tools (e.g. fax, e-mails, voicemails etc.) are used commonly almost in every working area as standard tools currently, whether

workers are physically close together or not. So, the meaning of informal communication has changed. Inherently, informal communication features intimate, private, and close relationships. Members may mention about their mistakes or future plans which are related with team, company, or in person. Since it can be

risky and includes gain or loss; trust is an unavoidable fact for all parties concerned. It is hard to develop and resume such a relationship without trust.

*H<sub>4</sub>: Team factors influence team formal and informal communication through the mediating effect of team trust*

Figure 1. Conceptual Framework.



## METHODS

### Procedures and sample

To test the above hypotheses, a questionnaire was designed to include all the measurement scales. To measure team trust, team formal and informal communication, team stability, team autonomy, team member experience, and team empowerment items were developed based on past researches. To operationalize the variables, a 10-point Likert scale was used (0: strongly disagree to 10: strongly agree). 10-point scale offers higher degree of precision with same sample size and more variance than 5-point or 7-point Likert scales (Wittink & Bayer, 1994). A brief summary of the measures follows.

We adapted Kanawattanachai and Yoo's (2002) 4 items to assess Team Trust. For Team Autonomy, we asked three question items adapted from Sethi (2000). Four Team Member Experience items were adapted from Akgün, Byrne, Keskin, & Lynn (2006). To assess Team Stability, we asked five questions as adapted from Akgün and Lynn (2002). Three items were used to assess Team Empowerment adapted

from Lynn (2001). For information dissemination, both informal and formal communication modes were used. The informal communication and formal communication were measured using two for each item adapted from (Akgün, Lynn, and Reilly 2002).

After pretesting and refining the questionnaire, a contact person in various technology companies in the Northeast region of the United States was selected. The contacts were product or team managers/leaders. Because this study focused on the NPD team as a unit of analysis, product or team managers were expected to assess team factors more accurately due to their bird's eye view of the project. Also, such respondents are likely to have a bigger picture view of a team and thus are expected to provide more reliable and objective data. The sample of respondents in this study is similar to samples used in prior studies on innovation (e.g., Larson & Gobeli, 1988; Rochford & Rudelius, 1992; Thamhain, 1990).

Each respondent was asked to select a recent, completed NPD project with which they were most familiar. Familiarity was used as a criterion to avoid the selection bias of more successful

projects. Additionally, to assess their performance more accurately, the selected products must have been commercialized and launched into the marketplace for at least six months. After their selection, the respondents were assured that their responses would remain anonymous and not be linked to a company or product name.

A total of 550 surveys were distributed, and 347 completed surveys were returned (63.1% response rate). Several industries were represented in the study, including: telecommunications (34.9%), military/defense (16.1%), petroleum/chemicals (11.0%), governmental (7.2%), machinery/manufacturing (6.3%), aerospace (6.1%), computer and electronics (5.5%), other (13.0%) biotechnology, healthcare, financial services, etc.

**Measurement properties**

After collecting the data, the measures were subjected to a purification process. The procedures included assessments of item and scale reliability, unidimensionality, and convergent and discriminant validity were used to validate measures (Anderson & Gerbing, 1988; Fornell & Larcker, 1981). First, a series of exploratory factor analyses were conducted. A single factor was extracted for each multiple-

item reflective scale in these analyses, using an eigenvalue of 1 as the cut-off point. Next, a series of approaches to test the reliability and validity were used. The initial measurement model was subjected to a confirmatory factor analysis (CFA) to assess convergent and discriminant validity.

The statistics indicated that a seven-factor model fits the data well. The fit indices also provided supportive evidence (RMSEA = .044, NFI = .95, and CFI = .98). The standardized item loadings also supported convergent validity since each item loads significantly on its respective construct (all loading are larger than .6).

Second, numbers ranged from .71 for team member experience to .89 for team trust, indicating acceptable levels of internal consistency. Further, as a check for discriminant validity, the variance extracted for each construct was greater than the squared latent factor correlations between pairs of constructs. After these tests, it was concluded that the measures are uni-dimensional and have adequate reliability, discriminant validity, and convergent validity. The reliabilities of the multiple-item reflective measures are reported in Table 1, along with construct correlations and descriptive statistics for the scales.

**Table 1:** Correlations and Descriptive Statistics.

		Mean	Std. Dev.	1	2	3	4	5	6	7
1.	Team Autonomy	6.74	2.38	-						
2.	Team Member Experience	4.08	1.59	.27*	-					
3.	Team Stability	6.79	2.69	.41*	.41*	-				
4.	Team Empowerment	6.29	2.02	.68*	.31*	.44*	-			
5.	Team Trust	7.40	1.57	.47*	.41*	.48*	.42*	-		
6.	Team Informal Communication	5.91	2.02	.14*	.14*	.22*	.33*	.39*	-	
7.	Team Formal Communication	6.72	1.88	.25*	.30*	.20*	.28*	.53*	.43*	-
	Composite Reliability			.86	.73	.85	.83	.89	.84	.78
	Cronbach's $\alpha$			.85	.71	.83	.83	.89	.84	.76

\*  $p < .01$  \*\*  $p < .05$  \*\*\*  $p < .1$

## Analysis

To test our hypotheses, we used maximum likelihood (ML) method for the structural equation model (Bentler, 1995). To assess the statistical significance of the model's estimates, single-step mediator model with a bootstrapping method was used. In this study, bias-corrected bootstrapping results were used to evaluate significance, with all bootstrap results for the indirect effects based on 95% level of confidence and 5,000 bootstrap samples as suggested by Hayes (2009). Bootstrapping is more valid and powerful method for testing mediation effects in comparison to other commonly used techniques (Hayes, 2009). The results of analyses are presented in Fig. 2.

Findings support that team factors are positively related with team trust. As Shown Fig. 2. Team Autonomy, H1 ( $t: 3.39, \beta: .25, p < .01$ ),

Team Stability, H2 ( $t: 3.77, \beta: .24, p < .01$ ), and Team Members Experience, H3 ( $t: 3.00, \beta: .18, p < .01$ ), significantly and positively associated with Team Trust. But, Team Empowerment, H4 ( $p < .34$ ) is not significantly associated with team trust.

Mediation influences, H5 and H6, have been tested between team factors and team formal and informal communication through team trust. We used Zhao, Lynch and Chen (2010) typology of mediations to evaluate results.

According to results in Table 2; for formal communication, there is indirect-only mediation (full mediation by Baron and Kenny approach) between team autonomy, stability, member experience, and team formal communication.

There is no-effect nonmediation between team empowerment and team formal communication.

Table 2. Standardized Mediation Effects Through Team Trust

Team Formal Communication	Direct Effects	Indirect Effects
Team Autonomy	.695	.001*
Team Stability	.233	.001*
Team Members Experience	.251	.005*
Team Empowerment	.348	.348

Note. = \*  $p < .01$  \*\*  $p < .05$  \*\*\*  $p < .1$

For informal communication, as can be seen in Table 3, there is complementary mediation (partial mediation by Baron and Kenny approach) between team autonomy and team informal communication. Also, there is indirect-only mediation (full mediation by Baron and Kenny

approach) between team stability, team member experience and team informal communication. Finally, there is direct-only mediation between team empowerment and team informal communication.

Table 3 Standardized Mediation Effects Through Team Trust

Team Informal Communication	Direct Effects	Indirect Effects
Team Autonomy	.074	.002*
Team Stability	.824	.001*
Team Members Experience	.548	.005*

Team Empowerment .008\* .316

Note. = \*  $p < .01$  \*\*  $p < .05$  \*\*\*  $p < .1$

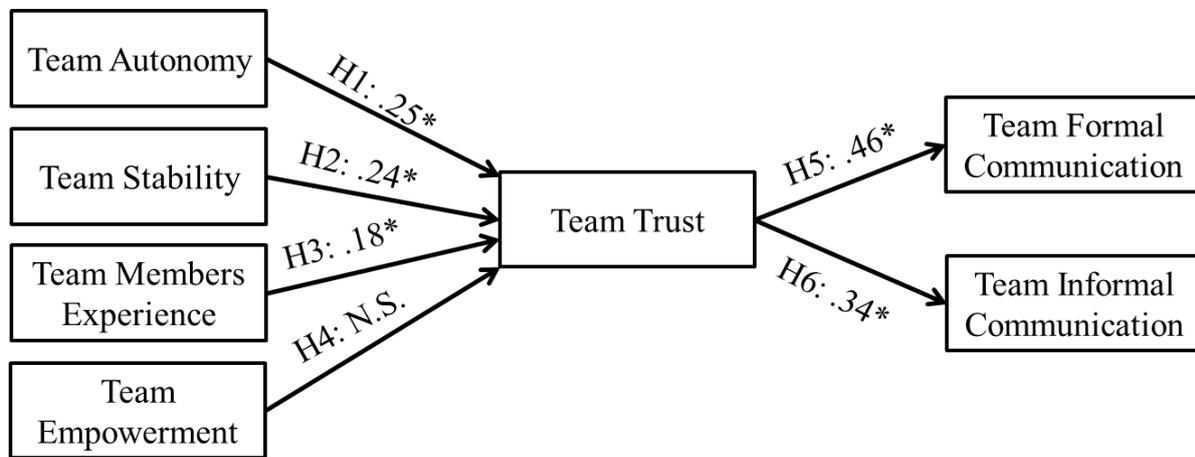
Table 4 Fit Measures

Fit Measure	Endogenous Construct	Final Model
$R^2$	Team Trust	.31
	Team Formal Communication	.26
	Team Informal Communication	.18

The results in Table 4 also show that team factors values explain the 31% of variance ( $R^2 = .31$ ) in team trust, team trust explains 26% of

variance ( $R^2 = .26$ ) in team formal communication, and 18% of variance ( $R^2 = .18$ ) in team informal communication.

Figure 2. Test Results



\*  $p < 0.01$ ; \*\*  $p < 0.05$

## DISCUSSION AND CONCLUSION

This paper attempted to offer a contribution to the TIM literature by presenting a model for researchers and project managers to understand potential interrelationships among team level factors, team trust, and team formal and informal communication in NPD teams. The findings of this study broaden understanding of NPD management and shed light to scholars and practitioners. This study shows that team autonomy, team member experience and team stability have effect on formal and informal communication with mediation effect of team trust, but team empowerment not.

First, several insights are revealed from this study on team factors which effect team trust. Results reveal that team autonomy is positively related with team trust. Autonomy is linked with

freedom and interdependence, and it removes walls and reduces bureaucratic relations between team members. Members can develop trust by showing their behavioral and social differences more freely and finding opportunities to know each other (Barrick & Mount, 1993). Besides, team autonomy is related with less absenteeism (Rousseau & Aubé, 2013). Since members participate to team works more regularly and effectively, they do not think about unfair distribution of workload and this contributes to build trust.

Second, this study highlights the importance of team stability. The socialization of new people takes time and they may not be easily accepted by others in unstable teams (Akgün & Lynn, 2002). Members would have enough time with team stability to know each other and have an atmosphere in which they do not feel alienated

and being evaluated. So, members can develop good relationship in a team in which have been accepted and build trust.

Third, members should have necessary skills and experiences to perform a task but having necessary skills and knowledge are not enough to maintain effectiveness. Social skills are also important in teams. According to Medsker and Campion (1998) performing effectively depends heavily on members' interpersonal competence or their ability to maintain healthy working relationships and to reactions to others with respect for their viewpoints (p. 475). Besides, unskilled team members are not able to see their inabilities in teamwork, furthermore, they tend to overrate their efforts (Ohland, Carolina, Bullard, Felder, & Layton, 2012). Under these circumstances, unrest rises in the team and undermines the trust of team members each other.

Although team empowerment and team autonomy are closely related concepts, interestingly, autonomy is positively related with trust but empowerment is not. This result is parallel with the discussion about the difference between empowerment and autonomy. A possible explanation for this might be that autonomy is an inherently individual concept and it is not granted from management. However, empowerment is given by top management and its' limits and hallmarks are decided by the management. Therefore, empowerment may affect or contribute trust which is a social concept and requires independent relations and it emerges from interactions.

For mediation analysis, the current study found that there are no direct relations between team autonomy, team stability, and team member experience and team formal communication; but team trust indirectly mediates these relationships. These might be due to the nature of formal communication. According to Morand (1995) formality refers to contingencies and relations that are more "regimented, deliberate, and impersonal" (p.832). Hence, team level features (autonomy, experience, and stability) do not contribute to team formal communication. However, if a safety climate is provided in team and members and if trust each other, they boost formal

communication and use tools more effectively. In other words, without trust, members consider formal communication as an official responsibility and do not employ their skills to contribute their tasks.

Surprisingly, team empowerment is not associated with team formal communication, either directly or indirectly. This result may be explained by the regimented feature of formal communication. Due to similar construction of formal communication and empowerment, they are controlled and arranged by the management. Team members act in boundaries which are drawn by top management. Members do not associate these concepts and use communication tools in their routines so empowerment does not contribute team formal communication directly or indirectly.

Another aspect of trust to contribute formal communication may be that technology provides more various and fast alternatives for communication. But recent developments in communication technology made these tools more individual oriented. People not only refrain communication with untrusted people, but also abstain to be listened or researched by other peoples. So, team trust helps soothe the anxiety of members to communicate with others.

On the contrary of formal communication, informal communication is characterized by behavioral spontaneity, casualness, and interpersonal familiarity (Morand, 1995). Results present that there is indirect-only mediation by team trust between team stability, team member experience, and team informal communication. This result emphasizes the importance of trust by demonstrating that team members do not intend to set up informal even if they have been working together for a long time and have extensive experience.

Team empowerment is directly-only and positively related with team informal communication. This might be due to participation of empowered team members in informal communication as a "formal" activity. Members can participate to informal social activities such as dinner, barbeque, picnic etc. and communicate informally. But team empowerment does not affect informal communication through trust. Due to social

structure of trust, “official” feature of empowerment conflicts with it. Hence, team trust is not related with this relationship between team empowerment and informal communication.

Our results suggest there is a complimentary mediation between team autonomy and team informal communication. Team autonomy is positively and directly related with informal communication, but with team trust this relation becomes stronger. Direct relation is based on features of team autonomy. Autonomy provides freedom and interdependence among members and so they participate to informal activities. The results of this study indicate that members develop their relations and communicate deeply and effectively provided team trust.

### **Limitations and implications for further studies**

This study is subject to the limitations inherent in survey design, particularly with the use of convenience sampling and reliance on self-reporting respondents. Gupta and Beehr (1982) have argued that studies employing a single-source methodology can be biased by artificially high inter-correlations produced by overall response tendency.

However, Avolio, Yammarino, and Bass (1991) noted that simply assuming that single-source data is less valid than multi-source data is overly simplistic. Implicit theories and other cognitive frameworks applied by respondents to social-perceptual stimuli (e.g., ratings of the performance of peers or supervisors) might not apply to the same extent with the present survey. Because there was a time lag between the time projects were completed and data were collected, there might be issue of recollection in survey responses.

Miller, Cardinal, and Click (1997) suggested that the use of retrospective data is an acceptable research methodology, if reported measures are reliable and valid. As noted previously, the measures used in this research demonstrated both high reliability and validity, and most of the measures used are well established in the literature.

Future research should address the single-source and convenience sampling issues. There are several possible approaches. First approach

involves obtaining data for a single project from multiple sources. Another variation of this approach is to obtain complete data from multiple sources so that the inter-rater reliability and response bias issues can be examined directly. Second, for a convenient sampling, targeting technology-based companies in the Northeast of the United States were used, thereby limiting the results to these industries.

Also, the majority of the projects were from large companies. Future research should explore the research questions by using samples of firms from other industries. Additionally, perception and usage of communication may vary according to culture and geography so other parts of the world (McDonough III, Kahn, & Griffin, 1999), such as Europe and Asia may be examined and compared.

Third, the projects in the samples were all finalized. By studying completed projects only, the investigation may be restricted to a certain performance level (limited range of the dependent variables).

The results of this study suggest several future research directions. First, while this study provides empirical evidence that supports the importance of team trust as a mediator for team formal and informal communication, future research should investigate how this relation affects team outcomes and performances.

For example, future research can examine the effect of team trust and team communication on new product success, speed-to-prototype or team effectiveness.

Second, it is noticeable that team trust is contingent on various factors. Future study should investigate different factors, such as management involvement, and management support etc.

Third, the results of the study show that team trust does not adequately explain the informal communication with low  $R^2$  value. Further studies can examine other factors that affect informal communication, instead of (or with) team trust which does not give sufficient explanation. Also, as we mentioned above, informal communication experienced a change in its format. Nowadays, social media tools also have become popular tools for informal communication at work (Zhao and Rosson, 2009). Although there are studies about this

subject, new researches which connect social media tools and technology intensive environments such as NPD teams may broaden the existing knowledge. Finally, time plays an important role in developing and maintaining trust (Schoorman, Mayer & Davis, 2007) and longitudinal studies may be performed to highlight deeper insights about these variables.

## REFERENCES

Akgün, A. E., & Lynn, G. S. (2002). Antecedents and consequences of team stability on new product development performance. *Journal of Engineering and Technology Management*, 19(3), 263-286.

Akgun, A. E., Byrne, J. C., Keskin, H., & Lynn, G. S. (2006). Transactive memory system in new product development teams. *IEEE Transactions on Engineering Management*, 53(1), 95-111.

Akgun, A. E., Lynn, G. S., & Reilly, R. (2002). Multi-dimensionality of learning in new product development teams. *European Journal of Innovation Management*, 5(2), 57-72.

Anderson, J. C., & Gerbing, D. W. (1988). Structural equation modeling in practice: A review and recommended two-step approach. *Psychological bulletin*, 103(3), 411.

Argyris, C. (1962). *Interpersonal competence and organizational effectiveness*, Homewood, IL: Dorsey

Avolio, B. J., Yammarino, F. J., & Bass, B. M. (1991). Identifying common methods variance with data collected from a single source: An unresolved sticky issue. *Journal of management*, 17(3), 571-587.

Bandura, A. (1994). Self-efficacy. In VS Ramachaudran. *Encyclopedia of human behavior*, 4, 71-81.

Baron, R. M., & Kenny, D. A. (1986). The moderator–mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of personality and social psychology*, 51(6), 1173.

Barrick, M. R., & Mount, M. K. (1993). Autonomy as a moderator of the relationships between the Big Five personality dimensions and job performance. *Journal of applied Psychology*, 78(1), 111.

Bentler, P. M. (1995). *EQS structural equations program manual*. Multivariate Software.

Boss, R. W. (1978). Trust and managerial problem solving revisited. *Group & Organization Studies*, 3(3), 331-342.

Costa, A. C. (2003). Work team trust and effectiveness. *Personnel review*, 32(5), 605-622.

Daniel, L. J., & Davis, C. R. (2009). What makes high-performance teams excel?. *Research-Technology Management*, 52(4), 40-45.

Deeter-Schmelz, D. R., & Ramsey, R. (1995). A conceptualization of the functions and roles of formalized selling and buying teams. *Journal of Personal Selling & Sales Management*, 15(2), 47-60.

Driscoll, J. W. (1978). Trust and participation in organizational decision making as predictors of satisfaction. *Academy of management journal*, 21(1), 44-56.

Duncan, T., & Moriarty, S. E. (1998). A communication-based marketing model for managing relationships. *The Journal of marketing*, 1-13.

Edmondson, AC. (2012). Teamwork on the Fly. *Harvard Business Review* (April): 72–81.

Ernst, C., & Chrobot-Mason, D. (2011). Flat world, hard boundaries: How to lead across them. *MIT Sloan Management Review*, 52(3), 81.

Fish, R. S., Kraut, R. E., Root, R. W., & Rice, R. E. (1992, June). Evaluating video as a technology for informal communication. In *Proceedings of*

the SIGCHI conference on Human factors in computing systems (pp. 37-48). ACM.

Fornell, C., & Larcker, D. F. (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of marketing research*, 39-50.

Friedlander, F. (1970). The primacy of trust as a facilitator of further group accomplishment. *The Journal of Applied Behavioral Science*, 6(4), 387-400.

Gerwin, D., & Moffat, L. (1997). Authorizing processes changing team autonomy during new product development. *Journal of Engineering and Technology Management*, 14(3-4), 291-313.

Golembiewski, R. T., & McConkie, M. (1975). The centrality of interpersonal trust in group processes. *Theories of group processes*, 131, 185.

Gupta, N., & Beehr, T. A. (1982). A test of the correspondence between self-reports and alternative data sources about work organizations. *Journal of Vocational Behavior*, 20(1), 1-13.

Hackman, J. R., & Oldham, G. R. (1980). *Work redesign*. MA: Addison-Wesley.

Hackman, J. R., & Wageman, R. (2005). A theory of team coaching. *Academy of Management Review*, 30(2), 269-287.

Hayes, A. F. (2009). Beyond Baron and Kenny: Statistical mediation analysis in the new millennium. *Communication monographs*, 76(4), 408-420.

Henttonen, K., & Blomqvist, K. (2005). Managing distance in a global virtual team: the evolution of trust through technology-mediated relational communication. *Strategic Change*, 14(2), 107-119.

Ilgen, D. R., Hollenbeck, J. R., Johnson, M., & Jundt, D. (2005). Teams in organizations: From input-process-output models to IMOI models. *Annu. Rev. Psychol.*, 56, 517-543.

Jarvenpaa, S. L., Knoll, K., & Leidner, D. E. (1998). Is anybody out there? Antecedents of trust in global virtual teams. *Journal of management information systems*, 14(4), 29-64.

Jarvenpaa, S. L. & Leidner, D. E. (1999). Communication and trust in global virtual teams. *Organization science*, 10(6), 791-815.

Jassawalla, A. R., & Sashittal, H. C. (1998). An examination of collaboration in high-technology new product development processes. *Journal of product innovation management*, 15(3), 237-254.

Kanawattanachai, P., & Yoo, Y. (2002). Dynamic nature of trust in virtual teams. *The Journal of Strategic Information Systems*, 11(3), 187-213.

Kirkman, B. L., & Rosen, B. (1999). Beyond self-management: Antecedents and consequences of team empowerment. *Academy of Management journal*, 42(1), 58-74.

Larson, E. W., & Gobeli, D. H. (1988). Organizing for product development projects. *Journal of Product Innovation Management*, 5(3), 180-190.

Lynn, G. S., Skov, R. B., & Abel, K. D. (1999). Practices that support team learning and their impact on speed to market and new product success. *Journal of Product Innovation Management*, 16(5), 439-454.

Lynn, Gary S. (2001). *Innovation Audit*. Stevens Institute of Technology.

Manz, C. C., & Sims, H. P. (1991). Superleadership: Beyond the myth of heroic leadership. *Organizational dynamics*, 19(4), 18-35.

Marks, M. A., Mathieu, J. E., & Zaccaro, S. J. (2001). A temporally based framework and taxonomy of team processes. *Academy of management review*, 26(3), 356-376.

Mathieu, J., Maynard, M. T., Rapp, T., & Gilson, L. (2008). Team effectiveness 1997-2007:

A review of recent advancements and a glimpse into the future. *Journal of management*, 34(3), 410-476.

Mayer, R. C., Davis, J. H., & Schoorman, F. D. (1995). An integrative model of organizational trust. *Academy of management review*, 20(3), 709-734.

McDonough, E. F., Kahn, K. B., & Griffin, A. (1999). Managing communication in global product development teams. *IEEE Transactions on Engineering Management*, 46(4), 375-386.

McEvily, B., Perrone, V., & Zaheer, A. (2003). Trust as an organizing principle. *Organization science*, 14(1), 91-103.

Medsker, G. J., & Campion, M. A. (1997). Job and team design. *Handbook of Industrial Engineering: Technology and Operations Management*, Third Edition, 868-898.

Mierlo, H. V., Rutte, C. G., Vermunt, J. K., Kompier, M. A. J., & Doorewaard, J. A. C. M. (2007). A multi-level mediation model of the relationships between team autonomy, individual task design and psychological well-being. *Journal of Occupational and Organizational Psychology*, 80(4), 647-664.

Miller, C. C., Cardinal, L. B., & Glick, W. H. (1997). Retrospective reports in organizational research: A reexamination of recent evidence. *Academy of management journal*, 40(1), 189-204.

Moe, N. B., & Šmite, D. (2008). Understanding a lack of trust in Global Software Teams: a multiple-case study. *Software Process: Improvement and Practice*, 13(3), 217-231.

Morand, D. A. (1995). The role of behavioral formality and informality in the enactment of bureaucratic versus organic organizations. *Academy of Management Review*, 20(4), 831-872.

Ohland, M. W., Loughry, M. L., Woehr, D. J., Bullard, L. G., Felder, R. M., Finelli, C. J., ... &

Schmucker, D. G. (2012). The comprehensive assessment of team member effectiveness: Development of a behaviorally anchored rating scale for self-and peer evaluation. *Academy of Management Learning & Education*, 11(4), 609-630.

Park, J. G., & Lee, J. (2014). Knowledge sharing in information systems development projects: Explicating the role of dependence and trust. *International Journal of Project Management*, 32(1), 153-165.

Patanakul, P., Chen, J., & Lynn, G. S. (2012). Autonomous teams and new product development. *Journal of Product Innovation Management*, 29(5), 734-750.

Pelled, L. H., Eisenhardt, K. M., & Xin, K. R. (1999). Exploring the black box: An analysis of work group diversity, conflict and performance. *Administrative science quarterly*, 44(1), 1-28.

Porter, T. W., & Lilly, B. S. (1996). The effects of conflict, trust, and task commitment on project team performance. *International Journal of Conflict Management*, 7(4), 361-376.

Price, J. L. (1997). Handbook of organizational measurement. *International journal of manpower*, 18(4/5/6), 305-558.

Rajagopal, & Rajagopal, A. (2006). Trust and cross-cultural dissimilarities in corporate environment. *Team Performance Management: An International Journal*, 12(7/8), 237-252.

Rochford, L., & Rudelius, W. (1992). How involving more functional areas within a firm affects the new product process. *Journal of Product Innovation Management*, 9(4), 287-299.

Rousseau, V., & Aubé, C. (2013). Collective autonomy and absenteeism within work teams: A team motivation approach. *The Journal of psychology*, 147(2), 153-175.

Sanford, A. C., Hunt, G. T., & Bracey, H. J. (1976). *Communication behavior in organizations*. Merrill Publishing Company.

Sarker, S., Ahuja, M., Sarker, S., & Kirkeby, S. (2011). The role of communication and trust in global virtual teams: A social network perspective. *Journal of Management Information Systems*, 28(1), 273-310.

Schoorman, F. D., Mayer, R. C., & Davis, J. H. (2007). An integrative model of organizational trust: Past, present, and future. *Academy of Management review*, 32(2), 344-354.

Senior, B. (1997). Team roles and team performance: is there 'really' a link?. *Journal of occupational and organizational psychology*, 70(3), 241-258.

Sethi, R. (2000). New product quality and product development teams. *Journal of Marketing*, 64(2), 1-14.

Slotegraaf, R. J., & Atuahene-Gima, K. (2013, May). Product development team stability and new product advantage: The role of decision-making processes. *American Marketing Association*.

Suchan, J., & Hayzak, G. (2001). The communication characteristics of virtual teams: A case study. *IEEE transactions on Professional Communication*, 44(3), 174-186.

Takeuchi, H., & Nonaka, I. (1998). The new new product development game, *Innovation and learning*, 64(1), 321.

Thamhain, H. J. (1990). Managing technologically innovative team efforts toward new product success. *Journal of Product Innovation Management*, 7(1), 5-18.

Wickramasinghe, V., & Widyaratne, R. (2012). Effects of interpersonal trust, team leader support, rewards, and knowledge sharing mechanisms on knowledge sharing in project teams. *Vine*, 42(2), 214-236.

Wittink, D. R., & Bayer, L. R. (1994). The measurement imperative. *Marketing Research*, 6(4), 14.

Zárraga-Oberty, C., & De Saá-Pérez, P. (2006). Work teams to favor knowledge management: towards communities of practice. *European Business Review*, 18(1), 60-76.

Zhao, D., & Rosson, M. B. (2009, May). How and why people Twitter: the role that micro-blogging plays in informal communication at work. In *Proceedings of the ACM 2009 international conference on Supporting group work* (pp. 243-252). ACM.

Zhao, X., Lynch Jr, J. G., & Chen, Q. (2010). Reconsidering Baron and Kenny: Myths and truths about mediation analysis. *Journal of consumer research*, 37(2), 197-206.