The Effects of Project Management Mechanisms on Innovation Performance in Hi-Tech Firms: Mediation of Teamwork Processes and Moderating Effects of Different Team Members' Cultural Values

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Abstract

High tech firms increasingly form innovation projects composed of team members with different cultural backgrounds to respond to their customers' needs. Prior studies have regarded these cross cultural innovation projects as an important instrument for developing innovative products, yet little effort has been investigated on the issue of the effect of project management mechanisms (autonomy and control) on these projects and the impacts of team members' cultural backgrounds on different project management mechanisms. Moreover, prior studies have neglected to bridge the gap between the effect of these project management mechanisms on communication and coordination of teamwork processes. Therefore, this study aims to fulfill the gaps in project management and cross cultural study by exploring the effects of different project management mechanisms on several types of innovation performance. In particular, it examines the relationships of these project management mechanisms on innovation performance mediated by the teamwork processes and moderated by the different backgrounds of team members represented by their cultural values.

Structural equation modelling was used to test all hypotheses from 434 new product development project team members. The results indicated that control mechanisms had stronger effects on innovation performance than providing autonomy. Additionally, the study showed that all project management mechanisms (autonomy and control mechanisms) had indirect effects on radical innovation and project efficiency through communication and coordination. However, these control mechanisms had indirect impacts on incremental innovation only through coordination but not communication. Importantly, this study revealed that control mechanisms could apply to the team members with different cultural backgrounds in encouraging higher innovation performance. In order to enhance higher innovation performance, the suggestions to apply the appropriate project management mechanisms to their team members with different cultural backgrounds are provided.

Keywords: *Project management, NPD projects/innovation projects, Teamwork Processes in communication and coordination, Project management in cross-cultural study, Individualism, and Power Distance, and Innovation Performance*

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List of Abbreviations

AVE	Average Variance Exact
D.F	Degree of Freedom
C.R.	Composite Reliability
CFI	Comparative Fit Index
e.g.,	For example
i.e.	That is
Indiv.	Individualism
Innov.	Innovation
ISO	International Organization for Standardization
NFI	Normed Fit Index
NPD	New Product Development project/Innovation Project
n.s	Non –significant
OECD	Organization for Economic Co-operation and Development
PD	Power Distance
PMI	Project Management Institute
PMMs	Project Management Mechanisms
PMBOX	Project Management Body of Knowledge
QFD	Quality Function Deployment
R&D	Research and Development
RMSEA	Root mean square error of approximation
SEM	Structure Equation Model
TQM	Total Quality Management
TLI	Tucker-Lewis Index

Chapter 1: Introduction

This chapter provides an overview of this study including project background, research questions, objectives, research scope, research contributions, and an outline of the document.

1.1 Introduction

Due to increasing diversity of workforce, shifting in scope of work environment from local to international markets, increasing numbers of mergers and acquisitions among cooperation from different countries, and high global market competition, these factors have changed the aspects of business practices, and new product development (NPD) in multi-national firms (Gibson, 1995; Nakata and Sivakumar, 1996). Many multinational high tech firms launch new products to serve the needs of emerging markets while maintaining their existing markets to maximize profit and remain competitive. Given the competitive environment in both new and existing markets, firms seek to speed up their innovation. Scholars have discovered that the New Product Development (NPD) project model is often used as an instrument for the development and implementation of innovations (Kanter, 1983; Keegan and Turner, 2002; Kreiner, 1992), as well as the differentiation of customized products (Hobday, 1998; Sydow, Lindkvist, and DeFillippi, 2004). These firms as well increasingly form NPD projects characterized by different cultural team members to response their customers' needs around the world. NPD projects help firms achieve their objectives by providing a fast, flat, and flexible approach for developing new products (Keegan and Turner, 2002). However, the flexible structure of NPD may not guarantee the success of a project. Due to uncertain environments and markets and the complexity of technology, NPD projects face high risks and result in high rates of failure due to budget overruns, missed milestones, and unachieved project specifications (Hans, Herroelen, Leus, and Wullink, 2007). Therefore, professional project management is critical to the successful implementation of innovative projects (Pinto and Kharbanda, 1995).

Previous studies provide evidence that project management mechanisms composed of autonomy and control are important for NPD projects in terms of tracking projects, increasing the rate of development of radically innovative projects, increasing project performance/success, and generating ideas for the development new products (e.g., Lewis, Dehler, and Green, 2002; Tatikonda and Montoya-Weiss, 2001). Planning and control mechanisms can reduce the risks and uncertainties of the market and technology on the development of innovative projects. Additional studies indicate that monitoring, controlling and evaluating activities help a team to track a project, make decisions, measure the completion of activities and milestones, and allow resource and objective adjustments (e.g., Lee, Wang, and Chen, 2008; Rosenau and Moran, 1993; Salomo, Weise, and Gemünden, 2007; Wheelwright and Clark, 1992b). However, some scholars argue that control mechanisms (e.g. too detailed in process control) may reduce team member creativity (Bonner, Ruekert, and Walker, 2002). Still others find that some control mechanisms (e.g., monitoring progress) enhance radical innovation (Eisenhardt and Tabrizi, 1995; Kessler and Chakrabarti, 1999). Another study finds that that granting stronger autonomy to Research and Development (R&D) team members encourages them to generate new ideas and to speed NPD project development and enhances overall team performance (e.g., Amabile and Gryskiewicz, 1987; Gerwin and Moffat, 1997b; McDonough and Barczak, 1991). Conversely the study by Thammain (1990) found no correlation between autonomy and R&D team performance. However, the literature is limited with respect to concurrently investigating and comparing the effects of both autonomy and various types of controls on project outputs (innovation performance). In addition, previous studies have focused on the influence of various project management mechanisms/styles on outputs/outcomes of projects (e.g., NPD project performance/enhancing innovation or speeding radical innovation projects) rather than the influence of project management mechanisms/styles on various types of projects (e.g., radical innovation and incremental innovation projects). Different kinds of projects may require different management practices to be successful. Therefore, more research is needed in this area.

Project management mechanisms can influence communication and coordination in team environments. The roles of communication and coordination have been widely investigated as the essential components of the NPD process (Brown and Eisenhardt, 1995) and project team performance (Hoegl and Gemuenden, 2001). These studies investigated communication and coordination as the antecedent to project performance or project success. Even though it is generally recognized that project management mechanisms encourage communication and coordination, some mechanisms may decrease communication and coordination between project team members. Some mechanisms may have indirect effects leading to an increase in innovation performance. For example, autonomy may affect performance indirectly by generating coordination among members (McDonough, 2000). Process control by a senior manager may decrease communication and coordination among NPD team members due to explicitly informed instruction. Nevertheless, previous studies have rarely investigated communication and coordination as mediators of the relationship between project management mechanisms and innovation performance.

Finally, there has been recent discussion regarding the effect on project performance due to cross-cultural differences and similarities among NPD team members. In the past decade, multinational companies have increased their overseas operations. The growth of overseas operations is a result of the expansion of emerging new markets. In order to respond to customers' needs, project teams are formed at overseas operations sites consisting of project managers, members of the mother company, and members from the region. Some teams are intentionally formed with members of different backgrounds in order to conduct a particular task (e.g., new product development). Due to their diverse backgrounds, team members may react differently to project management mechanisms (in autonomy and control mechanisms) implemented by project managers. For instance, employees from low power distance cultures often make decisions without input from their supervisors to get their job done whereas employees from high power distance cultures expect managers to lead and become uncomfortable with a high degree of autonomy (Adler, 1997; Kirkman and Shapiro, 1997). In addition, granting autonomy to high power distance team members may decrease project innovativeness as these team members may be accustomed to a high level of control (Shane, 1992). Another study comparing Japanese and US companies revealed that in Japan, a collectivism country, companies employ more implicit controls for monitoring, evaluation and rewarding than in the US where individualism prevails (Snodgrass and Grant, 1986). Although sufficient empirical evidence indicates that management practices, strategic management, and leadership styles differ by national culture (Newman and Nollen, 1996), there is little literature addressing the role of cultural differences in project management (Eriksson, Lillieskold, Jonsson, and Novosel, 2002; Kruglianskas and Thamhain, 2000; Shore and Cross, 2005). The diversity among project team members' nationalities and cultural backgrounds calls into question how firms can balance and practice project management mechanisms successfully. In addition, there are limited studies that investigate the relationship between project management mechanisms and the project's innovation performance given to the individual team members' behaviours with respect to their cultural backgrounds (Bouncken, Imcharoen, and Winkler, 2010).

From the gaps in the literature and the significance of project management mechanisms in fostering both innovation and related problems, as mentioned above, there is a need to further explore the impacts of different project management mechanisms (in terms of autonomy and control) on innovation performance (radical innovation, incremental innovation, and project efficiency). It is also interesting to study whether the project management mechanisms influence team communication and coordination. Another important issue to consider is the effect of project management mechanisms on innovation performance in a culturally diverse team environment.

1.2 Research Questions

Based on the literature review, this study seeks to investigate the following research questions:

First, "*How do project management mechanisms, including both autonomy and control mechanisms, affect innovation performance, in terms of radical and incremental innovation, as well as project efficiency?*" This question aims to determine which factor—an autonomy or control mechanism has/have a greater impact on innovation performance. This question also explores the varying ways in which these different mechanisms encourage innovation performance in terms of radical innovation and incremental innovation, as well as project efficiency. The answer to this question would aid in determining which project management mechanisms should be applied in practice. In addition, the answer would establish which project management mechanisms are most effective for specific project types.

Second, "*How do these project management mechanisms in autonomy and control influence the teamwork processes?*" For example, these mechanisms affect communication and coordination when employed by project managers. What are the communication and coordination impacts resulting from use of these mechanisms? In other words, "Does the communication and coordination within a project team mediate the relationships between project management mechanisms (autonomy, monitoring progress, process control, and output control) and innovation performance (radical, incremental innovation), and as well project efficiency?" If NPD projects are deficient/poor in teamwork processes, the performance of NPD projects may be decrease. Therefore, this question would provide answers as to whether project management mechanisms in the form of autonomy and control foster teamwork processes of communication and coordination thereby influencing innovation performance.

Due to globalization, multinational firms have increased operational sites around the world. These firms must operate effectively in many specialized countries, while remaining integrated at a regional level (Søndergaard, 2006). This results in the formation of innovation teams with members from different counties. The individuals' differences associated with their national cultural may cause them to react differently to various project mechanisms. This leads to the **third** research question: "*how well these project management mechanisms in autonomy and controls increase innovation performance given the different cultural backgrounds of project team members?*". Within the context of contingency theory, the answer to this question may help project managers to better understand the optimal way to organize and manage teams across different geographic and cultural environments. It would also help project managers select the most effective project management approaches for an individual's cultural background for a given project type, in order to achieve optimal innovation performance.

1.3 Objectives

Regarding the above research questions, this study aims to fulfil the gaps with specific objectives as follows:

- To examine the direct effects of project management mechanisms on innovation performance
- To investigate indirect effects of project management mechanisms on innovation performance using communication and coordination as mediators
- To examine the direct effects of project management mechanisms on innovation performance given differences in the cultural backgrounds of team members
- To determine whether these project management mechanisms in autonomy and control have different effects on innovation performance for NPD team members with different cultural backgrounds

1.4 Research Scope

In this study, different project management mechanisms regarding autonomy and control are examined. To explore the different effects of these project management mechanisms on innovation performance, on communication and coordination within project teams, and on different cultural groups of team members, NPD projects and innovation projects are scope in this study. These innovation projects create radical innovation products/services or develop low radical innovation products/services (incremental innovation products); both types are included in this study. The effects of project management mechanisms (PMMs) applied to those projects were collected from project managers and team members of NPD projects or innovation projects in high technology industries in various countries .

1.5 Contributions

With regard to the problem statement, research questions, and objectives as mentioned above, this research contributes to the NPD literature in several aspects. First, there is limited research on the effects of project management mechanisms of autonomy and different control on various types of innovation performance including radical, incremental and project efficiency. Therefore, the examination of this topic increases the understanding of project management mechanisms and their influence on innovation performance. In addition, this study will demonstrate the relationships between different types of innovation performance and various levels of project management mechanisms (high autonomy to low autonomy).

Secondly, the results of this study are expected to provide a better understanding of the issue of communication and coordination as intervening variables between project management mechanisms and innovation performance.

Thirdly, the results would expand the utilization the different project management mechanisms with different cultural backgrounds of team members as contingent variables/situations. This may yield additional knowledge on cross-cultural project management with respect to the application of project management mechanisms to team members with different cultural backgrounds.

In practice, the results of this study may help project managers and senior managers to apply these project management mechanisms with different types of projects, and select the appropriate control mechanisms to maximize the innovation performance of their team. A successful project enhances a firm’s opportunities to meets its objectives and optimize its profit. Within its varying contexts, the results of this study may help project managers, senior managers, and executives to understand the optimal way to organize and manage people in different geographic and cultural environments.

1.6 Outline of this Study

This dissertation has been structured as follows:

Chapter one provides an overview of this study.

Chapter two reviews relevant literature providing the theoretical background and identification of national culture theories, cultural dimension and linkage between cultural dimensions and individual behaviors. It also includes innovation typology, measurements of innovation performance, project definition, project structure and NPD team, NPD process and project management, a description of the project management mechanisms. The relationships between project management mechanisms and teamwork processes with respect to communication and coordination are reviewed. In addition, the effects of project management mechanisms on innovation performance given differing cultural backgrounds of team members are discussed. From the literature review, hypotheses based on previous studies are presented.

Chapter three introduces the research methodology used to collect data, sample, and measurement development, and pre-test of measurement. This is followed by the selection of the statistical method to test all hypotheses.

Chapter four provides an assessment of measurement steps, descriptive analysis, and testing of the hypotheses. The results of hypotheses testing are presented, as are the findings from the empirical analysis.

Chapter five presents a discussion of the results and findings pursuant to the hypotheses of this study.

Chapter six provides the conclusion and contributions, limitations and future research.

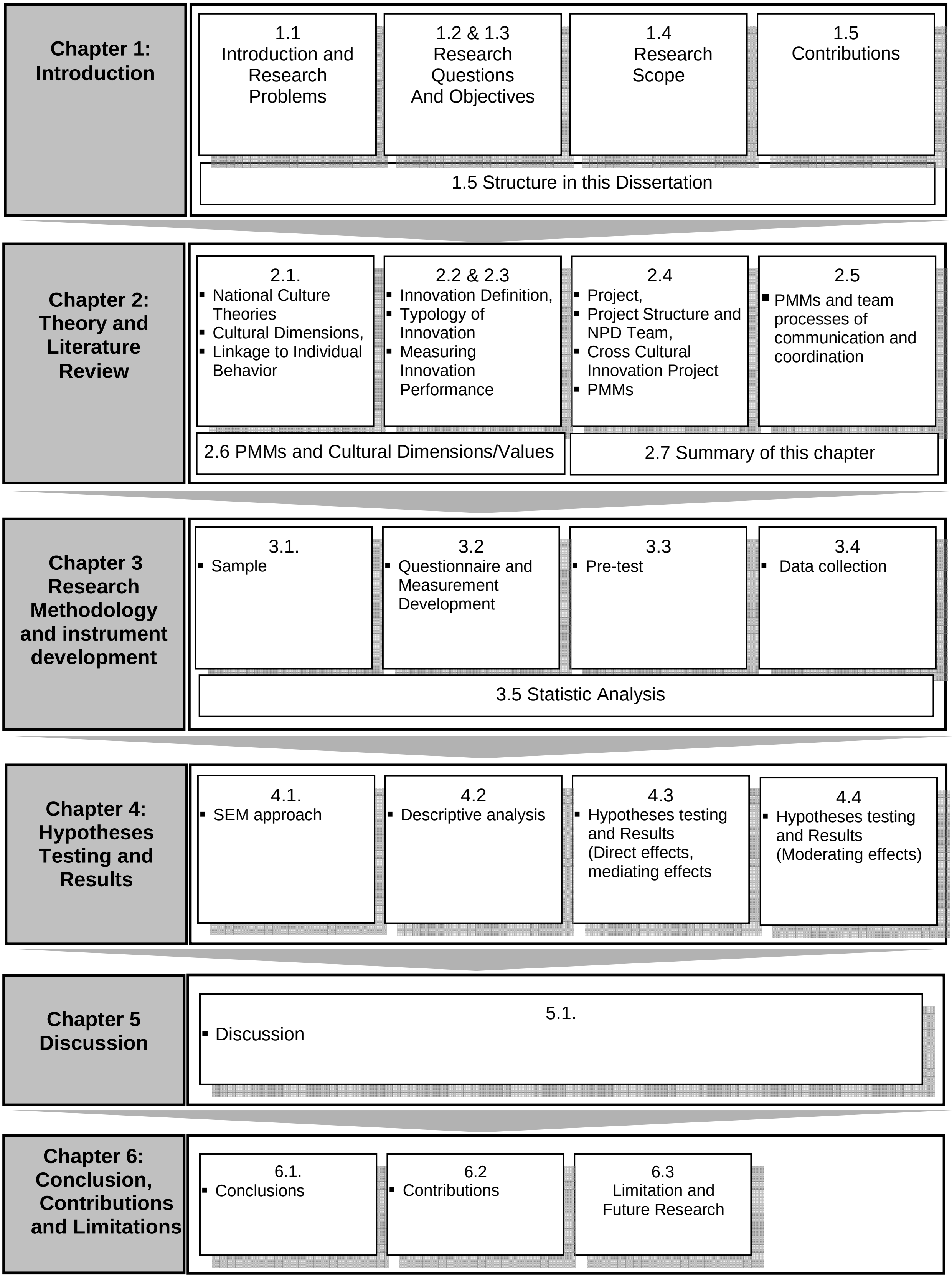


Figure 1-1: Structure of This Dissertation

Chapter 2: Theory

This chapter reviews the theoretical approaches related to and previous studies regarding, national culture and project management. The chapter will be divided into four sub-sections. First, this chapter addresses national culture, cultural values, and linkage between cultural dimensions and individual behaviors. In addition, innovation and innovation typologies are described as an essential source of competitive advantage for high-tech firms. Second, this chapter reviews project definition, project structure, measurements of innovation performance, project structure and team, NPD process and project management and project management mechanisms. The section also discusses the relationships between project management mechanisms (in term of autonomy and different kinds of control) and innovation performance. Third, teamwork processes are introduced in the context of the relationship between project management mechanisms and innovation performance. These communication and coordination teamwork processes are utilized as mediators between project management mechanisms and innovation performance. Fourth, this chapter reviews project management mechanisms and cultural values. Two cultural values are selected as moderators of the relationship between project management mechanisms and innovation performance.

2.1 National Culture Theories

2.1.1 What is Culture?

The origin of the word '*culture*' is from the Latin word 'cultura' and the verb 'colere', which means tending or cultivating (Kroeber and Kluckhohn, 1952, p.86). Scholars define culture from several perspectives. Kluckhorn (1951, p.86) articulates that "culture consists in pattern ways of thinking, feeling, and reacting, acquired and transmitted mainly symbols, constituting the distinctive achievement of human groups, including their embodiment in artifacts; the essential core of culture consists of traditional ideas and especially their attached values". Similarly, Kroeber and Parsons (1958, p. 583) refer to culture as the "transmitted and created content and patterns of values, ideas, and other symbolic meaningful systems as factors in the shaping of human behaviors". Hall and Hall (1990) define culture as a system for creating, sending, storing, and processing information. The most prominent scholar in cross cultural study, Hofstede (1980), defines culture as "the collective program of the mind that distinguishes the member of one human group from another". Hosftede (1991) further explains culture as the set of collective believes and values that distinguishes people of one nationality from those of another. He adds that culture might be defined as the interactive aggregate of common characteristics that influences a group's response to its environments. More importantly, these scholars share the belief that cultures could be collective values shaped and transmitted to be core values through social learning processes and observation reflecting to individuals' attitudes, individuals' thinking, individuals' behaviors, and individuals' actions (Bandura, 1986; Erez and Gati, 2004). Therefore, people live in different parts of the world with diversified environments and geographies; they may have different cultures, values, norms, and behaviors according to the place they live. People in one nation are expected to behave differently from another nation.

In order to demonstrate the cultural differences among nations, many scholars developed their framework, conceptualized, and categorized national culture into various dimensions and attempted to measure these dimensions/values for various nations (Child, 1981; Newman and Nollen, 1996). For example, Hall (1977) and Hall and Hall (1990) specify their cultural dimensions based on context (communication), time, and space orientation. Trompenaars (1993) describes seven cultural dimensions: Universalism versus Particularism; Individualism versus Collectivism; Affective versus Neutral; Specific versus Diffuse; Achievement versus Ascription; Orientation toward time; and orientation toward the environment. Among these scholars, Hofstede (1980, 1990) categorized cultural dimensions based on work related values into four dimensions and he revealed cultural differences exist among nations. Hence, these differences in national cultural dimensions/values may help people in one nation to better understand why people in different nations behave, expect and react differently to the same circumstances (e.g., management practices or leadership styles). The differences in individuals' behaviors might be rooted from cultural values that differ across the world (Hofstede, 1980, 1991; Trompenaars, 1994). The national cultural dimension concept findings of three prominent scholars are further explained in detail in the next section.

2.1.2 Cultural Dimensions

2.1.2.1 Hall & Hall's Cultural dimensions

In order to understand cultural differences, Hall (1976, 1983), Hall and Hall (1990) distinguished culture into three concepts of cultural dimension. The first, cultural dimension is identified based on the ways of information is transmitted and communicated: ***High-Context (HC) or Low-Context (LC)***. According to Hall (1976), HC communication involves the use of implicit and indirect messages (e.g., facial expressions, tone of voice and gestures) in which meanings are embedded in the person or in the socio-cultural context. Gudykunst, Ting-Toomey (1988) summarize that HC communication is indirect, ambiguous, harmonious, reserved, and understated. On the other hand, Hall (1976) further explains that LC communication involves the use of explicit and direct messages in which meanings are contained mainly in the transmitted messages. Therefore, communication in LC cultures is expected to be clear and direct, explicit, and easily understood, with the information accessible to everyone (Schneider and Barsoux, 2003). According to Hall and Hall (1990), the Arab countries as well as France are HC cultures. On the other hand, he describes the USA, the UK and Germany as LC cultures.

The second cultural dimension described by Hall and Hall (1990) identifies the method in which activities are organized by individuals with regarding to time: ***Polychronic or Monochronic.*** According to Hall and Hall (1990, p. 15), people belonging to Monochronic societies tend to do one task/activity at a time, plan, adhere to schedules, and fully commit to the job. People from monochronic societies are LC and need to search for more information to support their decision making (Morden, 1999). In addition, they tend to be concerned with privacy, respect private property and be accustomed to short term relationships. On the other hand, people belonging to Polychronic societies tend to do many tasks/activities at the same time. Their emphasis is on human transactions rather than holding to schedule, and they change plan often and easily. Furthermore, in term of relationships, they are concerned with people who are closely related (e.g., family and close friends) and tend to build lifetime relationships.

The third cultural dimension described by Hall and Hall (1990) identifies culture based on ***space*** in terms of territory, physical and personal space. Degree of space can refer to levels of power and control, relationships to people (Hall and Hall, 1990), or the degree of involvement with others (Schneider and Barsoux, 2003). People from different cultural backgrounds require different levels of space between themselves and others. For example, Hall and Hall (1990) noted that American and German supervisors tend to establish their own territory (e.g., offices) separate from others. On the other hand, French supervisors prefer to occupy a space in the middle of an office surrounded by their sub-ordinates in order to control them (p.11). In terms of physical and personal space, people from colder climates (Germany, Scandinavia, England) use a larger physical distance when they communication. People from warm climates (French, Italy, and Greek) prefer close distances (Hall and Hall, 1990; Reisinger and Turner, 2003).

Hall's three cultural dimensions (1990) are beneficial in identifying the cultural differences among nations in terms of communication, use of time, and space. The differences in national cultures vary depending on the cultural orientation of people in a nation. However, cultural dimensions defined by Hall are somehow not clear (e.g., space), and they may be difficult to apply to the measurement of cultural differences in various countries. This argument is supported by Dahl (2004) who noted that one side of Monochromic/Polychronic time cultural dimension and the HC/LC context is extremely useful, but the other side is ambiguous. He further stated that the ambiguity makes it difficult to apply the concept within the framework of analytical approach (e.g., comparing culture).

2.1.2.2 Trompenaars's Cultural Dimensions

Trompenaars (1993) and Trompenaars and Hampden-Turner (2002) categorized a set of cultures into seven cultural dimensions based on human relationships, time and nature. Each concept is summarized below.

***Universalism versus Particularism*.** Trompenaars and Hampden–Turner (2002) specified this cultural dimension based on human relationships. Universalist societies tend to feel that general rules and obligations are a strong source of moral. Universalists tend to follow the rules and look for "one best way" of dealing equally and fairly with all cases (Trompenaars, 1996, p. 52). People in universalist societies tend to focus on rules more than relationships. They assume that the standards they hold are the "right" ones and they attempt to change the attitudes of others to match. On the other hand, particularist societies are those where "particular" circumstances are more important that rules (Trompenaars, 1996, p. 53). He further explained that in particularist societies, relationships (e.g., family or close friends) are stronger than rules and the response may change according to circumstances and people involved.

Individualism versus Communitarianism. Trompenaars and Hampden–Turner (2002) specified this cultural dimension based on how people relate to each other. Parsons (1955) describes individualism as "a prime orientation to the self" and collectivism as "a prime orientation to common goals and objectives (as cited in Trompenaars, 1996). People in Individualism cultures tend to focus on "I", and prefer the individual's responsibility and achievement. In contrast, people in communitarianism (collectivism) cultures prefer joint responsibility and the group's achievement. This cultural dimension is similar to Hofstede's Individualism-Collectivism cultural dimension.

Affective versus Neutral. Trompenaars and Hampden–Turner (2002) categorized this cultural dimension based on the relationships between people with respect to reasons and emotion. People in Affective societies tend to show their feeling openly through both verbal and non-verbal communication (e.g., laughing, smiling, and expressions on their faces of worrying or disgust). In contrast, people in Neutral societies do not reveal their thinking or feeling in public. They control their feelings carefully and keep them to themselves (Trompenaars and Hampden -Turner, 2002).

Specific versus Diffuse**.** This cultural dimension also emphasizes the relationships of people with others. According to Trompenaars and Hampden –Turner (2002), people in Specific societies are characterized by their direct and precise communication as well as their clear distinction between work life and private life. In contrast, people in diffuse societies are characterized by indirect and evasive communication as well as a combination between work life and private life.

Achievement versus Ascription. Trompenaars and Hampden–Turner (2002) identified this cultural dimension based on a societies definition of status. Status of people in Achievement societies is based on their recorded accomplishments, job performance, and their knowledge. In contrast, status of people in ascription societies is based on their birth, education, age, family, social position, and connections. Persons in ascription cultures use their titles extensively and respect their superiors in terms of hierarchy and age.

Time orientation. Trompenaars and Hampden –Turner (2002) divided this cultural dimension into the importance of past, present and future time orientation as well as the management of time (Sequential versus Synchronous). People in past orientation cultures view everything in the context of tradition or history and they tend to have great respect for ancestors and older people. People in present orientation cultures enjoy their current activities and tend to be most interested in present relationships. People in future orientation cultures talk of aspiration and future achievement. In addition, people in Sequential time cultures tend to do only one activity at a time and stick to their plan and schedules. On the other hand, people in Synchronous time cultures tend to do many activities at the same time. For them, schedules are less important than relationships.

Relationship to nature. Trompenaars (1996) and Trompenaars and Hampden–Turner (2002) specified this cultural dimension based on controlling nature (environments). People in inner-directness cultures focus their actions toward others and believe that they can control environments and outcomes. On the other hand, people in outer-directness cultures believe that environments control their actions.

2.1.2.3 Hofstede's Cultural Dimensions

Within the cultural dimension field of study, the most prominent work in cross–cultural studies has been performed by Hofstede (1980). He examined how culture varies based on work related values by using a standard survey to collect data from 116,000 IBM employees from 66 countries between 1967 and 1973. Hofstede (1980) found that cultural differences among nations can be categorized into four cultural dimensions. These dimensions are: (1) Power Distance; (2) Uncertainty Avoidance; (3) Individualism-Collectivism; and (4) Masculinity–Femininity. These four cultural values are viewed differently across countries. Additionally, Hofstede and Bond (1988) added a fifth dimension, the Confucian dynamic or Long-term relationship. The five cultural dimensions are described below.

Individualism-Collectivism is defined as pertaining "to societies in which the ties between individuals are loose : everyone is expected to look after himself or herself or his or her immediate family" and collectivism is defined as pertaining "to societies in which people from birth onwards are integrated into strong, cohesive in groups, which throughout people's lifetime continue to protect them in exchange for unquestioning loyalty" (Hofstede, 1991, p. 51). In organizations, people of individualist societies define the self as an autonomous entity, independent of groups, prioritize personal goals/interests over group goals/interests, with their behaviors driven by their own beliefs, values, and attitudes, and orientation toward task achievement (Kim, Triandis, Kagitcibasi, Choi, and Yoon, 1994; Markus and Kitayama, 1991; Triandis, 1995). In contrast, collectivists define the self in terms of its connectedness to others in various in-groups, focusing on collective goals/targets, with behaviors driven by social norms, duties, and obligations, and orientation toward harmonized relationship rather than tasks achievement (Markus and Kitayama, 1991; Triandis, 1995). Therefore, people from Individualist countries (e.g., U.S.A) tend to be self-directed and emphasize personal achievement toward their work and collectivists prefer having smooth and harmonic relationships with their in-group (relationship orientation).

Power Distance is defined as "the extent to which less powerful members of organizations and institutions accept and expect that power is distributed unequally" (Hofstede, 1991, p. 27). High power distance societies show great reliance on centralization and formalization of authority, and have great tolerance for the lack of autonomy, which fosters inequalities in power and wealth (Hofstede, 1980). In organizations or work places, power distance leads to unequal power between supervisors and subordinates. Subordinates are expected to be told what to do (Hofstede, 1991) and they prefer less participation in decision making (Newman and Nollen, 1996). On the other hand, people of low power distance societies shared power equally among their members and have more decentralized decision making (Jones and David, 2000).

Uncertainty avoidance is defined as "the extent to which members of a culture feel threatened by uncertain or unknown situations or a society's tolerance for uncertainty and ambiguity" (Hofstede, 1991, p. 113). In organizations, people of high uncertainty avoidance societies manage unstructured situations through the implementation of strict laws, rules and security measures and have a strong need to control environments and situations. On the other hand, people of low uncertainty avoidance tend to accept uncertainties and prefer to take risks.

Masculinity- Femininity is defined as "the dominant sex role pattern in the vast majority of both traditional and modern societies" (Hofstede, 1980, p. 227). People in masculinity societies consider masculine values, for example, assertive, ambitiousness, toughness, competitiveness, and success as importance. In contrast, people in femininity societies are more concerned with relationships, quality of life, and cooperation.

Confucian Dynamism or Long-term – Short term orientation is a cultural dimension later added based on the study of Hofstede and Bond (1988). According to Hofstede (1991, p. 165) , long term orientation, an orientation toward the future, is represented by values including perseverance, relationship order based on status, observation of the status relationship hierarchy, thrift, and having a sense of shame. On the other hand, short term orientation, an orientation toward the past and present, is represented by values such as personal steadiness and stability, saving face, respect for tradition, and reciprocation of greetings, favors, and gifts.

2.1.3 Linkage between Cultural dimensions and Individual Behaviors

According to concepts of national cultural dimensions described in the previous section, most of these cultural dimensions have been conceptualized and categorized into cultural dimensions based on the values of people who belong to that culture/nation (Schuler and Rogovsky, 1998). These cultural dimensions/values at national level have been used to investigate differences among people in various nations. The most famous framework by Hofstede's national cultural dimensions has been investigated in many studies, for example, cultural differences on the rate of innovation (Shane, 1992, 1993), on R&D operations (Ambos and Schlegelmilch, 2008; Jones and David, 2000; Kedia, Keller, and Julian, 1992), on new product development (Nakata and Sivakumar, 1996), on consumer innovativeness (Steenkamp, ter Hofstede, and Wedel, 1999), and on control mechanisms (Chow, Kato, and Shields, 1994; Chow, Shields, and Chan, 1991; Murphy, 2003). Hofstede's framework (1980) is even used to investigate the cultural differences at the national level. Scholars have also applied Hofstede's cultural dimensions to the measurement of cultural value at individual level between collectivism and cooperation, teamwork, and team performance (e.g., Eby and Dobbins, 1997; Gundlach, Zivnuska, and Stoner, 2006; Wagner, 1995).

Even though scholars revealed the cultural differences at a national level; several scholars argue from their reviews and studies that there are cultural differences within single nations as well. For example, Morris, Avila, and Allen (1993) found the variation in the levels of individualism and collectivism among firms in the same country (as cited in Tiessen, 1997). Tiessen (1997) further reasoned that it is possible to have different cultural values in one nation because of variations in proportion of population. In addition, Hayes and Allinson's study (1988) determined that many different cultures might exist within a single nation (as cited in Murphy, 2003). Gudykunst, Matsumoto, Ting-Toomey et al., (1996) further added that different individual's cultural background might be root of individual's behavior. Therefore, applying cultural concepts and measuring cultural differences at an individual level is possible. This is also supported by Donthu and Yoo (1998) who noted that the values of an individual person can be identified in terms of selected dimensions of culture. For example, a person can be described from a cultural perspective as being of high power distance, high individualism and strong uncertainty avoidance.

Based on the above arguments, two of Hofstede's cultural dimensions were selected and applied as moderators to explain individuals' behaviors related to their cultural backgrounds: individualism and power distance in this study. These two dimensions were selected because Hofstede's framework of cultural dimensions is based on work related values which were widely tested using IBM employees. In addition, these two cultural dimensions tend to elicit different responses when different management mechanisms are applied. Especially, individualists prefer freedom in making decisions on their own tasks supporting for innovation, whereas collectivists prefer groups' decisions making diminishing creative idea. People from high power distance cultures are associated with centralization, judgment given to managers, and less participation in decision-making (Gomez-Mejia, Balkin, and Cardy, 1998), therefore, they may prefer a high level of control from their supervisors or managers. However, these characteristics may spur incremental innovation rather than radical innovation (as cited in Ambos and Schlegelmilch, 2008) or may hamper innovation (Shane, 1992). On the other hand, people from low power distance cultures tend to expect their manager/supervisor to consult them, and are more satisfied when they have some control over their work outcomes (Jones and David, 2000; Lam, Schaubroeck, and Aryee, 2002). A study by Kedia, Keller et al., (1992) found that people from low power distance cultures promote innovation. Additionally, several studies have researched different control mechanisms. For example, Chow, Kato and Merchant (1996) compared the utilization of management controls (e.g., procedure control and direction given at the meetings) at American and Japanese firms. They found that the level of control varied between the two countries. American people (individualism country) utilized less procedures control (process control), whereas Japanese people (collectivism country) implemented tighter procedures control and control via directions given in the meeting. Thus, the different level of implemented control mechanisms can be varied depending on their national cultures.

The above studies support that cultures influence management with regard to both autonomy and control. The studies have focused on different issues of control mechanisms. Among the existing literature, there have been few studies that have investigated the relationship between project management mechanisms (autonomy and control) and innovation performance given the different cultural backgrounds of NPD /innovation project team members. Therefore, this current study aims to fill the gap in the literature by investigating the effects of various project management mechanisms on innovation project performance under different cultural backgrounds of team members.

2.2 Innovation Definitions and Typology of Innovation

2.2.1 Innovation Definition

Researchers define innovation through several perspectives. Roger and Shoemaker (1971, p.19) define innovation as *"an idea, practice, or material artifact*". Zaltman, Duncan and Holbek (1973, p.10) define innovation as "*an idea, practice, or material artifact perceived to be new by the relevant unit of adoption*". Similarly, Rogers (1983, p.11) further describes innovation as *"an idea, practice, or object that is perceived as* *new by individuals or other units of adoption*". However, some scholars argue that the above definitions of innovation might vary in the degree of newness to an adopting unit (Dewar and Dutton, 1986) and not everything that organization adopts is perceived as new (Zaltman et al., 1973, p.10). Utterback (1974, p. 621) defines another perspective of innovation as *"technology actually being used or applied for the first time".* From Utterback's perspective, innovation takes place in a process where a technology is first used or applied. His perspective of innovation is clearly distinguished by product and process innovation (Song and Parry, 1999).

Due to variation in terms of "new ideas perceived as new by adoption unit", innovation's later definitions include applying and implementing new ideas and launching them to users or the market. For instance, the definition of innovation provided by Urabe (1988, p.3), is as follows.

> *"Innovation consists of the generation of a new idea and its implementation into new product, process or service, leading to the dynamic growth of the national economy and the increase of employment as well as to a creation of pure profit for the innovative business enterprise. Innovation is never a one-time phenomenon, but a long and cumulative process of a great number of organizational decision-making processes, ranging from the phase of generation of a new idea to its implementation phase. New idea refers to the perception of a new customer need or a new way to produce. It is generated in the cumulative process of information gathering, coupled with an ever-challenging entrepreneurial vision. Through the implementation process the new idea is developed and commercialized into a new marketable product or a new process with attendant cost reduction and increased productivity".*

Another definition, Garcia and Calantone (2002) reviewed OECD study (1991) which uses the term "innovation" to refer to *"an iterative process initiated by the perception of a new market or new service opportunity for a technology-based invention, which leads to development, production, marketing tasks striving for the commercial success of invention".* Garcia and Calantone (2002) find that OECD's definition of innovation best captures innovation from an overall perspective. It combines technological development (as an invention) with market introduction of the invention to end users. In addition, innovation is iterative process of developing both the innovation and reintroduction of an improved innovation. This iterative process implies that there are different degrees of innovativeness and different types of innovation.

This study adheres to the definition proposed by OECD (1991) and Urabe (1988), which covers all perspectives of innovation from the creation of an idea to the implementation process, to the launching of the innovation product into existing or new markets. The two definitions emphasize innovation's outputs (e.g., new product, process and service) based on technological development. These outputs will be used as a basis for describing and discussing NPD projects and the resulting innovation performance in this study.

2.2.2 Typologies of Innovation

Stemming from the various definitions, scholars have classified innovation into several types of innovation. These various types of innovation are also known as typologies of new product development (Avlonitis, Papastathopoulou, and Gounaris, 2001). Figure 2-1 summarizes innovation typologies from many scholars as adopted and adapted from Popadiuk and Choo (2006). Some scholars have distinguished innovation based on technology and market perspectives/customers (Abernathy and Clark, 1985; Chandy and Tellis, 1998; Tushman, Anderson, and O'Reilly, 1997). Other scholars have classified innovation based on the link between core concepts and components (Henderson and Clark, 1990). Still others classify innovation based on the degree of change in a product or process (Wheelwright and Clark, 1992a), or the degree of newness of a product to the firm and to the market (Booz and Hamilton, 1982). The details of each innovation typology are as follows.

(1) *Abernathy and Clark (1985)* classified innovation based on the effects of technological capability of firm and market. As shown in Figure 2-1 (1), four categories of innovation are; (1) Architecture innovation; (2) Niche innovation; (3) Revolutionary innovation, and (4) Regular innovation. *Architecture innovation* is developed based on new technology, which in turn opens up new linkages to markets and users. *Niche market innovation* is built based on existing technology by strengthening on established design and matching it with customer demand to create a new market. *Revolution innovation is built based on new technology, which* is applied to existing markets and customers. Lastly, *Regular innovation* involves change that builds on established technical and production competence applied to existing customers and markets. This kind of innovation can reduce costs or improve the performance of products.

1. Abernathy and Clark (1985)

Market	Technological capabilities	
	Preserved	*Destroyed*
Preserved	Regular Innovation	Revolution Innovation
Destroyed	Niche Innovation	Architectural Innovation

2. Henderson and Clark (1990)

Components	Core Concept	
	Reinforced	*Overturned*
Unchanged	Incremental Innovation	Modular Innovation
Changed	Architectural Innovation	Radical Innovation

3. Tushman et al., (1997)

Market	Technology	
	Incremental	*Radical*
Existing	Incremental product, service, process	Major Process Innovation
New	Architectural innovation	Major Product Service Innovation

4. Chandy and Tellis (1998)

Newness of Technology	Customers' need fulfillment per Dollar	
	Low	*High*
Low	Incremental Innovation	Market Breakthrough Innovation
High	Technological Breakthrough	Radical Innovation

5. Bootz, Allen and Hamilton (1982)

Newness to Firm \ Newness to Market	Low		High
High	New product Lines		New to the world product
	Improved/ Revision to existing Products	Additions to existing product line	
Low	Cost Reduction	Repositioning	

6. Wheelwright and Clark (1992)

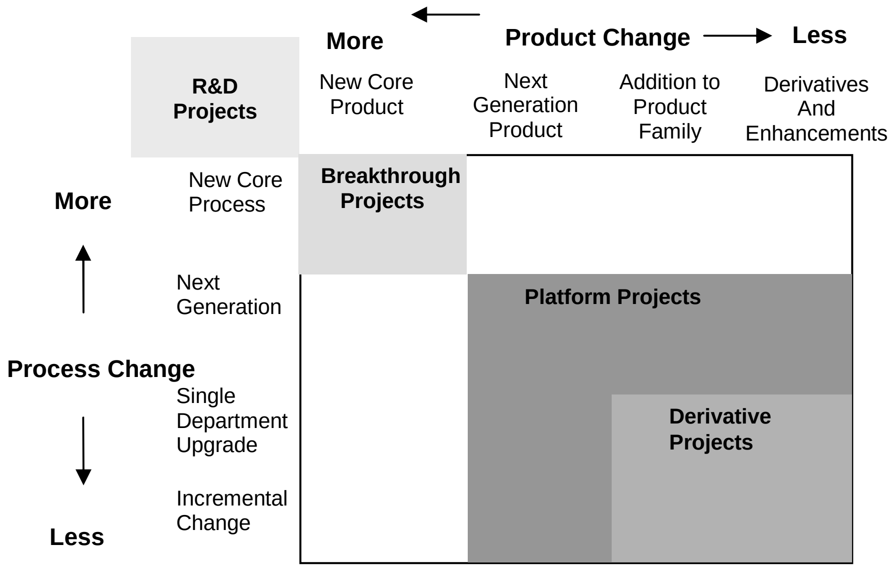


Figure 2-1: Typology of Innovation

Source: Adopted from Popadiuk and Choo (2006)

(2) ***Henderson and Clark (1990)*** categorize innovation based on product level with respect to the links between core concept (architectural knowledge) and components. According to Henderson and Clark's concept (1990, p.2), core concept (architectural knowledge) is knowledge in the ways in which the components are integrated and linked together into a coherent whole. A component is defined as a physically distinct portion of the product that embodies a core design concept. These types of innovation are; (1) Radical innovation; (2) Architecture innovation; (3) Modular innovation; and (4) Incremental innovation, as shown in Figure 2-1 (2). *Radical innovation* involves creating a dominant new design (component) that incorporates a link with new architecture (core concept). *Architecture innovation* is a reconfiguration of an established system to link components in a new way. In this type of innovation, the core concept (architecture knowledge) remains the same but new interaction and linkages between components are introduced. *Modular innovations* involve in replacing one or more core concepts (architecture knowledge) without changing the linkages between components of a product. *Incremental innovation* refines and extends individual components or the linkages between components under core concept (e.g. core established design).

(3) ***Tushman, Anderson, and O' Reilly (1997)*** differentiate types of innovation based on technology life cycle (R&D) and the impact of these types on the market. As shown in Figure 2-1 (3), typologies of innovation are classified into four types including; (1) Major product service innovation; (2) Architecture innovation; (3) Major process innovation; and (4) Incremental product service innovation. *Major product service innovation* is developed due to radical technological change and high competition. This forces the development of a new dominant design and creates a new market (e.g., from Analog to Digital). *Architecture innovation* is created based on incremental improvements in technology (e.g., reconfiguration of technology) and is sold in a new market. *Major process innovation* is developed based on radical technology which is applied to producing a product in an existing market (Tushman and Anderson, 1986). *Incremental product, process, service innovation* is based on incremental improvements in technology (e.g., in sub systems) with an emphasis on an existing market (e.g., Sony walkman).

(4) ***Chandy and Tellis (1998)*** categorize innovation into four typologies based on the degree of newness of the technology and degree of newness to markets. Newness of technology refers to the extent to which the technology involved in a new product is new or different from prior technologies. Newness to market indicates that the extent to which the new product fulfills key customers' needs better than existing products. Their concept is illustrated in Figure 2-1 (4) and classified into four typologies of innovation; (1) Radical innovation; (2) Technological breakthrough innovation; (3) Market breakthrough innovation; and (4) Incremental innovation. A *radical innovation product* is developed based on high newness of technology and significantly fulfills customers' needs. A *technological breakthrough innovation product* is created by employing high newness of technology but with a low achievement in fulfillment of customers' needs per dollar. In contrast, a *Market breakthrough innovation product* is created based on low level of newness of technology, but it provides high level of customers' fulfillment per dollar. An *Incremental innovation product* is built based on low-level of newness of technology and it provides a low level of fulfillment of customers' need per dollar as well.

(5) ***Bootz-Allen and Hamilton (1982)*** categorize innovativeness based on Newness to the market and Newness to the company, resulting in six product types ranking from low to high on each dimension. These six product types are: (1) cost reductions; (2) improvements in existing products; (3) repositioned products; (4) additions to existing product lines; (5) new product lines; and (6) new-to-the-world as shown in Figure 2-1 (5). For *cost reductions,* a new product is developed to provide similar performance at lower cost. *Repositioning of product* focuses on existing products that are target to new market segments. For *improvement and revision to existing products,* a new product provides improved performance or greater perceived value replace existing products of a firm. *Addition to existing product line*, a new product is developed to supplement a firm's established product lines. For *new product line,* a new product is developed to allow a firm to enter established market at the first time. Lastly, *new to the world product*, a new product is developed to create new entirely new market for a firm.

(6) ***Wheelwright and Clark (1992b)*** classify innovation in terms of the degree to which in-house projects changed the firm' s product portfolio. Their typologies of innovation included: (1) Derivative project; (2) Platform project; (3) Breakthrough project; and (4) R&D projects as shown in Figure 2-1 (6). First, *derivative project* refers to enhancements of an existing product process. The examples of derivative projects can be: (1) improved reliability, or minor change in material used; (2) new packaging or new feature with little or no manufacturing process change; and (3) design changes. Second, *platform projects* involve greater product or process changes than derivatives projects do. This type of project offers fundamental improvement in cost, quality, and performance. Third, *breakthrough projects* involve significant changes to existing products and processes that fundamentally differ from previous ones, namely, a completely new product category with a new market. Last, *Research and Development projects* involve the combination of know-how and know-why of new materials and new technologies.

According to the different typologies of innovation mentioned above, innovation can be categorized based on various aspects, for example, newness of technology, newness to market, newness to customers or even newness to a firm. Radical innovations have been described in many ways, but seldom precisely defined (Green, Gavin, and Aiman-Smith, 1995). In addition, the different aspects of radical innovation have led to the creation of many different labels/terms, for example, discontinuous innovation (Anderson and Tushman, 1990), architectural innovation (Abernathy and Clark, 1985), radical innovation (Chandy and Tellis, 1998), new to-the world product (Booz and Hamilton, 1982), major product innovation, (Tushman et al., 1997) or technology or marketing breakthrough innovation (Zhou, Yim, and Tse, 2005). Due to the varied aspects of innovation, and the terms used to describe innovation, it is a complex process to group typologies. Additionally, grouping typologies may lead to conflicting results (Jordan and Segelod, 2006).

In order to avoid conflicting of typologies, this study differentiates innovation according to Chandy and Tellis's concept (1998) into three general typologies: (1) breakthrough innovation; (2) radical innovation; and (3) incremental innovation. The three general typologies are described below.

- *Breakthrough innovation* is categorized based on S-curves of technology and benefits per dollar with respect to market breakthrough and technological breakthrough according to Chandy and Tellis (1998, 2000) and as shown in Figure 2-2. A technological breakthrough product adopts a substantially different technology than existing products. Firms develop new products based on state-of the art of technology which replaces the existing technology; however, these new products may not satisfy customers. This may be because the state of the art technology used for breakthrough innovation, while superior to the existing technology, may be complex for customers (Rogers, 1983). Customers may have no experience with the technology underlying these products and consequently they have to learn how to use this new product (Lee and O'Connor, 2003; Veryzer, 1998b). New products, developed by using state of the art technology, offer distinguished benefits to customers, however they are slightly imperfect in terms of compatibilities (e.g., product functions) because the technology may not be mature. Additionally, not every technology breakthrough product becomes a radical product innovation. While developing a market breakthrough product innovation, firms employ existing technologies, improve them for new products, and then sell them in a new market. Some scholars argue that developing a product under market breakthrough offers lower risk on technological development due to using existing technology, but it is still high risk on market side because the market lacks customers (Christensen and Bower, 1996). Therefore, in developing market breakthrough innovation products, firms require knowledge related to customer’s needs (Song and Parry, 1999).

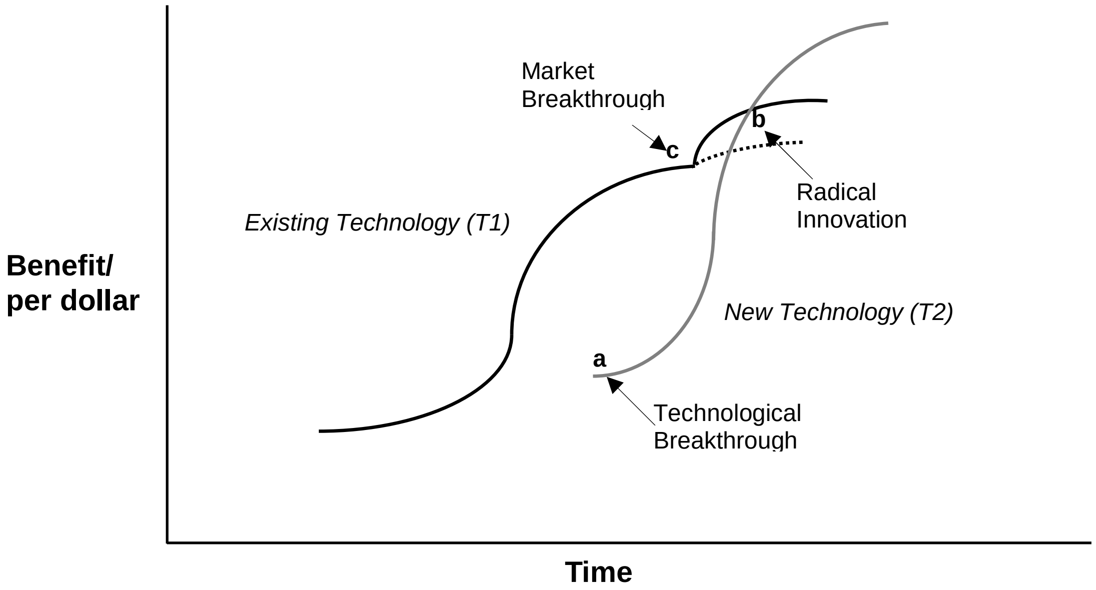


Figure 2-2: S-Curves

Source: Adopted from Chandy and Tellis (1998, 2000)

- *Radical Innovation* is based on a different set of engineering and scientific principles creating a new core concept for a firm (Henderson and Clark, 1990). By developing a new technical core concept with a different set of linking components, a radical innovation product offers high profits and makes existing products obsolete. Additionally, the radical innovation concept of Chandy and Tellis (1998) involves many new technologies and provides significantly greater customer benefit, relative to an existing product. These two criteria distinguish radical innovation products from technological breakthrough innovation products. Since the radical innovation product is a further developmental step from technical breakthrough, a firm faces high risks, high uncertainty in terms of technological and market feasibility, a high possibility of failure, high investment (Song and Parry, 1999; Veryzer, 1998a; Wind and Mahajan, 1997; Zhou et al., 2005) and a long term development period for R&D (McDermott and O'Connor, 2002). Even with high risk, uncertainty and investment, radical innovation products tend to contribute significantly to a firm’s growth and profitability (Veryzer, 1998a).

- *Incremental innovation* is the opposite of radical innovation. Based on Chandy and Tellis' definition (1998), incremental innovation involves relatively minor changes in technology and provides relatively low incremental customer benefit. Incremental innovation involves developing individual components, which underlies a core concept/core system (Anderson and Clark, 1990). Incremental innovation product development is focused on existing product improvements, or line extensions that minimally improve the existing performance (Zhou et al., 2005). In term of markets, incremental innovation products are developed for an existing market.

Although innovation can be categorized into three main types; in general, firms may use the results/outputs of technological breakthrough projects for the development of radical innovation products/projects. Thus, only radical and incremental innovation product/projects are mentioned in this study. These two types of innovation are important for firms (De Brentani, 2001). Firms develop products based on state of the art technology (radical innovation) in order to achieve long term competitiveness in the market by unveiling new to the world product. On the other hand, development of incremental innovation may provide a better response to customers' needs and differentiate their products from their competitors in the current market. These differences lead to different requirements for managing these kinds of products in terms of the structure of a firm, resources, and the skills and related knowledge of project team members (Lee and O'Connor, 2003; Song and Parry, 1999; Veryzer, 1998a). Stamm (2003) summarized differences between incremental and radical innovation according to nine aspects as shown in Table 2-1 (as cited in Popadiuk and Choo, 2006). From Table 2-1, it can be seen that developing radical innovation products based on discontinuous technology takes a long-term development time and involves a high degree of uncertainty with respect to failure. In contrast, developing incremental innovation products based on existing knowledge and step-by-step processes, takes a short-term development time and low level of uncertainty. Stamm (2003) further describes the different processes, structures, players, resources and skills that these two different types of innovation require.

Table 2-1: Difference between Incremental and Radical Innovation

Focus	Incremental	Radical
Time frame	Short term—6 to 24 months	Long term—usually 10 year plus
Development trajectory	Step after step from conception to commercialization, low levels of certainty	Discontinuous, iterative, set-backs, high levels of uncertainty
Idea generation and opportunity recognition	Continuous stream of incremental improvement; critical events large anticipated	Ideas often pop up unexpectedly, and from unexpected sources, slack tends to be required; focus and purpose might change over the course of the development
Process	Formal, established, generally with stages and gates	A formal, structured process might hinder
Business case	A complete business case can be produced at the outset, customer reaction can be anticipated	The business case evolves throughout the development, and might change; predicting customer reaction is difficult
Players	Can be assigned to a cross-functional team with clearly assigned and understood roles; skill emphasis is on making things happen	Skill areas required; key players may come and go; finding the right skills often relies on informal networks; flexibility, persistence and willingness to experiment are required
Development structure	Typically, a cross-functional team operates within an existing business unit	Tends to originate in R&D; tends to be driven by the determination of one individual who pursues it wherever he or she is
Resource and skill requirements	All skills and competences necessary tend to be within the project team; resource allocation follows a standardized process	It is difficult to predict skill and competence requirements; additional expertise from outside might be required; informal networks; flexibility is required
Operating unit involvement	Operating units are involved from the beginning	Involving operating units too early can again lead to great ideas becoming small

Source: Adopted from Stamm (2003)

Due to the different characteristics of radical and incremental innovation products/projects, it is interesting to examine which management mechanism can best manage radical innovation or incremental innovation. Various targets/goals in product development (e.g., innovation project or routine project) may require different project structure/management mechanisms to motivate/promote/support and contribute to innovation performance. The different project goals/targets have different measures of success or performance. These measures are discussed in the next session.

2.3 Measuring Innovation Performance

A number of researchers agree that measuring project performance is important to everyone involved in the project, including project managers, customers, and other stakeholders (Cleland, 1986; Shenhar, Levy, and Dvir, 1997). Firms need to know their performance whether productivity of technology have been reached to reward and motivate their performance, to identify area of improvement, and to inform their stakeholders (Behn, 2003; Cordero, 1990). Development of different types of innovation projects/purposes results in different outputs or performance, which require different measures.

Prior studies have investigated various aspects of project performance. Measurements of innovation performance based on three aspects, i.e. project efficiency, project effectiveness, and achievement of project goals or project performance are summarized in Table 2-2. ***Project efficiency*** is measured based on the degree to which the project is completed on time and within schedule, whereas ***project effectiveness*** is the completion of the project within budget. Kerzner (2009) noted that some scholars pooled project efficiency and effectiveness with proper performance, calling this "project success" or "project performance". Cleland (1986, p.8) argued that project success is meaningful if it is measured based on project technical performance and the contribution of the project to the strategic mission (as cited in Shenhar et al., 1997). Some scholars measure project success based on project performance (Kerzner, 2009). However, a project may be implemented successfully but it may fail in terms of customer satisfaction (Pinto and Slevin, 1988). Shenhar et al., (1997) support that these measurements in terms of effectiveness and efficiency may indicate a well-managed project, but may not indicate success in the long-term nor benefit to customers. Many scholars e.g., Shenhar et al.,(1997) and Kerzner (2009), suggest that a measurement of ***project performance or project success*** should be composed of multiple dimensions in order to cover all aspects including completion within allocated time and budget, proper performance, and the level of acceptance by customers/users.

In order to cover all aspects, recent studies measure project performance based on technical performance, and customers' satisfaction. For example, Hoegl and Germuenden (2001) measured a software team's performance in terms of effectiveness and efficiency. Efficiency was measured according to adherence to schedule and budget. Effectiveness was measured based on the technical quality of the software solution, including the satisfaction with the software solution from the perspectives of both customers and team members. Another study by Lewis et al., (2002) measured the project performance based on technical knowledge built, achievement of commercial success, and adherence to schedule and budget.

Apart from measuring project performance in terms of achieving project effectiveness, efficiency, and accomplishment of goals, there have been a number of studies focusing on the degree of product innovativeness as a measure of new product performance as shown in Table 2-2. Product innovativeness has been measured as an independent variable, a dependent variable, or a moderator in the previous studies (Danneels and Kleinschmidt, 2001). Measuring innovativeness (e.g., product superiority) is important for high tech firms as it helps to indicate their performance in developing new products (Griffin and Page, 1993) in terms of new product success, financial success, product profitability and market share (Cooper and Kleinschmidt, 1987). Since product innovativeness increases a firms' competitive advantage (Brown, 1992; Goldenberg, Lehmann, and Mazusky, 2001), it creates additional incentives for firms to invest in innovation in order to compete in high-tech markets (Lee and O'Connor, 2003).

From the literature review, there are many aspects for measuring product/project innovativeness. The ***innovativeness of a project*** can be measured in terms of: (1) product advantages; (2) technological newness; (3) product newness to the firm or to industry/market; and (4) financial performance. *Product advantage* can be measured from new product characteristics in perceiving superiority or uniqueness of product benefits (in quality, benefit, and functionality), product performance compared to competitors, and scope of newness (e.g., new platforms), or providing new modules (Jordan and Segelod, 2006; Kleinschmidt and Cooper, 1991). These characteristics of product advantages provide a more concrete picture of a firm's ability to meet customer needs (Li and Calantone, 1998). Additionally, product innovativeness can be measured by applying the state of the art of technology that has never used before in developing new product, which is *technological newness* (Song and Parry, 1997). Applying technology newness in developing new product may increase product superiority or uniqueness as well.

In relation to innovativeness, prior study has examined *product newness* in two aspects; that are "newness to the firm" and "newness to customers/competitors" (Atuahene-Gima, 1995; Cooper and de Brentani, 1991; Lee and O'Connor, 2003). The product, which is new to the firm, may not be new to the market. Under this perspective, product newness to the firm refers to the degree of similarity between the new product and the products already marketed by the firm, ranging from incremental products (product improvement and modifications) to radical products (new product lines and new to the world products)

(Atuahene-Gima, 1995). Product newness to customers refers to the extent to which the new product is compatible with the experiences and consumption of customers (Atuahene-Gima, 1995). It can be measured based on the level of difficulty customers face in adopting the product, e.g., whether or not product requires new knowledge (Atuahene-Gima, 1995; Lee and O'Connor, 2003).

Table 2-2: Measurements of Innovation Performance

Outputs/Outcomes	Constructs/Measures
1. **Project efficiency & effectiveness & Project performance**	**Efficiency & Effectiveness:** (Bonner et al., 2002; Cleland, 1986; Hoegl and Gemuenden, 2001; Kerzner, 2009; Lewis et al., 2002; Salomo et al., 2007; Shenhar et al., 1997; Song, Thieme, and Xie, 1998) ▪ Within schedule & within budget ▪ Meeting objectives/ goals of project **Project's Performance:** (Hoegl and Gemuenden, 2001; Kerzner, 2009; Shenhar et al., 1997) ▪ Technical quality of the software solutions ▪ Proper performance at specific level ▪ Meeting design goals in operational specifications, technical specifications **Customers satisfactions/ impact on customers:** (Hoegl and Gemuenden, 2001; Kerzner, 2009; Shenhar et al., 1997) ▪ Customers satisfactions ▪ Fulfilling customer needs/Actually used by customers
2.Product innovativeness at project level	**Product Advantage:** (Ali, Krapfel, and Labahn, 1995; Atuahene-Gima, 1995; Cooper, 1979; Cooper and de Brentani, 1991; Cooper and Kleinschmidt, 1995; Kleinschmidt and Cooper, 1991; Li and Calantone, 1998; Song and Xie, 1996) ▪ Uniqueness of product benefit (e.g., unique features) ▪ Superior performance comparing to competitors (e.g., faster and higher performance) ▪ Scope of newness (e.g., offering new product platform, or new module for an existing product) **Technological Newness:** (Brentani, 2001; Song and Parry, 1997) ▪ Providing advantage by relying on technology never used before **Product newness:** (AtuaheneGima, 1996; Brentani, 2001; Cooper and de Brentani, 1991; Kleinschmidt and Cooper, 1991; Lee and O'Connor, 2003; Song and Parry, 1997) ▪ Product newness to the firms (e.g., exploit technology totally new to the firm ▪ Product newness to the market/industry (e.g., the first product in the market or repositioning of an existing product) ▪ Market newness to the firm (e.g., new customers) ▪ Product newness to customers/ adoption difficulty to the customer (Lee and O'Connor, 2003) (e.g., customers needed to learn how to use this new product). **Financial performance:** (Cooper, 1979; Cooper and Kleinschmidt, 1995; Kleinschmidt and Cooper, 1991; Salomo et al., 2007; Song and Parry, 1996) ▪ Profit ▪ Sales vs. objectives (Sale attained relative to objectives) ▪ Market share

Source: Adopted and adapted from Jordan and Segelod (2006)

Furthermore, product newness can be measured by market newness to the firm, for example, whether a new product serves new customer needs or new customers for firm (Kleinschmidt and Cooper, 1991). Finally, product innovativeness can be correlated positively with the product's market performance, i.e. the level of its financial and competitive outcomes in the market (Li and Calantone, 1998). Therefore, *financial measures* are used to measure outcomes of a new product (at the firm level) in terms of sales, profits and market share in many previous researches (Cooper, 1979; Cooper and Kleinschmidt, 1995; Griffin, 1993; Kleinschmidt and Cooper, 1991; Salomo et al., 2007; Song, Souder, and Dyer, 1997).

Even though performance of a product/project can be measured from various aspects, most studies combined several aspects together and measured performance as "innovation performance", "product competitive advantages" (Song and Montoya-Weiss, 2001), "product success" (Akgun and Lynn, 2002), "new product performance" (Song et al., 1997) or "NPD project performance" (Bonner et al., 2002). This study will measure innovation performance using project efficiency and product innovativeness, either radical innovation or incremental innovation. Project efficiency measures the adherence of schedules, budgets, and degree to which rework is required. The other two measurements in this study are radical and incremental innovation, which demonstrate different level of developed product innovativeness. These two outputs for NPD projects reflect the level of development of the product in terms of newness to firm, to industry, and to customers. Outputs from radical innovation are created by using state of the art technology and generate unique product features to customers and into the market. On the other hand, outputs from incremental innovation projects may result in reduced costs for existing products, improved performance of existing products, or an extension of a line of products within a firm.

In order to achieve the firm's objectives in developing different innovation products, firms require project structure, team members, and management mechanisms employed by project managers to motivate their team members. Hence, project management mechanisms are essential to project performance/success. The next section will discuss the project definition, project structures, and team members. The development of projects will be described in terms of NPD projects and cross cultural projects. The relationship between project management mechanisms and innovation performance will be discussed.

2.4 Project and Project Management in Organizations

2.4.1 Definition of Project

There are various definitions of the project. Early work by Tuman (1983, p.498) defines a project as

> "*An organization of people dedicated to a specific purpose or objective. Projects generally involve large expensive unique or high risks undertakings which have to be completed by a certain date, for a certain amount of money, with some expected level of performance. At a minimum, all projects need to have well defined objectives and sufficient resources to carry out all the required tasks."*

Another project definition by Gibert (1984, p.189), defines a project as a *"task, or the organization set up to accomplish a task, of creating a product within pre-determined parameters"* (e.g., within time, cost, and technical functions). Pinto and Slevin (1988) define a project as possessing the following characteristics:

1. *defined beginning and end (specified time to completion).*
2. *specific, preordained goal or set of goals.*
3. *series of complex or interrelated activities.*
4. *limited budget.*

Lundin and Söderholm (1995) describe a project as "*a temporary organization*" which is distinguished from the permanent organization in "4T aspects": Time, Task, Team and Transition. A project has a limited timeframe of implementation and tasks are unique and specific (e.g., new product development). Project team members are formed around tasks and tasks are interrelated. A project strives to achieve something in terms of transition (e.g., new product).

Recent scholars, such as Kerzner (2001), who refers to a project in his book on project management as *a temporary undertaken, that has a specific objective and a definite beginning and end*. The Project Management Institute (PMI) (2000, p.4) provides a further definition of a project as

> *"A temporary endeavour undertaken to create a unique product or service. Temporary means that every project has a definite beginning and a definite end. Unique means that the product or services is different in some distinguished way from all other products or services."*

Most definitions of a project describe the characteristics of a project as a temporary organization and the role of the project within an organization. Only the definitions provided by Gibert (1984) and the PMI (2000) define a project as creating a unique/new product or service as well as the connection of the project to project success. The project definitions above do not suggest clearly how projects require support in creating a unique product. In practice, research on NPD has recognized the importance of the project in terms of integrating business functions and responding to complex technical challenges for the purpose of developing new products (Hobday, 1998). This leads to increasing the application of the "project" as a structure in firms (Clark, 1989; Iansiti, 1995; Rosenthal, 1992; Tatikonda and Rosenthal, 2000) to handle novel or complex activities, and to customize firms' specialization according to the demands of customers (Hobday, 1998; Kanter, 1983; Kreiner, 1992).

2.4.2 Project Structures and the NPD Team

The basic characteristics of project and applying project in developing new products within firms are mentioned in the previous session. To be successful in developing new product for customers, most firms create a structure for "*new product development project"* or "*innovation project*". In order to support this structure of NPD project/innovation project, teams are formed lead by a project manager in order to develop and launch new products into single market.

2.4.2.1 Project Structures for Developing Innovation

Different project structures are applied for developing innovation depending on different authorities, power, roles, and responsibilities of people involved. Five different organizational project structures have been identified by Galbraith (1971), Larson and Gobeli (1988), Hobday (2000), and PMI@ PMBOK Guide (2004) as shown in Figure 2-3.

The first structure is a ***functional organization**.* The product development project under a functional structure is implemented in each functional department and moves from department to department in a pre-arranged sequence (Stamm, 2003). Functional managers take responsibility for their segments of the projects. Projects implemented using a functional structure are designed to utilize and retain specialists especially for developing high technological products (Galbraith, 1971) and creating specialization (Miles, 1992). However, this structure of product development may fail to meet the project schedule due to long wait times for resources or information from departments.

Gray and Larson (2008) further argue that a project using a functional structure may suffer from a lack of focus, ownership, and poor integration among departments.

The second structure is a ***functional matrix*.** This type of project structure involves coordination between a project manager and functional managers in developing a new product. The project manager is responsible for coordination across the different functional areas and acts as a staff assistant with indirect authority to expedite and monitor the project (Larson and Gobeli, 1988). The functional managers maintain responsibility and authority for their specific segments of the project. A case study cited by Hobday (2000) found that a project implemented via a functional matrix might result in poor performance, perhaps due to the lower status given to the project manager, lack of clear processes and procedures in controlling, and low project team commitment and coherence.

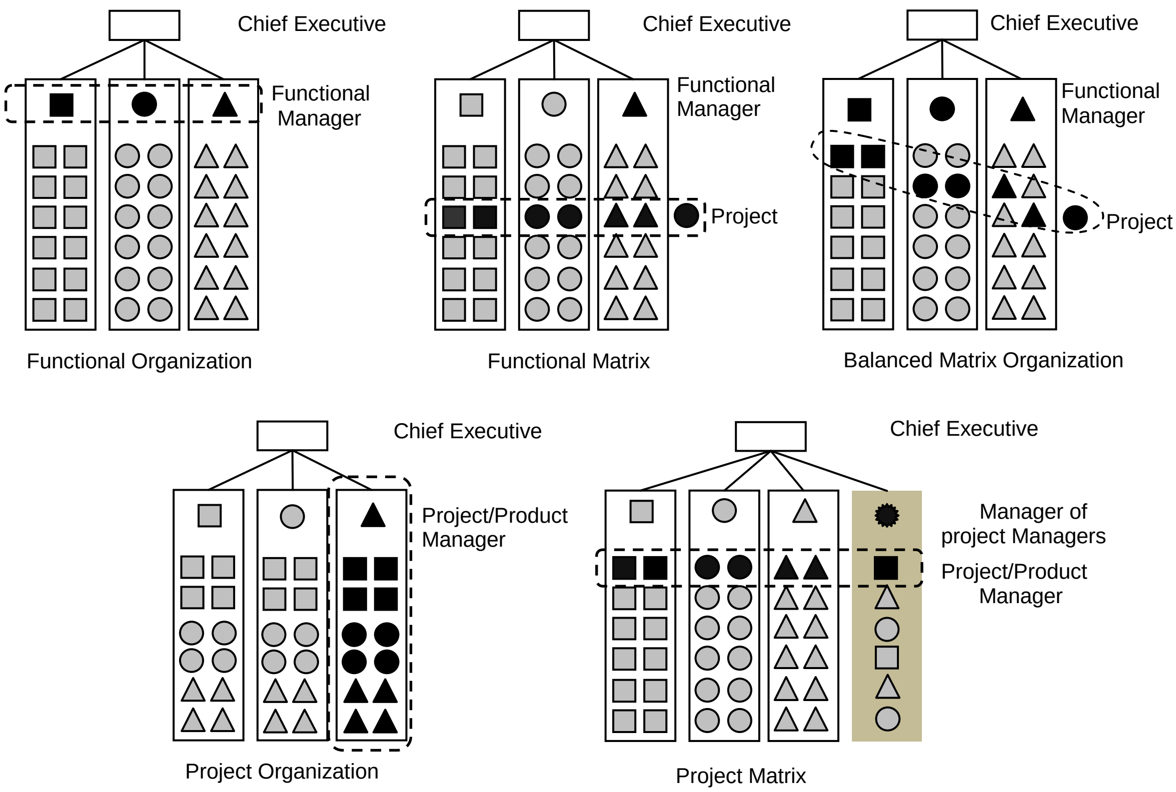


Figure 2-3: Project Structure in Organization

The third structure is a ***balance matrix.*** When new products are developed under this structure, the responsibilities and authorities of the project are shared between project managers and functional managers. Project managers are responsible for defining what needs to be accomplished and when, while functional managers establish staffing and define how tasks will be accomplished (Sy and D'Annunzio, 2005). Both parties work closely together and jointly approve workflow decisions (Larson and Gobeli, 1988). Project team members report simultaneously to both functional and project managers (Gray and Larson, 2008).

The forth structure is a ***project matrix or strong matrix structure*****.** Under this structure, a project manager is assigned to oversee the project and has primary responsibility and authority for completing the project. Functional managers assign personnel and provide technical expertise for a project (Larson and Gobeli, 1988). Gray and Larson note that this structure allows for greater integration of expertise among participants/project team members (Gray and Larson, 2008).

The fifth structure is a ***project organization or project-based structure.*** This structure is an extreme form where the business is organized solely around product/project lines (Hobday, 2000). A project manager is in charge of a project. A team operates as a separate group composed of members from various functional groups. Gray and Larson (2008) argue that this project structure is a flexible structure that allows for fast decision making and cross–functional integration. Disadvantages of this structure include higher cost and limited technological expertise.

Project structures in practice have advantages and disadvantages. Gray and Larson (2008) summarize the advantages and disadvantages of each project structure, as shown in Table 2-3. For example, a project with a functional structure, which lacks coordination with the other departments, may be suitable for a special technological development project or R&D project. A matrix project structure is flexible with a strong focus on project tasks. It is suitable for complex projects which require simultaneous efforts of experts from several disciplines (Stamm, 2003). However, this structure may become dysfunctional and generate conflicts. The project organization structure is flexible and supports cross-functional integration. It is suitable for developing innovative or NPD projects. However, this structure is expensive in practice and limited in terms of technological development.

Table 2-3: Advantages and Disadvantages of Project Structures

Project Structure	Advantages	Disadvantages
1. Functional structure	▪ No Structural Change ▪ Flexibility ▪ In-Depth Expertise ▪ Easy Post-Project Transition	▪ Lack of Focus ▪ Poor Integration ▪ Slow ▪ Lack of Ownership
2 Project matrix structure (Strong matrix structure/ Balance matrix structure/ weak matrix structure)	▪ Efficient ▪ Strong Project Focus ▪ Easier Post-Project Transition ▪ Flexible	▪ Dysfunctional Conflict ▪ Infighting ▪ Stressful ▪ Slow
3. Project organization	▪ Simple ▪ Fast ▪ Cohesive ▪ Cross-Functional Integration	▪ Expensive ▪ Internal Strife ▪ Limited Technological Expertise ▪ Difficult Post-Project Transition

Source: Adopted from Gray and Larson (2008)

Scholars state that project structures, including project matrix or project structure, are viewed as a fast, flat, and flexible approach for managing innovation within an organization (Keegan and Turner, 2002). Larson and Gobeli’ s study (1987) found that the project organization structure increased effectiveness for a new product project greater than the other project structures as shown in Figure 2-4.

Figure 2-4: Project Organization and Its Effectiveness

Source: Adopted from Larson and Gobeli (1987)

2.4.1.2 NPD Team

NPD projects/innovative projects are different from other routine tasks or normal operations projects. NPD projects are formed in order to increase customers and market focus by using cross-functional integration (Barczak and Wilemon, 2003). Prior studies have revealed that the performance of NPD projects depends on many factors including the skills and competencies of the project leader as well as the team members' skills and attributes (Barczak and Wilemon, 1992; Kendra and Taplin, 2004; McDonough, 2000).

The project manager of a NPD project/innovative project, as opposed to a project manager for a routine task, is required to perform many diverse roles in order to manage successfully (Kim, Min, and Cha, 1999). A technical background combined with an understanding of the business requirements helps a project manager to integrate technical development (Sheremata, 2000). Because team members come from various departments such as marketing, technology development, product design and sales and may only know his or her part in the project, the project manager is responsible for holding the team together, creating project plans, and keeping overall objectives in sight (Pons, 2008). The project manager integrates this pooling of diverse knowledge and creates a link between technology and market opportunities to develop successful new products (Dougherty, 1992).

However, management of a team comprised of members with different backgrounds may be difficult. In order to optimize the level of innovativeness of their team, a project manager may empower team members by setting boundaries and allowing team members to perform within these boundaries without specifying how the work is to be performed (McDonough, 2000). At the same time, the project manager must stimulate communication and coordination among team members to share more ideas, information, and their knowledge related to tasks. Importantly, the project manager provides critical evaluation (control) in order to keep team members focused on project goals (Barczak and Wilemon, 1992; McDonough, 2000).

2.4.3 The Global NPD Project & Cross Cultural Innovation Project

As previously mentioned, in general, firms establish a NPD project using a co-located team with a project structure focused on developing new products in a market (one nation) in which firm is operating. Because international firms focus on developing new products and launching them to multinational market (many nations), the original NPD project team may not fulfill this objective. To introduce a new product to markets in multiple countries, the firm must understand the needs of customers who are located in different countries, speak different language, have different cultural beliefs, and express their preferences in different ways (McDonough, Kahn, and Barczak, 2001). In addition, diverse cultural backgrounds of project team members could promote creativity (Bouncken, 2004) that may lead to development of an innovative product. Therefore, multinational firms increasingly rely on a "global project team" (McDonough et al., 2001), a virtual project team (Jarvenpaa and Leidner, 1999), or a disperse project team (Boutellier, Gassmann, Macho, and Roux, 1998) in developing new products.

According to Maznevski and Athanassiou (2006, p.632) a "***global project team***" is an internationally distributed group of people, identified by its members and the organization as a team unit, with a specific mandate to make or implement decisions that are international in scope. In the similar vein, McDonough, Kahn and Barczak (2001) define the ***"global NPD project team"*** as one comprised of individuals who work and live in different countries and are culturally diverse. McDonough, Kahn and Barczak (2001) summarize that a global NPD project team is both geographically dispersed and culturally diverse. In the same way, Jarvenpaar and Leidner (1999) describe "***a global virtual project team***" as cultural diverse with team members spanning the globe. Another type of project team e.g., ***cross-cultural project team*** is established for developing a new product based on the diverse cultural backgrounds of team members.

Figure 2-5 depicts a project team composes of many members with different cultural backgrounds and responsibilities who work together on a project. Even though rarely defined as a cross-cultural project team in the literature, a global team composed of members from different nations could be a cross-cultural NPD project team as well, since diverse cultural backgrounds may bring new ideas for the development of new products (Bouncken, 2004). Some research evidence has shown that a diverse project team contributes significantly to innovation in product and system development (Eriksson et al., 2002; Wheatley and Wilemon, 1999). Cox and Blake (1991) also claim from their study that people of different genders, nationalities, and racioethnic groups hold different attitudes and perspectives on issues; therefore cultural diversity should increase team creativity and innovation.

Figure 2-5: Cross-Cultural Project Team

However, the cross-cultural innovation team may face complexities and difficulties in terms of communication, geographical disparity, and cultural differences that influence team members' behaviors (McDonough et al., 2001). Cultural values stemming from different backgrounds influence team members' behaviors related to how members work together in a team and respond to management mechanisms provided by a project manager. Management of the cross-cultural innovation team is challenging with respect to fostering the development of new ideas and stimulating coordination among team members. All of these issues can influence the level of innovativeness of project. Research on cross-cultural NPD project teams has rarely investigated the use of project management mechanisms to enhance innovation performance under different team members' cultural backgrounds (Shore and Cross, 2005). Therefore, one objective of this study is to shed more light on cross-cultural innovation project management. In the next section, the relation between NPD process and project management, project management mechanisms and innovation performance will be discussed.

2.4.4 NPD Process and Project Management

When NPD projects are formed to develop innovation within firms and their own structures and teams are established, these projects and teams must be managed by project managers in order to achieve the project's goal. It is important to clarify the idea to be developed by NPD team before launching into the market; these teams have to go through the process of idea generation into production and launching a new product (from the idea) into the market (Aleixo and Tenera, 2009; Garcia and Calantone, 2002). This is called NPD process or innovation process. Johne (1984) suggests that NPD process may consist of two phases; (1) initiation (idea generation, screening, and concept testing); and (2) implementation (product development, test marketing, and product launch)(as cited in Nakata and Sivakumar, 1996). However, several scholars view NPD process within different perspectives, for example, six Stage Gate of Cooper (1990) or two phases of innovation process of Johne (1984). Most of the perspectives of innovation/NPD process have more than two stages/phases which were based on their NPD process according to the state of product during its development (Aleixo and Tenera, 2009). This NPD process may increase the success of the development of a new product (Cooper and Kleinschmidt, 1986). It might also facilitate matching customers' needs to a new product. Regarding the NPD process, for example, the Stage-Gate-system (Cooper, 1990), the project manager drives the NPD project from phase to phase and organizes the team to meet the requirements (specified deliverables) of each phases. Senior managers act as gate keepers to approve needed resources, review output quality and approve an action plan for the next phase as shown in Figure 2-6.

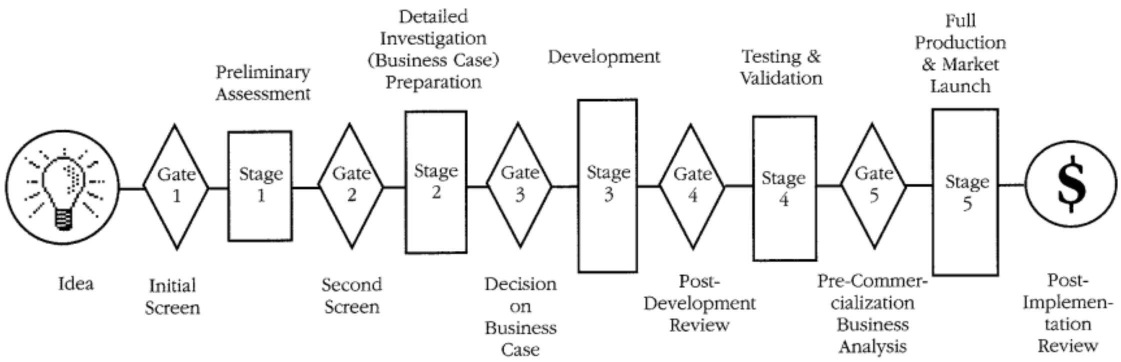


Figure 2-6: An Overview of a Stage-Gate System (Cooper, 1990)

As already mentioned the project manager drives their team to pass all needs of each phase and thereby achieving the project's goals. However, during project execution, characteristics of NPD process (e.g., goals and requirements) are always change (De Maio, Verganti, and Corso, 1994) due to technical uncertainty or changing customers' needs. In order to pass all deliverables of each phase and achieving project goals, project managers require some tools to help them with their management tasks. Project management is found to be an important role in product development in terms of competency integration, logical planning, emphasis on anticipation of constraints, and the control of critical areas execution (De Maio et al., 1994). It is vital for project managers in having the necessary management tools to motivate their team to achieve those project's goals.

Project management has typically been defined as including planning, monitoring, organizing, and control processes. For example, the UK Association of Project Management (1995) provides a definition of project management as

> "*The planning organization, monitoring and control of all aspects of projects and the motivation of all involved to achieve the project objectives safely within agree time, cost, and performance criteria.*"

Similarly, Kerzner (2009, p.4) further defines "project management" as

> *"The planning, organizing, directing, and controlling of companies resources for a relatively short term objective that has been established to complete specific goals and objectives."*

Kerzner further commented that there are five principles underlying project management: planning, organizing, staffing, controlling, and directing which are important processes related to the development of new products.

Munns and Bjeirmi (1996) refer to project management as the process of controlling the achievement of the project objectives by applying a collection of tools and techniques. They further describe project management using project life cycle and explain that project management covers only stages 2 to stage 4, i.e. planning, production, and handover as shown in Figure 2-7. Munns and Bjeirmi's definition of project management can be applied to all types of projects (e.g., R&D projects, product development projects or customized projects for customers). Therefore, it can be concluded that project management composing of planning, production and handover relates to managing NPD project in identifying customers' needs, keeping a project on schedule and meeting milestones and rapidly producing a product (McDonough et al., 2001).

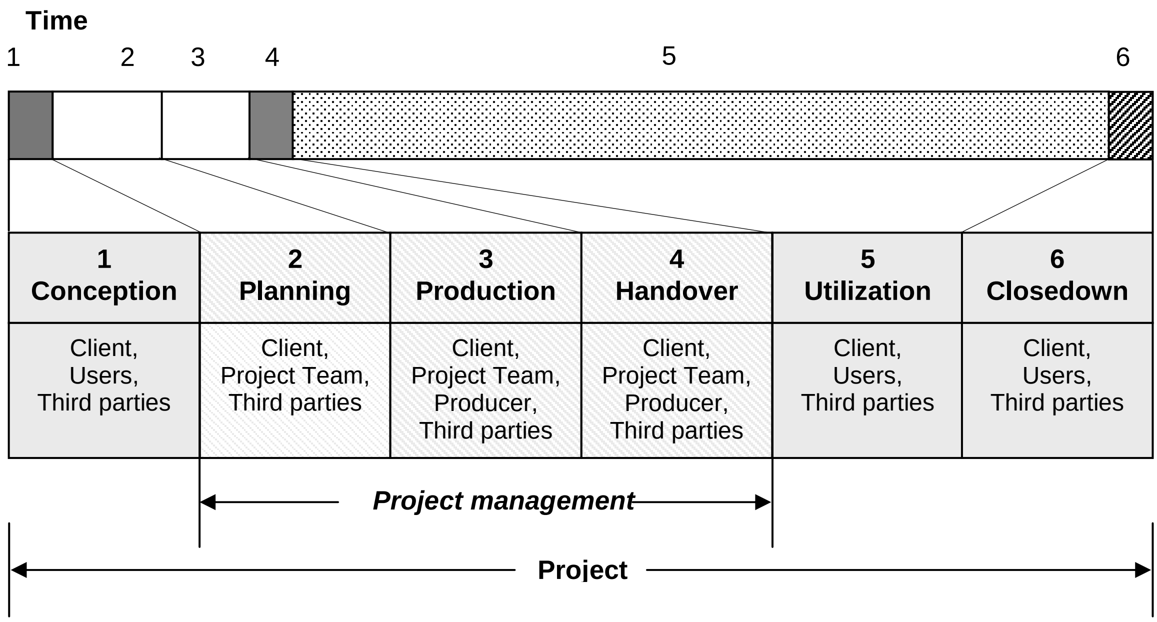


Figure 2-7: Stage of Project Life Cycle

In this current study, the above definitions of project management will be used as the foundation of project management. These definitions clearly state that project management is control of a project to keep a team focused on tasks in order to achieve a project's goals. Although the above project management definitions emphasize project control through planning and monitoring of a project, NPD projects need another management mechanism such as granting autonomy or participation in management as well. This is supported by Kessler and Chakabarti (1999) who revealed that both granting autonomy and control through monitoring of milestones had an impact on a radical innovation project, however, granting autonomy had a higher effect on the radical innovation project than monitoring of milestones.

In order to monitor, organize, and control NPD projects, the project manager requires management mechanisms/tools for the project and team. The next section discusses the relationship between project management mechanisms and innovation performance in further detail.

2.4.5 Project Management Mechanisms of NPD Projects

In general, project management is the planning, monitoring, and evaluating of a project and team in order to achieve project goals. During project implementation, project managers require mechanisms/tools/techniques to help them identify customers' needs, keep projects on schedule, and integrate and coordinate tasks. These mechanisms/tools/techniques may include an informal leadership style, procedure/planning diagrams, Gantt charts and Work Breakdown Structure (WBS) (McDonough and Leifer, 1986; Sicotte and Langley, 2000). Mechanisms such as, the Gantt chart or WBS help the project manager to plan, monitor, and evaluate innovative tasks according to project milestones. These mechanisms also help the project manager to control the project to reduce the risks of technology and market uncertainty, but may limit team members' creativity (Bonner et al., 2002) which is needed for developing new products. Therefore, contrasting mechanisms in both autonomy and control are necessary for NPD projects.

Feldman (1989, p.83) supported that both autonomy and control mechanisms are always necessary in organizations and neither can exist without the other: "not only are autonomy and control needed in organizational innovation, but they cannot be understood separately, because autonomy is dependent both structurally and managerially on a context of control". Feldman analyzed the relationship between autonomy and control and developed four conclusions:

1. Autonomy and innovation always depends on a context of control for their relevance to an organization.
2. Under conditions in which innovation is required and autonomous behavior is important, general management control is needed.
3. When control and autonomy are not balanced, a vicious cycle can develop.
4. Innovation within an organization requires participants to have a highly developed sense of the legitimate possibilities of autonomy.

Due to the above mentioned conclusions, a project, as a temporary organization, requires both autonomy and control mechanisms. In order to provide a framework of project management mechanisms, it is necessary to review the relevant literature regarding project management mechanisms (autonomy and control) and their relationship to innovation performance as summarized in Table 2-4.

According to the literature review, scholars use different statements to describe project management mechanisms such as project management styles (Lewis et al., 2002), project management method (Tatikonda and Rosenthal, 2000), project leadership style (McDonough and Barczak, 1991), project management characteristics (Thieme, Song, and Shin, 2003), and control mechanisms (Bonner et al., 2002) to measure the relationship between project management mechanisms and innovation performance or NPD success. It should also be noted that each study included a different level of analysis, and applied different measurements of both project management mechanisms and innovation performance. However, it is worth to observe the relationships between each project management mechanism and innovation performance.

Table 2-4: Related Studies on Project Management Mechanisms

Topics	Authors	Samples	Results
Autonomy	Amabile and Gryskiewicz (1987)	R&D scientists	From their interviews with R&D scientists, they found that *lacking of operational autonomy or freedom* over one's work or ideas inhibited creativity.
	Thamhain (1990)	934 Professionals participating R&D project teams	*Autonomy (freedom)* did not significantly correlate with innovative R&D team performance.
	McDonough and Barczak (1991)	30 NPD projects in 12 British companies	*Granting autonomy to project team members* significantly increased the speed of development of NPD projects.
	Barzack and Wilemon (1992)	Project teams	Technical professionals desired a high *degree of autonomy to control* their activities and to make their own decisions about their roles and how to solve specific problems
	Bart (1991; 1993)	57 sub-ordinate managers in 10 large companies	*Granting autonomy* to subordinates in making decisions (as one of informal control), appeared to support both exponential new product projects and incremental new product projects.
	Kim and Lee (1995)	103 R&D Project teams in Korea	*Autonomy climate* was negatively associated with team performance in Korea.

Table 2-4: Related Studies on Project Management Mechanisms (Continued)

Topics	Authors	Samples	Results
	Gerwin and Moffat (1997a)	53 Cross-functional product development team	*Withdrawing autonomy* was negatively correlated with both task and process aspects of team performance.
	Olson, Walker, and Ruekert (1995)	45 projects from 12 firms	They noted that a *high level of autonomy* within the firm was an advantageous for radical product innovation.
	Kessler and Chakrabarti (1999)	75 New product development projects from 10 firms	*Empowerment team had a positive effect on the speed of development of a* radical project. *Empowerment team* had no impact on incremental project.
	Tatikonda and Rosenthal (2000)	120 project managers in the execution phase (individual level)	*Autonomy* positively was associated with project execution and success in terms of technical performance, unit cost, and time to market
	Lewis et al., (2002)	Project managers in 80 projects	*Participative control reflecting team autonomy* had a positive effect on commercial objectives (reasonable manufacturing cost & market share)
	Bourgault Drouin and Hamel (2008)	149 project managers of technical projects	*Granting team autonomy* had positive effect on teamwork effectiveness for both moderated and highly dispersed teams.
Monitoring Progress	Eisenhard and Tabrizi (1995)	72 product development projects drawn from European, Asian, and U.S. computer firms.	Faster product development was associated with *frequent milestones*.
	Kessler and Chakrabarti (1999)	75 New product development projects from 10 firms	*Frequent milestones* were associated with faster development of radical project. Frequent milestones had no effect on the development of an incremental project.
	Lewis, Dehler, and Green. (2002)	project managers in 80 projects	*Monitoring milestones and progress,* one project management style, negatively impacted technical knowledge.
	Salomo, Weise and Gemünden (2007)	132 Project managers of NPD projects	Process formality (*milestones monitoring*) had a non-significant effect on innovation success.
Process Control	Bart (1991)	57 sub-ordinate managers in 10 large companies (firm level)	*Less reliance on firms' formal systems (i.e. formal screening/evaluation)* supported both exponential new product projects and incremental new product projects.
	Itter and Larcker (1997)	Consulting company survey of organizational practices covering the automobile and computer industries in four countries	*Process improvement tool* was associated with enhanced performance of industries' profitability

Table 2-4: Related Studies on Project Management Mechanisms (Continued)

Topics	Authors	Samples	Results
	Tatikonda (1999)	108 new product development projects	*Project management formality* was significantly correlated with derivative projects (extensions to an existing product family).
	Tatikonda and Rosenthal (2000)	120 project managers in the execution phase	*Formal processes* were positively associated with project execution success (technical performance, unit cost, and time to market).
	Cardinal (2001)	148 participants related to SBU in 57 Pharmaceutical firms	*Process control* (centralization and formalization) enhanced new drug development (radical innovation).
	Bonner et al., (2002)	95 NPD Projects	*Process control* had a significantly negative effect on NPD project performance.
	Benner and Tushman (2002)	Two large-sample, longitudinal studies of the photography and paint industries	*Process management activities* (e.g., ISO)in firms were associated with an increase in both explore and exploit innovation (radical and incremental innovation)
	Li et al., (2006)	194 participant of high technology firms	*Process control* increased radical innovation, but decreased incremental innovation in Chinese technology firms.
	Bourgault , Drouin and Hamel (2008)	149 project managers of technical projects (team level)	*Formalized processes had a strong effect on teamwork effectiveness only for highly distributed teams.*
Output Control	Bonner et al., (2002)	95 Projects across a variety of industry	*Output control* had no effect on NPD project performance.
	Cardinal (2001)	148 participants related to SBU in 57 Pharmaceutical firms	*Output control* had a positive effect on radical innovation and incremental innovation.
	Li et al., (2006)	194 participant of high technology firms	*Output control* increased incremental innovation, but decreased radical innovation in Chinese technology firms.

In relation to granting autonomy, West (1997) found that creative people are self-confident, need autonomy, make independent judgments, and thrive on risk (as cited in McAdam and McClelland, 2002). Amabile and Gryskiewicz (1987) further stated that autonomy is one factor that encourages new ideas. The creation of ideas is assumed to be related to innovation among R&D scientists. Most studies of NPD projects and R&D projects found that freedom/autonomy granted to project members enhanced innovativeness of the project and led to faster project development (Kessler and Chakrabarti, 1999; Lewis et al., 2002; McDonough and Barczak, 1991; Tatikonda and

Rosenthal, 2000). Granting autonomy to a team may be important for NPD projects in generating ideas for new products at initiation stage, as well as in solving technical problems occurring during implementation stage. Granting autonomy to a team allows individual team members to make decisions and select flexible ways of developing products in uncertainty situations. However, some scholars found that autonomy had a negative effect on team performance in Korea (Kim and Lee, 1995) and that autonomy did not correlate with R&D team performance (Thamhain, 1990).

Project management control mechanisms are the opposite of autonomy. Research covering different types of control was reviewed in the literature. Ouchi (1977) categorized organizational control into output and behavior control. Jaworski (1988) identified control of marketing activities as formal control (e.g., input, process and output) and informal control (e.g., self, social, and culture). Snell (1992) used human resource management control in input, behavior (process) and output control to investigate the relationship between management control and standard of desirable performance. Several studies pooled control mechanisms together and referred to formal management control. For example, Chow, Kato, and Merchant (1996) examined the management control consisting of new income target, discretionary program expense, headcount control, procedure control and directives given at meetings at the profit center level of large U.S. and Japanese firms. However, only a few studies (e.g., Bonner et al., 2002; Cardinal, 2001) have investigated various control mechanisms applied in NPD projects.

From the literature review (Table 2-4), some studies revealed that control mechanisms are associated with the success of NPD projects. Thus, this study emphasizes different types of control mechanisms including: (1) monitoring progress (i.e., the extent to which innovative tasks are monitored and controlled according to project milestones); (2) process control/behavior control (i.e., the extent to which tasks are monitored according to pre-defined procedures); and (3) output control or outcomes control (i.e., the extent to which performance goals are utilized as a control). According to the literature review, these control mechanisms have both negative and positive influence on innovation performance. For example, formalization, an organizational structure utilized by a software group, had a strong influence on technical innovation (Zmud, 1982). One study indicated that formal processes and output control might enhance both radical and incremental innovation within R&D projects at pharmaceutical firms (Cardinal, 2001). Bonner et al., (2002) found that process control had a negative effect on NPD project performance and output control had no effect on NPD project performance. The literature review as well indicates that most studies investigated some variables (e.g., control mechanisms) effect on single innovation performance (e.g., team performance or NPD project performance). There are few studies (e.g., Tatikonda and Rosenthal, 2000) that examine both autonomy and control mechanisms concurrently. Therefore, this study explores mechanisms including: (1) autonomy; (2) monitoring progress; (3) process control; and (4) output control, and investigates whether they contribute differently to innovation performance in radical innovation, incremental innovation, and project efficiency. The first conceptual framework of this study is shown in Figure 2-8.

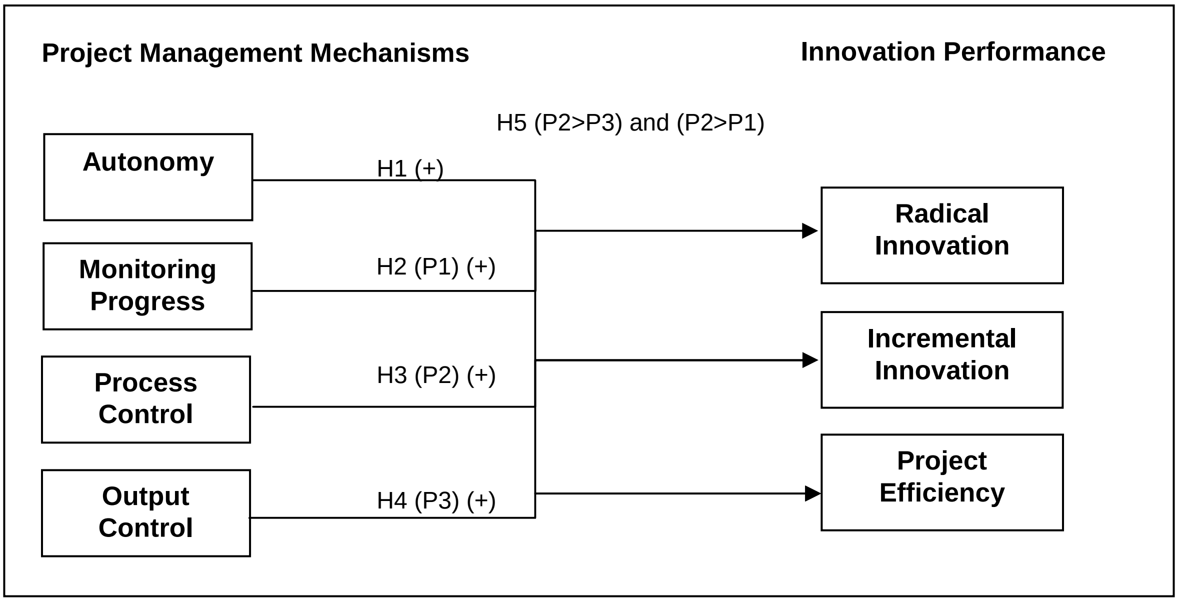


Figure 2-8: First Conceptual Framework

This conceptual framework demonstrates the relationship between project management mechanisms and innovation performance. Project management mechanisms are considered independent variables. The four independent variables demonstrate both autonomy and control mechanisms. These mechanisms are: (1) autonomy; (2) monitoring progress; (3) process control; and (4) output control. Autonomy represents the empowerment/freedom given to project team members in exploring, discussing, and making decisions about problems and how to solve those problems related to their tasks. The other three mechanisms represent different control mechanisms of work on the NPD/innovative project. Project management mechanisms of autonomy and control are selected for this study because they represent the range of levels of project management mechanisms from granting high autonomy to granting low autonomy (control) that are essential for developing NPD projects. From a review of the previous literature, it has been determined that these four project management mechanisms help to improve innovation performance as a dependent variable consisting of: (1) radical innovation; (2)

incremental innovation; and (3) project efficiency. The function of project management mechanisms is explained in the next sections.

2.4.5.1 Autonomy and Innovation Performance

Autonomy refers to the degree to which individual team members are granted freedom, independence, and discretion in scheduling the work and in determining the procedures to be used in carrying it out (Hackman and Oldham, 1975). Some scholars have referred to autonomy using different terms such as “decentralization” of structure (Brock, 2003), “empowerment” (Leonard-Barton, 1992) or “freedom”. In other words, autonomy can be described as the empowerment of individuals to contribute meaningfully to the tasks (Gerwin and Moffat, 1997a; Leonard-Barton, 1992). Similarly, Sethi (2000) states that autonomy in NPD refers to the extent to which individuals in a team have the freedom to make own project-related decisions and conduct work without interference from senior managers.

Previous studies have shown that autonomy is an important antecedent of a work group’s performance, individual creativity, and innovation. For example, Cotgrove and Box (1970) and Pelz and Andrews (1966) note that autonomy and decision freedom are essential to innovative behavior (as cited in Scott and Bruce, 1994). Amabile and Gryskiewicz (1987) found that a lack of operational autonomy or a lack of freedom over one's work or ideas inhibited creativity and innovation. In a similar vein, studies of NPD projects show a strong relationship between autonomy and innovation performance. For example, McDonough and Barczak (1991) found that the speed of new product development is significantly related to the amount of freedom and responsibility given to team members. Another study by Barczak and Wilemon (1992) noted that technical professionals desire a high degree of autonomy to control their activities and to make their own decisions about their roles and how to solve specific problems.

Most previous studies investigate the impact of autonomy on a single innovation performance and only a select number of studies differentiate between different types of innovation (e.g., radical innovation and incremental innovation) with respect to the influence of autonomy. For example, Bart (1991; 1993) found that granting autonomy to subordinates in making decisions (as one of informal control) supports both exponential new product projects and incremental new product projects. A study by Kessler and Chakrabarti (1999) revealed that granting autonomy to team members increased the rate of development of radical innovation, but had no effect on incremental innovation.

In addition, autonomy is also found to be associated with project execution success (Tatikonda and Rosenthal, 2000). Another study has shown that autonomy given to a NPD team had a positive effect on team performance and the success of NPD project (Gerwin and Moffat, 1997b). Based on the above literature review, granting autonomy appears related to increased creativity, development of innovation, and increased performance, which leads to the first hypothesis of this study:

Hypothesis 1: *Autonomy increases innovation performance (radical innovation, incremental innovation, and project efficiency).*

2.4.5.2 Monitoring Progress and Innovation Performance

Monitoring progress is defined based on the concept of monitoring or tracking actual progress with regard to the project's plan. When implementing a NPD project, the project manager and team create a project plan composed of specifications of customers, tasks, and sub-tasks and set milestones for tracking the progress of project. The project plan called a WBS represents a framework for the timescale, manpower and budget (Hodgson, 2004). In the WBS, tasks are assigned to team members and monitored by project managers based on qualitative milestones enabling ongoing performance to be assessed against milestones (Hodgson, 2004). In a similar vein, Jelinek and Schoonhoven (1990) add that milestones convert a project strategy into analyzable technical, budgetary and time related objectives (as cited in Lewis et al., 2002). These milestones also clarify task priorities, relationships between tasks, and duration of each task of the NPD project. Concrete milestones help managers to have a clear indication of a project's progress, and serve as a guide for team members (Eisenhardt and Tabrizi, 1995; Lewis et al., 2002; Wheelwright and Clark, 1992a). In addition, milestones are used to monitor a project systematically and allow project managers to adjust project resources and objectives as necessary (Salomo et al., 2007). Thus, monitoring progress according to a project plan is a management mechanism, which project managers utilize to monitor the progress of tasks, and control whether team members achieve innovative tasks according to schedule and plan.

Previous researches have examined the impact of monitoring progress on innovation performance. In developing radical innovation products, team members face difficulties of technologies and market uncertainties. Lewis et al., (2002) found that monitoring progress increased project innovation (in building technical knowledge and achieving commercial objectives) under technical and market uncertainty and in normal situations.

Eisenhardt and Tabrizi (1995) also found that frequent milestones in an NPD project are associated with faster product development as they motivate and force team members to look at what they are doing. Salomo et al., (2007) noted that monitoring progress helps a project stay on track, however they found that monitoring milestones is not associated with innovation success. Cardinal (2001) noted that frequent progress monitoring by project managers might decrease innovativeness because of interference to research activities.

Comparing to developing radical innovation products, development of incremental innovation products is less risky. In most cases, these products are invented for specific demands of customers, or redeveloped for improved performance. Only a few studies have examined the influence of frequent monitoring of progress on different types of innovation. Kessler and Chakrabarti (1999) revealed that milestone frequency promoted radical innovation, but had no effect on incremental innovation. Even if monitoring progress does not affect incremental innovation projects, team members still need to deliver these products to customers or to the market on time. Therefore, monitoring progress may help team members stay on track and deliver outputs on time for incremental innovation projects as well. It can be also argued that monitoring progress can help project managers to manage high and low uncertainties of developing innovation and increase project efficiency. A second hypothesis was formed based on the above literature review and assumption:

Hypothesis 2: *Monitoring progress increases innovation performance (radical innovation, incremental innovation, and project efficiency).*

2.4.5.3 Process Control and Innovation Performance

Process control is exercised when a firm attempts to influence the means of achieving desired ends (Jaworski, 1988). Process control is called behavior control because it focuses on the process which turns appropriate behavior into desirable outputs (Das and Teng, 2001). Therefore, process control monitors the adherence to certain procedures and activities specified in the project plan (Ouchi, 1979). To ensure that team members adhere to procedures, project managers or senior managers closely monitor and evaluate team members' actions (Ouchi, 1977). Process control also includes monitoring how well team members follow written processes. If the expected results are not achieved, senior managers can fine-tune the things that deviate from those standard processes (Bonner et al., 2002). Process control provides closer supervision at the management level where managers give both guidance and feedback to team members (Oliver and Anderson, 1994). At times, the application of process control can appear as if senior managers are intervening during the implementation of NPD/innovative projects (Bonner et al., 2002).

The concept of process control was initially applied in manufacturing to reduce the variance and more recently this control has been used in administration and product development (Benner and Tushman, 2002). In their study, Benner and Tushman (2002) identify three main practices utilized in the process management approach: (1) predefined process and mapping process with requirements, (2) process improvement, and (3) adhering to improved process. Various process control techniques are applied within firms, namely, ‘Stage Gate’ by Cooper (1993), ‘Quality Function Deployment’ method (QFD) by Hauser and Clausing (1988), and ‘ISO 9000’. These process control techniques reduce variance in product production and supposedly increase performance.

Several empirical studies have explored the relationship between the process control approach and innovativeness (Benner and Tushman, 2002) and between process control and reduction of time to market (Booz and Hamilton, 1982). For example, Herbig and Palumbo (1996) studied innovation within Japanese firms and found that a focus on process innovation improved new products, reduced time to market (speed), and reduced costs. Another study by Itter and Larcker (1997) found that the use of process improvement tools is associated with enhanced profitability in the automotive industry. However, Bonner et.al., (2002) found that NPD projects that heavily relied on process resulted in lower project performance. Dictating procedures can make team members overly dependent on the process, less motivated to change, and less likely to experiment and seek new information (Bonner, 2005; Cardinal, 2001; Merchant, 1985).

Some studies have considered the relationship between process control and different types of radical and incremental innovation. For example, Benner and Tushman (2002) investigated process management (ISO 9000 quality program certifications) and patenting activities in the paint and photography industries. They found that process management activities in firms were associated with an increase of both exploitative innovation (incremental innovation built on existing firm knowledge) and explorative innovations (radical innovation) in both industries. Another study by Tatikonda (1999) showed that project management formality significantly correlated with derivative projects (extensions to an existing product family) however, there was no correlation with platform projects (new product family platforms). Based on the above literature review regarding process control and its effect on radical innovation, incremental innovation, and project efficiency, the following hypothesis was developed:

Hypothesis 3: *Process control increases innovation performance (radical innovation, incremental innovation, and project efficiency).*

2.4.5.4 Output Control and Innovation Performance

Output control is exercised to the extent that management set performance standards and evaluate results (Bonner et al., 2002). Output control regulates outcomes and results (Cardinal, 2001; Eisenhardt, 1985; Ouchi, 1977; Snell, 1992). Additionally, output control implies little monitoring and managerial direction by instead using objectives (performance goals) to measure individual performance (Krafft, 1999). The kinds of outputs/outcomes standards typically can be specified for a new product, for example, technical performance and cost parameter, revenue, market share, customer satisfaction, profit, product quality, and competitive product advantage (Bonner et al., 2002). This form of control allows project team members to choose the means to achieve the targets of projects (Snell, 1992).

Output control may encourage project team members. It provides autonomy and freedom to team members to create the methods in which to develop radical innovation products but still has some control on outputs, e.g., developing a product with new specific features. Radical innovation products developed by using state of the art technology face particularly high risks and resource consumption (Dewar and Dutton, 1986), output control provides a flexible means for team members to adjust to uncertain situations. On the other hand, incremental product innovation involves less risk and less time in development due to the application of existing technology and knowledge. Output control allows team members to adjust and change sub-components in order to meet the demands of customers. Cardinal (2001) investigated formal control mechanisms in 75 pharmaceutical firms and found that output control enhanced both drug enhancement innovation (incremental) and new drug innovation (radical). Output control led to increased performance when applied specifically to a sales team member (Fang, Evans, and Zou, 2005), but had no effect on NPD performance (Bonner et al., 2002). The mixed results regarding the effect of output control on innovation performance described above leads to hypothesize that:

Hypothesis 4: *Output control increases innovation performance (radical innovation, incremental innovation, and project efficiency).*

2.4.5.5 Comparing the Effects of Control Mechanisms on Innovation Performance

Several studies have investigated the effects of control mechanisms (monitoring progress, process control, and output control) concurrently on innovation performance. The findings of these studies reveal mixed and balanced effects on innovation performance. For example, process control is found to enhance radical innovation (Cardinal, 2001; Li et al., 2006). The study by Li et al., (2006) found that process control not only increases radical innovation but also deceases incremental innovation. Output control had a positive impact on radical innovation and incremental innovation in pharmaceutical firms (Cardinal, 2001). The same study by Li et al., (2006) found that output control increases incremental innovation but decreases radical innovation. Monitoring progress was found to increase the speed of radical innovation projects (Kessler and Chakrabarti, 1999). Another study by Lewis et al., (2002) examined six different project management styles and found that monitoring milestones had a negative impact on technical knowledge (e.g., yielding a major breakthrough) in general, but enhanced the achievement of commercial objectives in highly technical and commercially uncertain situations. Directive control (process control) was found to increase technical knowledge (e.g., yielding a major breakthrough) in general and in high technical uncertainty situations. However, Lewis et al., (2002) found that both monitoring milestones and directive control (process control) had negative effects on completing projects on time.

Due to the complexity of NPD in terms of technology and market uncertainty, previous studies suggest that control mechanisms (monitoring progress, process control and output control) might enhance innovation performance by pushing team members to focus on their tasks and time, reducing variance of unexpected future outcomes and placing emphasis on project goals to follow. From the above findings, it can be assumed that process control may have stronger effect on radical innovation than output control or monitoring progress, leading to the following hypothesis:

Hypothesis 5: *Process control has a stronger effect on innovation performance (radical innovation, incremental innovation, and project efficiency) than the other control mechanisms (output control and monitoring progress).*

2.5 Teamwork Processes

Project management mechanisms can be applied by project managers to stimulate and encourage team members in NPD projects. A NPD project composed of team members from different functions/department or different cultural backgrounds requires teamwork processes that facilitate task accomplishment through task related collaborative behaviors e.g., coordination and cooperation (Rousseau, Aube, and Savoie, 2006). Communication and coordination help a team exchange information, share knowledge, and coordinate tasks. In a team setting, members combine their diverse knowledge and experiences to create new products or new services (Leenders, van Engelen, and Kratzer, 2003).

To capture the complex nature of innovation project teamwork, Hoegl and Gemuenden (2001) conceptualized and empirically validated a teamwork quality concept composed of six facets. The six facets of teamwork quality are composed of: (1) communication; (2) coordination; (3) balance of member contributions; (4) mutual support; (5) effort; and (6) cohesion, as indicated in both task execution and social interaction within a team. This study focuses on two of the facets of teamwork quality: communication and coordination.

Communication and coordination have been shown to be important for developing NPD projects. For example, Brown and Eisenhardt (1995) revealed that communication is an essential component of the NPD processes. Frequent communication leads to clear roles, responsibilities, and cooperation of team members (Barczak and Wilemon, 2001). In addition, most innovative tasks are interrelated; therefore, task coordination enhances task accomplishment (Rousseau et al., 2006) and project performance (Gerwin and Moffat, 1997b; Souder and Moenaert, 1992).

Project management mechanisms provided by project managers may influence the communication and coordination of team members. For example, Stewart and Barrick (2000) noted that a decentralization structure within a firm (where a high level of autonomy is granted to employees) might improve communication. Control mechanisms, namely monitoring tasks, could motivate and promote coordination and communication among different parts of the development team (Eisenhardt and Tabrizi, 1995), thereby increasing innovation performance.

Most previous studies investigated the coordination and communication of team members as antecedents of innovation performance (e.g., Hoegl and Gemuenden (2001). There are few investigations, which focused on communication and coordination as mediators between project management mechanisms and innovation performance. Therefore, coordination and communication of teamwork quality are selected as mediators of the relationship between project management mechanisms and innovation performance in this study. This leads to the second conceptual framework of this study as shown in Figure 2-9. This framework explains the effects of the project management mechanisms composed of: (1) autonomy; (2) monitoring progress; (3) process control; and (4) output control on communication and coordination teamwork processes. The communication and coordination variables further affect innovation performance in radical innovation, incremental innovation, and project efficiency. The details of each teamwork process are explained below.

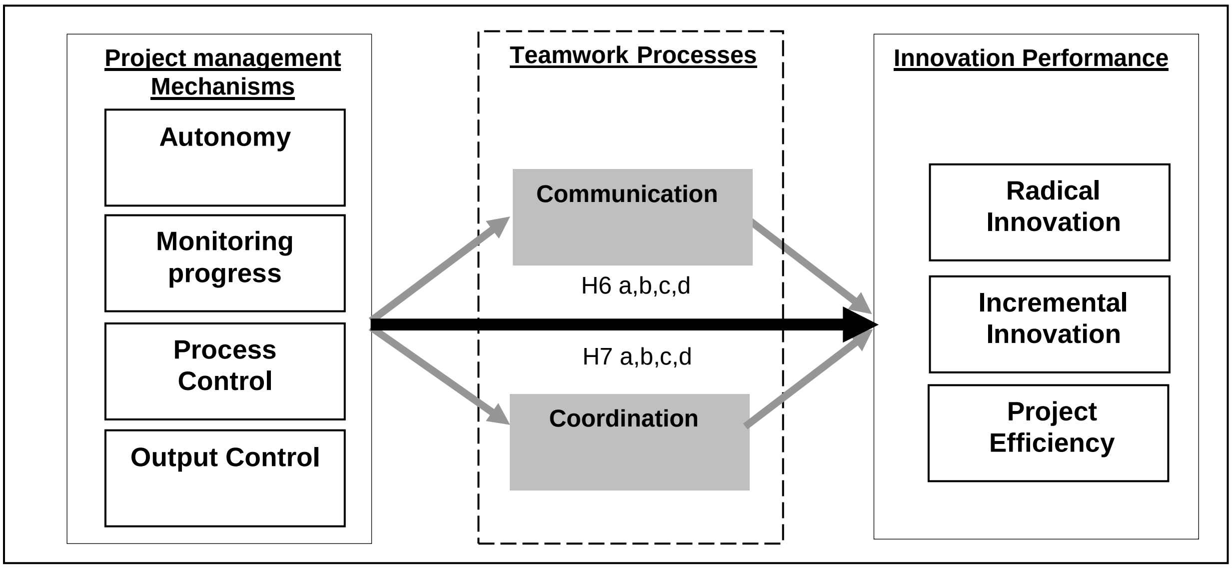


Figure 2-9: Second Conceptual Framework

2.5.1 Communication as a Mediator

According to White (1992), communication is the 'nervous system' that makes organizations and organizational units cohered, permits their members to coordinate all work, affects as well as creates the social environment, and stimulates the creative performance of employees. Nobel and Birkinshaw (1998) define communication as the exchange of information through various media including face-to-face contact, telephone, letter, and electronic mail. In cross-functional teams, communication is the vehicle through which personnel from multiple functional areas share information and therefore it is critical to the successful implementation of a project (Pinto and Pinto, 1990).

Previous studies revealed that communication is essential to innovation projects, because communication aids the dissemination of knowledge and ideas (e.g., generating new knowledge and insights) (Kratzer, Leenders, and van Engelen, 2004). Communication is also essential to the timely availability of information required by innovation team members (Leenders et al., 2003). Communication within a team promotes a better understanding of sub-task coordination as well. It has been widely investigated that communication is an essential component of the NPD process (Brown and Eisenhardt, 1995). In addition, communication between team members will maximize performance (Allen, 1977; Katz, 1982; Katz and Tushmann, 1981; Keller, 2001). Research on R&D projects suggests that intra-project communication is positively related to performance (Barczak and Wilemon, 1991; Faris, 1973; Pelz and Andrews, 1966; Rubenstein, Chakrabarti, O'Keefe, Souder, and Young, 1976). Although many studies explored communication as an antecedent of projects' success, they rarely investigate it as a mediator between project management mechanisms and innovation performance.

With respect to the relationship between ***autonomy and communication***, granting autonomy promotes communication of project team members. Empowerment granted to individual team members in decision making on their role of the project allows them to search for new information and to share new ideas and information freely with other team members. Prior scholars supported that autonomy (decentralization) encouraged open communication within groups (Stewart and Barrick, 2000). The development of complex new products can be initiated from a vague idea. The stronger the communication within a team, the more ideas are shared and the roles as well as responsibilities are clarified, leading to increased innovation performance. Therefore, autonomy enhances communication and thereby increases innovation performance of projects.

Monitoring progress and communication. Innovative project tasks are ambiguous and difficult to define. A work break down structure (WBS) and established milestones help team members to clarify and prioritize tasks. A WBS also identifies the interrelated sub-tasks, personnel, duration, and completion date for each task. When innovative tasks deviate from schedule or milestones are missed, progress monitoring by project managers allows the team to discuss how to solve problems or speed up projects. Due to complex and interrelated tasks, arising problems may force team to frequently communicate with the others to fine-tune tasks and provide feedback, which are essential to innovation project performance (Hoegl, Weinkauf, and Gemuenden, 2004). In addition, innovative projects are implemented within a limited timeframe and always face uncertainties (Gratton and Erickson, 2007). In order to complete tasks effectively, team members must search for information related to their tasks, which leads to frequent communication with the others. Therefore, monitoring progress may encourage communication among the project manager and team members. The combined effects of monitoring progress and communication lead to improved innovation performance.

With regard to ***process control and innovation performance***, predefined processes or procedures encourage communication of team members. Some scholars found that Quality Function Deployment (QFD), a type of process control, enhances communication levels and sharing of information within the core-team (Griffin and Hauser, 1992). This type of process control focuses on sequencing processes, which allow teams to bring the requirements of customers together and manage all the elements needed to define, design and deliver a product to meet or exceed customer needs (Cooper, 1990; Griffin and Hauser, 1992). Another study by Johnson, LaFrance, Meyer, Speyer, and Cox (1998) found that specific procedures had indirect effects on organizational innovativeness through communication. Process control may encourage communication among team members because standardized processes and procedures may not fit with the development of complex NPD projects. Because of this reason, project team members must communicate to make adjustments and changes to the processes and procedures to meet the complex needs of their NPD projects. Therefore, applying process control with a NPD team stimulates communication and thereby enhances innovation performance.

Output control and communication. Specific goals for individual team members may also promote communication within a team. In innovative projects, performance goals for team members may be ambiguous (e.g., developing breakthrough products) and difficult to achieve. Therefore, team members with ambiguous goals need to communicate with their project managers and team members. It is found that output control enhanced the interaction of a NPD team with its customers (Bonner, 2005). Based on prior studies of output control, it can be assumed that output control may encourage communication within a team. Team members also need to discuss with other team members as to how they should proceed with their innovative tasks in order to achieve performance goals. These circumstances push team members to communicate with each other, thereby increasing innovation performance.

Thus, considering the results of previous studies, project management mechanisms support team communication and enhance higher innovation performance. It can be assumed that communication, which is one of the teamwork quality dimensions, may be a mediator of the relationship between project management mechanisms and innovation performance. This relationship leads to a series of hypotheses as follows:

Hypothesis 6a: *Communication mediates the relationship between autonomy and innovation performance (radical innovation, incremental innovation, and project efficiency).*

Hypothesis 6b: *Communication mediates the relationship between monitoring progress and innovation performance (radical innovation, incremental innovation, and project efficiency).*

Hypothesis 6c: *Communication mediates the relationship between process control and innovation performance (radical innovation, incremental innovation, and project efficiency).*

Hypothesis 6d: *Communication mediates the relationship between output control and innovation performance (radical innovation, incremental innovation, and project efficiency).*

2.5.2 Coordination as a Mediator

According to Cannon-Bowers, Tannenbaum, Salas, and Volpe (1995) “coordination” refer to integration of team members’ activities to ensure task accomplishment within established temporal constraints. NPD project’s tasks are interdependent and complex. Coordination ensures that team members’ tasks are sequenced, synchronized, integrated, and completed within established temporal constraints without double work or wasting efforts (Cannon-Bowers et al., 1995; Rousseau et al., 2006; Spreitzer, Cohen, and Ledford, 1999). Thompson (1967) suggests that the greater the number of interdependent tasks, the greater the cooperation effort required. According to Hoegl and Gemuenden’s study (2001), coordination is the interrelatedness and current status of individual contributions depending on delegated tasks to individual members working on parallel sub tasks. They further add that team members need to agree on a common WBS, schedule, budget, and deliverables to coordinate tasks effectively and efficiently.

Prior studies revealed that coordination of team members fosters innovation and project performance. For example, a study by Ancona and Caldwell (1992) demonstrated that task coordination increased innovation of NPD teams. Another study by Hoegl, Weinkauf, and Gemuenden (2004) revealed that coordination helps increase overall team performance when interrelated innovative tasks are high. Although many studies examined coordination as an antecedent of projects’ success or team performance, they rarely investigated it as a mediator between project management mechanisms and innovation performance. The relationship between each project management mechanism and coordination is discussed below.

Regarding the relationship between ***autonomy and coordination***, granting autonomy to individual team members in making decisions may affect innovation performance indirectly by generating coordination among team members. In general, granting autonomy to project team members for decision making on their project tasks promotes individuals' motivation (Hackman and Oldham, 1976) and responsibility for outputs and outcomes of work (Kirkman and Rosen, 1997). At the same time, they realize their responsibility and commitment to accomplish their innovative tasks on time. NPD projects with technical interrelated systems and components could not be accomplished without coordinating with others. Autonomy increases authority and decision making of how to coordinate with the others to achieve technical tasks within schedule. This may push the team members to coordinate with the others to complete their assigned tasks, thereby enhancing innovation performance (McDonough, 2000).

Monitoring progress and coordination. In addition, monitoring progress of innovative tasks may promote coordination among different parts of a NPD team because of the interrelation of tasks and timeframes (Eisenhardt and Tabrizi, 1995). The complex systems and sub components of innovative tasks force team members to coordinate integrating complex tasks. Marks and Panzer (2004) revealed that computer-mediated team monitoring improves coordination and feedback processes, which in turn improves team performance (as cited in Chiocchio, 2007). Monitoring progress may push the team members to coordinate with the others to complete their assigned tasks within schedule, thereby enhancing innovation performance.

Process control (standardized processes and procedures) normally encourages ***coordination*** of team members. Pre-defined processes and monitoring of how well team members follow these processes push team members to follow procedure. Sometimes, standardized processes or specific sub-process may not be applicable to the customers' needs, customers' problems, or senior managers' requirements. For example, project managers and team members may develop new sub-components to increase more functions into a new product development according to customers' needs. Coordination among a team or between the team and customer facilitates testing whether these sub-components are compatible with the whole system and which sub-components need to be reworked (Crowston, 1997). Imai, Ikujiro, and Takeuchi (1985) found that the process management approach eases the coordination of a cross-functional team. Similarly, Pinto, Pinto and Prescott (1993) indicated that formalized rules and procedures have significant direct and/or indirect effects on project outcomes by influencing cross-functional cooperation. Based on the above discussion, process control may force team members to coordinate based on interdependent tasks, thereby increasing innovation performance.

Output control and coordination. Output control may also enhance coordination among team members through the establishment of specific performance goals. Specific goals without guidelines from project manager are not only challenge for team members but also motivate them to coordinate with the others as to how to proceed with their related tasks. This coordination helps the team to complete their tasks, thereby promoting innovation performance.

With regard to the above discussion and the results of previous studies, project management mechanisms support team coordination and enhance higher innovation performance. Hence, it can be assumed that coordination, which is one of the teamwork quality dimensions, may be a mediator of the relationship between project management mechanisms and innovation performance. This relationship leads to a series of hypotheses as follows*:*

Hypothesis 7a: *Coordination mediates the relationship between autonomy and innovation performance (radical innovation, incremental innovation, and project efficiency).*

Hypothesis 7b: *Coordination mediates the relationship between monitoring progress and innovation performance (radical innovation, incremental innovation, and project efficiency).*

Hypothesis 7c: *Coordination mediates the relationship between process control and innovation performance (radical innovation, incremental innovation, and project efficiency).*

Hypothesis 7d: *Coordination mediates the relationship between output control and innovative performance (radical innovation, incremental innovation, and project efficiency).*

2.6 Project Management Mechanisms and Cultural Dimensions

Due to increasing diversity in the workforce, a shift in the scope of the work environment from local to international markets, the increasing numbers of mergers and acquisitions between different countries, and high competition in the global market (Gibson, 1995), there has been an increase in the form of NPD project teams consisting of members with different cultural backgrounds. Additionally, many firms have been using a diverse, multi-national innovation project team for a new product development. It is claimed that this type of team may increase innovativeness (e.g., developing more alternatives to problems) and provide a better response to customers' needs due to the diverse of cultural backgrounds and geographic distribution of team members (McDonough et al., 2001). This type of team also encounters communication problems and differing working behaviors possibly due to varying cultural backgrounds of team members (Gudykunst et al., 1996). Individuals' behaviors based on their cultural backgrounds may affect the way they work together in a NPD project team. Additionally, some members of this NPD project may react differently to project management mechanisms (autonomy and control) applied by project managers.

To support this claim, Table 2-5 summarizes the studies on the impact of cultural values on different management practices. Most of these multinational research studies have examined different kinds of control at organizational levels, only a few studies have investigated project management mechanisms (autonomy and control) concurrently and their effects on innovation performance given differing cultural backgrounds of team members. However, these findings suggest that cultural values of individualism and power distance tend to relate to management practices, which are implemented by their supervisors/project managers. For example, evidence from two case studies by Shore and Cross (2005) suggest that national cultures play an important role in how team members think, behave, and how they make decisions. However, there is a little literature addressing culture's role in project management (Shore and Cross, 2005). Thus, these two cultural dimensions of Hofstede (1980), individualism and power distance, are applied in this study to demonstrate how different individual team members with their different cultural backgrounds react to given project management mechanisms. These prior findings are used to discuss how different project management mechanisms influence on different cultural backgrounds of team members in the next section.

Table 2-5: Summary of Research on the Role of Cultural Values in Different Management Practices

Authors	Values	Impact of Values	Methodology	Results
Agarwal, DeCarlo, and Vyas (1993)	▪ Low Power Distance/Individualism ▪ High Power Distance/Low Individualism	**Independent Variables:** *Job Codification*, Rule Observation (*Close supervision*), Role Ambiguity, Role Conflict, Organization commitment. **Dependent Variables:** Work Alienation	▪ **Quantitative analysis:** Regression analysis ▪ **Respondents:** 184 American and 178 Indian salespersons	▪ **Low PD/High Indiv***. :* U.S. sample reacted more negatively to organizational formalization (Rule observation)*.* ▪ **High PD/ Low Indiv.:** Indian salespersons reacted positively to organizational formalization (Rule observation).
Chow, Kato and Shield (1996)	▪ Individualism ▪ Power Distance ▪ Uncertainty ▪ Masculinity	**Variables:** ▪ Net income target ▪ Discretionary program expense targets ▪ Headcount control ▪ *Procedure control* ▪ *Directive given at meeting*	▪ **Quantitative analysis:** Analysis of variance ▪ **Respondents:** U.S. and Japanese profit center managers	▪ Japanese profit center managers were subject to tighter procedural controls and controls via directives given at meetings. ▪ Japanese managers were subject to significantly tighter controls overall than were the U.S. managers.
DeCarlo and Agarwal (1999)	▪ Low Power Distance/Individualism ▪ High Power Distance/Low Individualism	**Independent Variables:** ▪ Autonomy ▪ Management consideration **Dependent Variables:** Job satisfaction	▪ **Quantitative analysis:** Regression analysis ▪ **Respondents:** Indian, American and Austrian salespeople	▪ **High PD/ Low Indiv.:** Managerial consideration behavior had a positive influence on salespersons' job satisfaction in India, but has no influence on salespersons' job satisfaction in either the United States or Australia. ▪ **Low PD:** Autonomy had positive influence on job satisfaction of salespeople in United States, Australia and India.
Kirkman and Shapiro (1997)	▪ Power Distance ▪ Individualism ▪ Being oriented ▪ Determinism ▪ Perception of the fairness of team pay ▪ Perceived congruence of values between agent and target	**Independent Variables:** *resistance to self-management*, resistance to team, resistance to self-management working team **Dependent Variables:** Global self-management working team effectiveness	▪ **Literature review and propositions**	▪ **High PD/Low PD.** Individuals from high power distance culture will resist a high level of self-management more than individuals from low power distance cultures. ▪ **High Indiv.**: Individuals from individualistic cultures will resist teams more than individuals from collectivistic cultures.

Table 2-5: Summary of Research on the Role of Cultural Values in Different Management Practices (Continued)

Authors	Values	Impact of Values	Methodology	Results
Eylon and Au (1999)	▪ High and Low Power Distance	**Independent Variables:** ▪ Empowered (information availability, active belief and perceived responsibility) **Dependent Variables:** ▪ Job Satisfaction ▪ Job Performance	▪ Quantitative **analysis:** Analysis of ANOVA ▪ **Respondents:** 135 MBAs students	▪ Individuals from high power distance cultures did not perform well when empowered. ▪ Participants from low power distance cultures performed similarly when empowered, controlled, and disempowered.
Murphy (2003)	▪ Individualism ▪ Power Distance ▪ Uncertainty ▪ Masculinity	**Variables:** ▪ Formal rules ▪ Top-down planning process/participative planning ▪ Relative evaluation ▪ Team-based rewards	▪ **Quantitative analysis:** Analysis of variance ▪ **Respondents:** final-year or senior-level students in the business school of two universities in Mexico City and in the Los Angeles area.	▪ No differences were found in preferences for organizational formality (formal vs. informal rules and procedures) or participative planning (top-down vs. participative budgeting). ▪ American students exhibited stronger preferences for personal evaluations and individual rewards rather than team-based rewards preferred by the Mexican respondents.
Shore and Cross (2005)	▪ Individualism-Collectivism ▪ Power Distance ▪ Future Orientation ▪ Performance Orientation ▪ Human Treatment	**Variables:** ▪ Management structure and style ▪ Geographic work distribution ▪ Budgetary commitment ▪ Family and education ▪ Pay and equity	▪ **Case analysis Interview:** team members of two large science projects. Team members (Japan, USA, France, China)	▪ **Collectivists:** Research group in Japan tended to favor a strong central team, worked closely with their Home Team, and was comfortable with strong central control and clearly defined structure. ▪ **Individualists:** Research group in the U.S. tended to work more independently and preferred a decentralized structure. ▪ **High PD:** The French preferred to have top people involved. ▪ **Low PD:** The low power distance members preferred a structure that is more decentralized with greater autonomy.

To capture an overview of concept, it is important to illustrate how the basic characteristics of each project management mechanism (autonomy and control) affects innovation performance given different cultural backgrounds of team members. This study adopted and adapted the matrix table from Bouncken, Imcharoen, and Winkler (2010) to illustrate the relationships between project management mechanisms for team members identified as high and low individualism and high and low power distance as shown in Table 2-6.

Table 2-6: Relationships between PMMs and Cultural Backgrounds of Team

Cultural Values	Project Management Mechanisms (PMMs)			
	Autonomy	**Monitoring progress**	**Process Control**	**Output Control**
1. High Individualism Preferring freedom, focusing on personal goals, and task orientation	Freedom to decide how to solve problems and implement their tasks may increase innovation performance	Schedules, stages, and milestones are task and time orientation promoting innovation performance	Pre-defined processes, procedures in advance may limit individuals' creativity and innovation performance	Output control (specific performance to implement and no means) fosters innovation performance
2. Low Individualism Relationship orientation, establishment of group harmony, and focus on collective groups	Granting individual autonomy is dominated by ideas of group, thereby decreasing innovation performance	Monitoring task against milestones seems to create conflict in relationships, thereby decreasing innovation performance	Pre-defined process and monitoring procedures based on incremental improvement may encourage innovation performance	Output control with vague goals for product quality decreases innovation performance
3. High Power Distance Preferring directions/ decision from leaders, and less participation in decision making	Autonomy for individuals without supervisor's direction may discourage risk taking, decreasing of innovation performance	Sense of order and evaluation of tasks forces teams to improve innovation performance	Pre-defined process and procedures signals that senior managers care, encouraging team to take tasks and maximizing innovation performance	Output control with specific performance goals but without direction appears as abandonment to teams, thereby decreasing innovation performance
4.Low Power Distance Preferring participation in decision making	Autonomy allows open communication; sharing ideas and information promotes innovation performance	Frequent milestone monitoring allows discussion among team members maximizing innovation performance	Process control directs process and approach thereby decreasing innovation performance	Output control with specific performance goals motivates team participation, thereby encouraging innovation performance

Note: Adopted and adapted from Bouncken et al., (2010)

Both research evidence related to autonomy and control mechanisms in multinational countries (Table 2-5) and the matrix of the relationship between project management mechanisms (Table 2-6) have been developed into a third framework in this study, as shown in Figure 2-10. Each relationship is explained in further detail in the following sections.

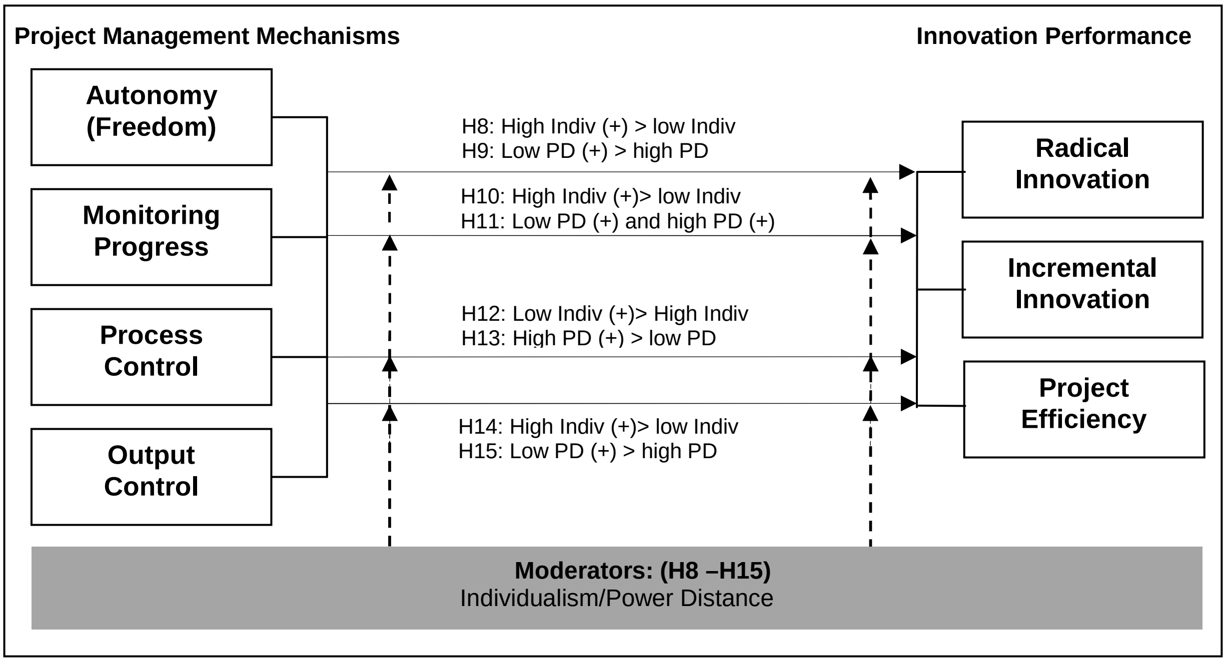


Figure 2-10: Third Conceptual Framework

2.6.1 High Individualism and Autonomy

Individualism pertains to societies in which ties between individuals are loose; everyone is expected to look after himself or herself and his or her immediate families. Collectivism pertains to societies in which people from birth onwards are integrated into strong, cohesive in-group, which throughout their lifetime continues to protect them in exchange for unquestioning loyalty (Hofstede, 1997, p.51). Based on this concept, individualists prefer to act as individuals rather than members of a group. Individualists develop a great sense of autonomy and personal achievement. On the other hand, collectivists are more likely to be influenced by their group and focus on group goals more than personal goals.

In general, autonomy tends to improve radical innovation (Amabile, 1988) due to the freedom provided to project team members to solve technical problems and proceed with their innovative tasks. Autonomy granted to team members also speeds up the development of NPD projects (McDonough and Barczak, 1991) and enhances NPD success (Tatikonda and Rosenthal, 2000). When autonomy is applied to individualist team members, who value freedom, independence and personal achievement, it may serve the interests of individualists well in developing new products. These characteristics impact individual creativity and have strong impact on innovation, especially breakthrough innovation (Ambos and Schlegelmilch, 2008; Jones and David, 2000). Therefore, individualist team members may prefer autonomy because it enables them freedom to create ideas, and make their own decisions in solving the technical problems of project (McDonough and Barczak, 1991), or developing customized products for customers.

On the other hand, low individualist (collectivist) team members are dominated by the group's decisions when a large numbers of people are involved (Kopp, 2000; Proctor, Hua Tan, and Fuse, 2004). Furthermore, individual aspiration and initiation are less important than the ideas of groups (Jones and David, 2000). When autonomy is applied to collectivists, it may not encourage them in either developing radical innovation or incremental innovation products. Collectivists may prefer group decision making to support the development of radical and incremental innovation products rather than granting autonomy. This argument is supported by Nakata and Sivakuma (1996) in that in order to develop innovation (both incremental and radical innovation) in the highly collectivist Japanese culture, there is a focus on teamwork and a search for consensus. If autonomy is granted to collectivist team members, it may be ignored and the team may seek other members' opinions or depend on the team's decisions. This may be an obstacle for generating new ideas and lead to lower innovation performance. This was shown in the study by Kim and Lee (1995) who found that autonomy negatively affected the performance of a R&D project team in Korea except in terms of high change orientation (e.g., encouraging risk taking) and high work pressure.

Based upon these above reasons and argument, autonomy may support individualists in achieving their personal goals and the NPD's goals, enhancing innovation performance rather than collectivists. A hypothesis is formed as follows:

Hypothesis 8: *Autonomy is likely to increase innovation performance (radical innovation, incremental innovation, and project efficiency) for high individualists rather than low individualists (collectivists).*

2.6.2 Power Distance and Autonomy

People from high power distance cultures tend to accept unequal power in their society, whereas people from low power distance cultures desire equal rights in their society.

These different perceptions of power may cause people to react differently if granted autonomy by project managers when working on innovation projects.

High power distance team members tend to depend on their supervisor for direction (Hofstede and Bond, 1988) and participate less in making decisions (Newman and Nollen, 1996). They prefer to have project manager closely supervise or give them direction. Close supervision builds confidence in subordinates that their tasks will be completely successfully (Aycan, Kanungo, and Sinha, 1999). This was observed in a study by Eylon and Au (1999) who found that empowerment is associated with lower job performance for high power distance MBA students. Autonomy without direction from project managers may hamper radical innovation for high power distance team members (Shane, 1992). Even high power distance team members are experts in their fields, but they still require project managers to guild them to integrate their complex tasks together when developing radical or incremental innovation products. It may be because high power distance people are used to be under control and they feel comfortable with centralized structure. Consequently, providing autonomy without direction for high power distance team members may decrease performance and efficiency in the development of radical or incremental innovation products, and achieving project efficiency.

In contrast, in low power distance societies, people are likely to frequently ignore their manager(s) in order to get their work done (Adler, 1997; Kirkman and Shapiro, 1997). They are more comfortable in accepting higher levels of responsibility and autonomy (Adler, 1997; Kirkman and Rosen, 1997). Several studies have found that people from low power distance countries tend to correlate to higher innovation. For example, Kedia, Keller, and Julian (1992) revealed that people from low power distance cultures generally had greater R&D productivity. Shane (1992) also found that people in low power distance societies tend to invent more than the others based on the number of patents issued. Based on the above evidence, providing autonomy for low power distance team members may promote innovation performance as previously mentioned. This hypothesis can be formulated as follows:

Hypothesis 9: *Autonomy is likely to increase innovation performance (in radical innovation, incremental innovation, and project efficiency) for low power distance members rather than high power distance members.*

2.6.3 Individualism and Monitoring Progress

Monitoring progress refers to focusing on tasks and schedule and the use of milestones to control innovation projects, specifically to reduce risks due to unexpected situations and to increase project efficiency and innovativeness in terms of technical knowledge (Lewis et al., 2002). It also speeds radical innovation projects (Kessler and Chakrabarti, 1999) and can shorten product development time (Eisenhardt and Tabrizi, 1995).

When monitoring progress is applied to high individualist team members who are task orientated and concerned about their personal interests and individual achievement rather than the good of organization, it encourages them to focus on tasks and schedule of a NPD project (Case and Young, 2002; Jones and David, 2000; Panina and Aiello, 2005). Due to their specific characteristics, monitoring progress may be suitable for individualists in providing some sense of achievement when their sub-tasks are completed on schedule (Eisenhardt and Tabrizi, 1995).

On the other hand, collectivism team members prefer building relationships among the team to complete tasks. Monitoring progress using a task-and time-oriented approach may not support them in building relationships, however it compels them to focus on tasks and schedules. Additionally, monitoring progress of tasks requires face to face discussion and may lead to conflict, thereby reducing social harmony among team members. Chen, Chen and Meindl (1998) revealed that Asian employees in collectivist's societies, such as Japan, tend to prefer a manager who monitors tasks and extends this care for his/her team member's personal matters. Therefore, monitoring progress may not be appropriate for collectivist team members. The effect of monitoring progress may provide different consequences for individualist team members who are individually orientated and encouraged by their self-achievement.

Thus monitoring progress may support individualists in achieving the goals of the project, enhancing innovativeness, and performance. Thus, it leads to hypothesize that:

Hypothesis 10: *Monitoring progress is likely to increase innovation performance (radical innovation, incremental innovation, and project efficiency) for high individualist team members rather than low individualist team members.*

2.6.4 Power Distance and Monitoring progress

People in high power-distance societies are willing to accept authority and their lower status (Adler, 1991). Hofstede (1980) explained that power distance is the extent to which a subordinate expects to be told what to do (Hofstede, 1997). High power distance people prefer to inform and consult their project managers about innovative activities and receive support before implementing the innovative tasks (Shane, Venkataraman, and MacMillan, 1994). Moreover, power distance team members give decision-making power and control to project managers (Gomez-Mejia et al., 1998) and prefer to follow their orders. Frequent monitoring of NPD projects makes high power distance team members anxious about the monitored results (e.g., poor test results), but creates a feeling of security. Because project manager knows what is going on, problems are discussed, and the team can response to their project managers' suggestions (order) quickly about test results or technical problems. Because of these characteristics of power distance members including monitoring progress’s activities, it may improve radical innovation, incremental innovation products, and project efficiency for high power distance team members.

In contrast, in low power distance societies, relationships between managers and subordinates are based on consultation (Hofstede, 1991). Characteristically, low power distance people tend to share information and participate in decision making (Newman and Nollen, 1996). Monitoring progress, which give a sense of participation and discussion, becomes a tool for low power distance team members to discuss and share ideas about how to proceed on innovative tasks, or how to solve technical problems. In addition, achieving milestones may provide a sense of accomplishment (Eisenhardt and Tabrizi, 1995) for low power distance members. Thus, monitoring progress can be a motivational tool to enable low power distance team members to achieve their individual goals. This may encourage successful performance on radical and incremental innovation projects, and project efficiency.

Despite the differences between high and low power distance people, monitoring progress may encourage both high and low power distance team members. As previously mentioned, it is expected that monitoring progress by project managers may be an acceleration tool for innovation performance for high and low power distance team members. Therefore, it is hypothesized that:

***Hypothesis 11**: Monitoring progress is likely to increase innovation performance (radical innovation, incremental innovation, and project efficiency) for both high and low power distance members.*

2.6.5 Individualism and Process Control

Process control is implemented in high technology firms. Generally, the process control concept, for example, the stage-gate process, is a method used to manage the NPD process to increase the probability of a new product success (Cooper and Kleinschmidt, 1991). Previous studies have shown that process control improved both radical and incremental innovation (Benner and Tushman, 2003) but decreased NPD project performance (Bonner et al., 2002). When process control is applied to high individualists, who prefer freedom and self-achievement, it may be perceived as a reduction in autonomy and an increase in direct control. Highly individualistic team members with a preference for autonomy may not prefer this kind of control because a specific process is dictated to them. This argument is partially supported by Forrester (2000) who found that in American firms (an individualist society), innovations are conducted without adherence to formal process, while in Japanese firms (a collectivism society), innovations are developed using predefined processes. Similarly, managers in western countries value their experience more than rules and procedures (Smith, Peterson, and Wang, 1996).

On the contrary, low individualist (collectivist) team members, who prefer group decision-making, may appreciate this kind of control because it provides a guideline and a sense of consensus with regard to project goals. At the same time it provides a sense of the supervisor's concern, level of care, and support (Atuahene-Gima and Li, 2002); sentiments which are highly valued in collectivist countries. Process control may reduce risks from unexpected outcomes, and avoids task related conflicts with others team members (Atuahene-Gima and Li, 2002). In addition, process control requires the attention of project managers and senior managers during every stage of the NPD project. A study of innovation projects in Japan (a collectivist society) by Herbig and Palumbo (1996) found that Japanese firms focused on process innovation to improve new products with new applications, reduce time to market (speed), and reduce costs. Consequently, it could be assumed that process control would increase innovation performance for low individualists. Based on the above literature, it may be hypothesized that:

Hypotheses 12: *Process control is likely to increase innovation performance (radical innovation, incremental innovation, and project efficiency) for low individualist team members rather than high individualist team members.*

2.6.6 Power Distance and Process Control

People in high power distance societies accept that the power in institutions is unequally distributed, and depend on their managers to lead their innovative projects (Adler, 1997; Kirkman and Shapiro, 1997). Process control, which provides written guidelines and monitoring following these guidelines of team, may be suitable for high power distance team members because senior managers and project managers pay close attention to. Process control also sends a sign of concern, care, and support to team members who are developing new products (Atuahene-Gima and Li, 2002). Evidence revealed that process control is positively associated with radical innovation in Chinese (high power distance country) technology firms (Li et al., 2006). Similarly, a study by Agarwal, DeCarlo and Vyas (1993) revealed that Indian sales people (high power distance) reacted positively to organizational formalization, whereas American sales people (low power distance) reacted negatively to organizational formalization. Thus, if provided with process control (guidelines and structure), high power distance team members will be enthusiastic to take risks and responsibilities for developing radical innovation and incremental innovation products, thereby promoting innovation performance.

In contrast, people in low power distance societies expect their project leaders to consult with them and to discuss related tasks (Begley, Lee, Fang, and Li, 2002; Lam et al., 2002). Elenkov (1998) found that leadership in the United States, a low power distance country, promoted subordinates' participation in managers' decisions. Process control, which emphasizes the process and monitors whether team members follow the specified process, may not fit with low power distance members’ preferences because this approach directs the way they must complete their tasks therefor limiting participation in decision making. Hence, high power distance people tend to accept process control more than low power distance people. Based upon the above related literature, the following hypothesis was developed:

Hypothesis 13: *Process control is likely to increase innovation performance (radical innovation, incremental innovation, and project efficiency) for high power distance team members than for low power distance team members.*

2.6.7 Individualism and Output Control

In literature review, output control implemented by project managers emphasis on results when monitoring, evaluating and rewarding (Anderson and Oliver, 1987) and tends to give autonomy to team members without specifying means/processes to achieve the expected results. Several studies revealed that output control increased new drug innovation and drug enhancement innovation in the pharmaceutical industry in the United States (Cardinal, 2001) and influences job performance in strategic business units (SBUs) (Jaworski, Stathakopoulos, and Krishnan, 1993). When output control is employed to individualists, who value autonomy and prefer to work individually to achieve their personal goals, they are allowed to determine their own methods in developing innovation products. Application of output control, which is a “hands off” approach, may motivate individualists to create alternative solutions for new products (Atuahene-Gima and Li, 2002). However, output control requires a crystallized standard of desirable performance and clear performance goals at an early stage of NPD projects (Bonner et al., 2002; Snell, 1992). This is supported by Fang, Evans, and Zou (2005) who revealed that highly specific output control increased the performance of American sales persons who are individualists. Hence, it is assumed that output control with clear and specific performance goals would increase radical innovation, incremental innovation, and project efficiency for individualist team members.

On the other hand, when output control is employed to collectivist team members who value group goals and team members' decisions, they will ignore the autonomy of output control in determining their own methods and search for an agreement and opinions among team members to fulfill their tasks. Collectivists do not only require the team’s opinion to implement their innovation tasks, but also desire their supervisors to show concern for them by telling how to do their tasks (Atuahene-Gima and Li, 2002). Implementing specified goals of output control may be ambiguous and difficult for the team to implement. Without support of a project manager during project execution, output control may not result in the achievement of innovation performance for collectivist team members.

Therefore, with the above arguments, output control implemented by project managers allows high individualist team members to manage their own innovative tasks. For individualist team members, the higher the use of output control, the greater the project performance. It can be hypothesized that:

Hypothesis 14: *Output control is likely to increase innovation performance (radical innovation, incremental innovation, and project efficiency) for high individualist team members rather than low individualist team members.*

2.6.8 Power distance and Output Control

Output control employed by project managers can imply that there are no means/procedures/guidelines on how to achieve a project objective, thereby providing some autonomy. Output control provides team members with the freedom to create and select their own means of implementation; however, they need to be responsible for the project's outputs such as technical specifications for a new product. Normally, it is difficult to predict the outcomes of a NPD project, therefore output control used as a performance measurement, can cause high risk for high power distance team members. The reason is that they have to decide on their own on the method to implement and are responsible for achieved or unachieved outcomes. In addition, outputs/outcomes of project may be affected by environmental and firm' factors beyond their control (Atuahene-Gima and Li, 2002; Oliver and Anderson, 1994). Therefore, high power distance team members may feel unsecure. Including selecting their own methods to implement without any participation from their supervisor, this may increase their insecurity because they are used to a hierarchy in the organization, where senior managers are the decision makers (Sagie and Koslowsky, 2000). Thus, it is expected that output control applied to high power distance team members may decrease their innovation performance.

On the other hand, people in low power distance societies assume that the status between project managers and team members is equal. As such they believe they have an equal right to participate in decisions that concern them (Sagie and Aycan, 2003). Output control seems to fit low power distance team members well, as they are self-determined and prefer having some control over the achievement of tasks' outcomes (Lam et al., 2002). Output control implemented by project managers allows low power distance team members to manage their innovative tasks on their own. In accordance with the above arguments, it can be hypothesized that:

Hypothesis 15: Output control is likely to increase innovation performance (radical innovation, incremental innovation, and project efficiency for low power distance members rather than high power distance members.

2.7 Summary of this Chapter

This conceptual framework is developed from a literature review of NPD project management/ project styles/project control e.g., Lewis et al., (2002), Bonner et al., (2002), Cardinal (2001), Tatikonda and Rosenthal (2000), which have direct influence on innovation performance. This relationship is assumed to be mediated by communication and coordination of teamwork processes. Furthermore, this relationship is assumed to have different effects on innovation performance based on team members' cultural backgrounds as illustrated in Figure 2-11. The relationship between 11 constructs can be divided into three parts of the conceptual framework as described below.

First, ***innovation performance*** is described according to project managers' and team members' perception of various aspects. Innovation performance is composed of radical innovation, incremental, and project efficiency. Radical innovation and incremental innovation indicate different levels of newness of products, which depends on the newness of the technology used in developing the product and provides many new features to customers. Project efficiency indicates how well these development projects are managed (within time, budget, and specific performance).

Second, the four ***project management mechanisms*** investigated include autonomy, monitoring progress, process control, and output control. These mechanisms demonstrate the different levels of project management ranging from high level of granting autonomy to low level of granting autonomy (control). Each of these managerial controls may have a different effect on innovation performance.

Third, the ***teamwork processes*** investigated include communication and coordination. Generally, communication and coordination facilitate teamwork and innovation performance. It is assumed that project management mechanisms (both autonomy and control) employed by project managers could foster communication or coordination in teamwork processes, thereby increasing innovation performance. Therefore, communication and coordination are expected to be mediators between the four project management mechanisms and innovation performance.

Fourth, in order to measure the effects of project management mechanisms on innovation performance given different groups of team members, cultural values of the members in terms of ***Individualism and Power Distance*** are employed in this study. It can be assumed that the different cultural backgrounds of team members will cause them to react differently to project management mechanisms applied by project managers as shown in Figure 2-11.

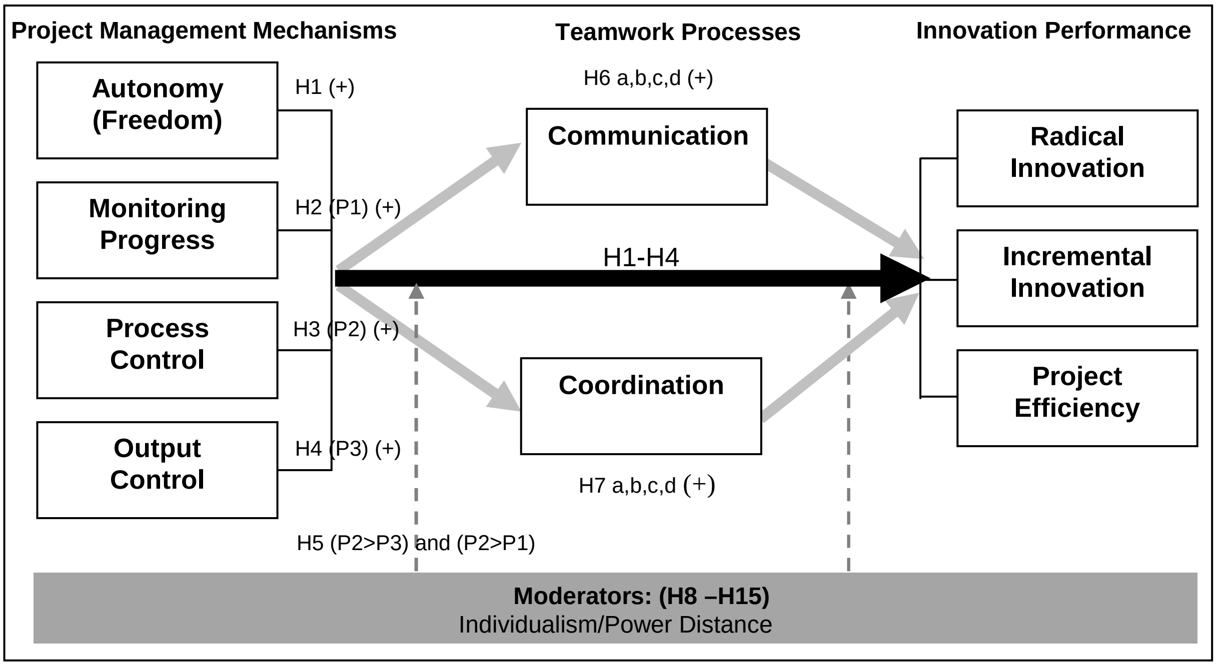


Figure 2-11: Overall Conceptual Framework

Chapter 3: Methodology

This chapter describes sample and data collection, the research instrument, measurement development, and pre-test. It also includes a description of the statistical analysis to be used in this study.

3.1 Sample

The population in this study included project managers and team members who work on the development of innovation projects (e.g., developing high radical innovation products or low radical innovation products for customers) for international high technology companies. In actual work environments, it is difficult to find such a population. Therefore, this study used the purposive selecting method to find representative participants for this study by drawing the representatives from high-tech firms. High–tech industries, namely foods, electronics, semiconductor, and software, were selected because these industries often form project teams to develop new products.

3.2 Questionnaire and Measurement Development

In order to collect data, a questionnaire was developed from relevant literature. The questionnaire included several constructs to be measured including project management mechanisms, teamwork processes, and innovation performance. The questionnaire was designed based on the Likert-scale ranking from 'strongly disagree' (1) to 'strongly agree' (5).

3.2.1 Predictor Variables

In this study, project management mechanisms and teamwork processes are the independent variables. The four project management mechanisms adopted from Lewis et al., (2002) and Bonner et al., (2002) include autonomy, monitoring progress, process control, and output control. The two teamwork processes adopted from Hoegl and Gemuenden (2001) include communication and coordination. These mechanisms are discussed below.

Autonomy reflects the delegation of decision-making and problem solving to team members by the project manager (McDonough and Barczak, 1991). Autonomy was measured from three items adopted from McDonough and Barczak (1991). Under the autonomy construct, the three items that were measured are: “I have freedom to explore, discuss, and challenge ideas on my own”, “I have freedom to make my own decisions about what problems need to be solved”, and “I have freedom to run my part of project”.

Monitoring Progress is assessed based on frequent monitoring according to NPD project milestones and schedule (Lewis et al., 2002). This construct was measured using with three items adopted from Lewis et al., (2002). Under the monitoring progress construct, the three items that were measured are: “To what degree is reaching milestones controlled in the project?”, “To what degree is tracking process about being on schedule implemented in the project?”, and “To what degree is progress about "hard data" (e. g., test results) controlled in the project”.

Process control refers to setting procedures used to perform the tasks, and monitoring how well they follow specific innovation processes (Bonner et al., 2002; Jaworski and Kohli, 1993). This construct was measured with three items adopted from Bonner et al., (2002). Under the process control construct, the three items that were measured are: “Management monitors the extent to which I follow established procedures”, “Management evaluates the procedures I use to accomplish a given task“, and “Management modifies my procedures when desired results are not obtained.”

Output control indicates the degree to which managers set specific outcome goals for NPD team members, quality standards, and specific goals for NPD team members. This construct was measured using three items adapted from (Bonner et al., 2002). Under the output control construct, the three items that were measured are: “Specific performance goals are established for my job”, “Management monitors the extent to which I attain my performance goals.”, and “I receive feedback from management concerning the extent to which I achieve my goals”.

Coordination reflects the degree of common understanding regarding the interrelatedness and current status of individual contributions under sub-tasks (Hoegl and Gemuenden, 2001). This construct was measured with three items adapted from Hoegl and Gemuenden (2001). Under the coordination construct, the three items that were measured are: “The work done on subtasks is closely harmonized”, “There are clear and fully comprehended goals for subtasks within our team”, and “The goals for subtasks are accepted by the team members”.

Communication refers to the exchange of information among team members based on mutual support. This construct was measured with three items adapted from Hoegl and

Gemuenden (2001) Under the communication construct, the three items that were measured are: “Discussions and controversies are conducted constructively in the team”, “Suggestions and contributions of team members are respected in the team”, and “Suggestions and contributions of team members are discussed and further developed”.

3.2.2 Dependent Variables: Innovation Performance

This study utilizes multiple perspectives of innovation performance as judged by project managers and team members of NPD projects. This innovation performance measured in terms of radical innovation, incremental innovation and project efficiency are discussed below.

Radical Innovation refers to the degree to which the product of the NPD project is developed on based new technology, offers superior features to customers, and creates a new product for the market. This construct was measured with four items adapted from Lee and O’Connor (2003) and Song and Parry (1997). Under the radical innovation construct, the four items that were measured are: “Product/service/software features were novel/unique to customers”, “This product/software/service introduced many completely new features for product/software/service into the market”, “This product/software/service was highly innovative/totally new to the market”, and “The product/software/service from this project relied on technology never used in the industry before”.

Incremental Innovation reflects the development of a product built on existing knowledge and technology to present an updated version of the product, and/or improve the product’s existing performance. This construct was measured with three items adapted from Lee and O’Connor (2003) and Gatignon, Tushman, Smith, and Anderson (2002). Under the incremental innovation construct, the three items that were measured are: “This product/software/service was an updated version of existing products/services/ software solutions”, “The product/software/service was redeveloped to improve performance of existing products/service/SW.”, and “This product/software/service was customized based on existing knowledge and technology within firms”.

Project Efficiency represents the degree to which efficiency and effectiveness was achieved in tasks in the development project. This construct was measured with three items adapted from Hoegl and Gemuenden (2001). Under the project efficiency construct, the three items that were measured are: “This project was within schedule”, “This project was within budget” and “This project required little rework.

3.2.3 Moderating Variables

Individualism considers an individual's preference with the degree to which individuals are integrated into groups. The ties between individuals are loose in individualistic societies, the emphasis is on individual' goals, and individual achievement is higher. This construct was measured with four items adapted from Triandis, McCusker and Hui (1990), and Shulruf, Hattie and Dixon (2003). Under the individualism construct, the three items that were measured are: "I do work better alone than in groups", "I prefer to be self-reliant rather than depend on others", and "It is important to me that I perform better than others on a task".

Power Distance refers to an individual's preference related to an unequal distribution or power between supervisors and subordinates in the work place. This construct was measured with three items adapted from Maznevski, Gomez, DiStefano, Noorderhaven, and Wu (2002), Adler (2002), and Shulfruf et al., (2003). Under this construct, the three items that were measured are: "Lower levels in the hierarchy should carry out the requests of senior people without question", "The supervisor is always right because he or she is the boss" and "You should be quiet when you don't agree with your boss".

3.3 Pre–test

As this is a cross-cultural study, all respondents need to understand the meaning of the constructs and associated measurement questions. Hence the questionnaire was pretested in two stages. First, some parts of questionnaire (e.g., related to culture values) were tested using MBA students from four countries: Thailand, Poland, Germany and Syria, to obtain feedback on clarity and appropriateness of questions. The questions asked about their behaviour related to cultural values. Based on the first stage, some items of cultural constructs were modified to ensure respondents could understand the questions and choose appropriate answer. Some items were dropped from the questionnaire. Furthermore, statistical methods, such as Cronbach-Alpha and factor analysis, were used to analyze the data and to select the best and most reliable items for this study. All constructs were then put into a questionnaire was pre-tested again (second stage) before final data collection using several groups of project managers and team members. The tests were conducted in Thailand and Germany. After the second pre-test, the questionnaire with some minor changes, such as wording and the addition of some information, was completed and carried out. The final questionnaire is presented in Appendix 1.

3.4 Data Collection

To collect the data across nations, the original questionnaire was developed in English and distributed to willing participants (project managers and team members). While almost all of respondents were surveyed in English, the questionnaire was also translated into German and Thai by native speakers under the principle of blind translated-back-translation procedures (e.g. from English to Thai/German, and from Thai/German to English) as suggested by Brislin (1980).

The questionnaire was administered through two channels. First, by directly contacting targeted firms, some of these firms were chosen based on personal connections at senior management level, which enabled relatively easy access to participants for data collection. At these firms, upper level managers requested that their project managers and team members to participate in this study. Through this channel, 235 completed questionnaires were received out of 420 distributed.

Second, participants were identified by selecting specific firms from (1) SoftGuild; (2) Software Park Thailand and (3) CEBIT and Electronika exhibition databases in Thailand and Germany. SoftGuild is the most visited online market overview for commercial software solutions in Germany. Software Park Thailand provided a database of software firms in Thailand. CEBIT and Electronika exhibition databases provided a complete list of firms for IT, components, systems, and applications in Germany. These firms were contacted via phone and asked whether they were project-based. If so, projects managers and team members from these firms were invited to participate in this study via email. Some of the project managers and team members were asked to participate in this study during conferences and exhibitions. This questionnaire was distributed by email to reduce costs, to widely reach the target respondents, and to provide a fast turnaround time (Klassen and Jacobs, 2001). The questionnaire was distributed to 600 project managers and team members, and 206 completed questionnaires were received. The response rate was 34.33%.

In summary, combining the two sources, 441 questionnaires were received, however there were only 434 completed questionnaires.

3.5 Statistical Analysis

Data were analysed using the Statistical Package for the Social Sciences (SPSS) program. Descriptive statistics (e.g. frequency, percentage, mean, standard deviation) were generated and used to describe and explain the general characteristics of respondents. In addition, inferential statistics (SEM) by AMOS 16 was used to analyze the relationships and test the hypotheses.

Chapter 4: Analysis and Results

This chapter presents data analyzed by using both the Statistical Package for the Social Sciences (SPSS) program and the Structure Equation Model (SEM) via AMOS 16. First, the SEM approach, measurement model, and criteria of assessment measurement model will be described. Second, the results of the assessment model will be presented. Then, descriptive statistics (e.g., frequency, percentage, mean, standard deviation) will be analyzed to explain the general characteristics of members. In addition, the relationship among all constructs in this study is calculated. Finally, the results of testing all hypotheses, including direct effects, mediation effects of communication and coordination, and moderator effects of individualism and power distance will be presented.

4.1 Basic Concept of Structure Equation Model (SEM)

Prior to hypotheses testing, both the SPSS program and Structure Equation Model (SEM) by AMOS16 software (Arbuckle, 2007) were used to test the measurement models and then to estimate the Structure Equation Model (SEM). Figure 4-1 illustrates the measurement models and structural model graphically with Greek notation by Backhaus et al., (2006). The basic concept of ***structural model*** describes the relationships among the latent constructs. In graphical terms, a structural equation model includes two types of latent constructs, which are exogenous and endogenous. An exogenous (Independent) construct is indicated by the Greek character “ksi” (ξ). An endogenous (Dependent) construct is indicated by the Greek character “eta” (η). In the structural model, Byrne (2001) further explains the relationship between exogenous constructs and endogenous constructs as a causal relationship. The exogenous constructs cause fluctuations in the values of other latent variables. The endogenous constructs are influenced directly or indirectly by exogenous constructs in the model as shown in the grey area of Figure 4-1.

In the ***measurement model,*** each of the latent constructs (factors) is associated with multiple measures (items/variables). These measures are linked to constructs via a term called “loading” which is labeled with the Greek character "lambda" (λ) as shown on the left and right side of Figure 4-1. SEM users typically recognize that their measures are imperfect. For this reason, terms representing measurement error are included. The measurement error terms associated with X measures are labeled with the Greek character "delta" (δ) while terms associated with Y measures are labeled with "epsilon" (ε)[1].

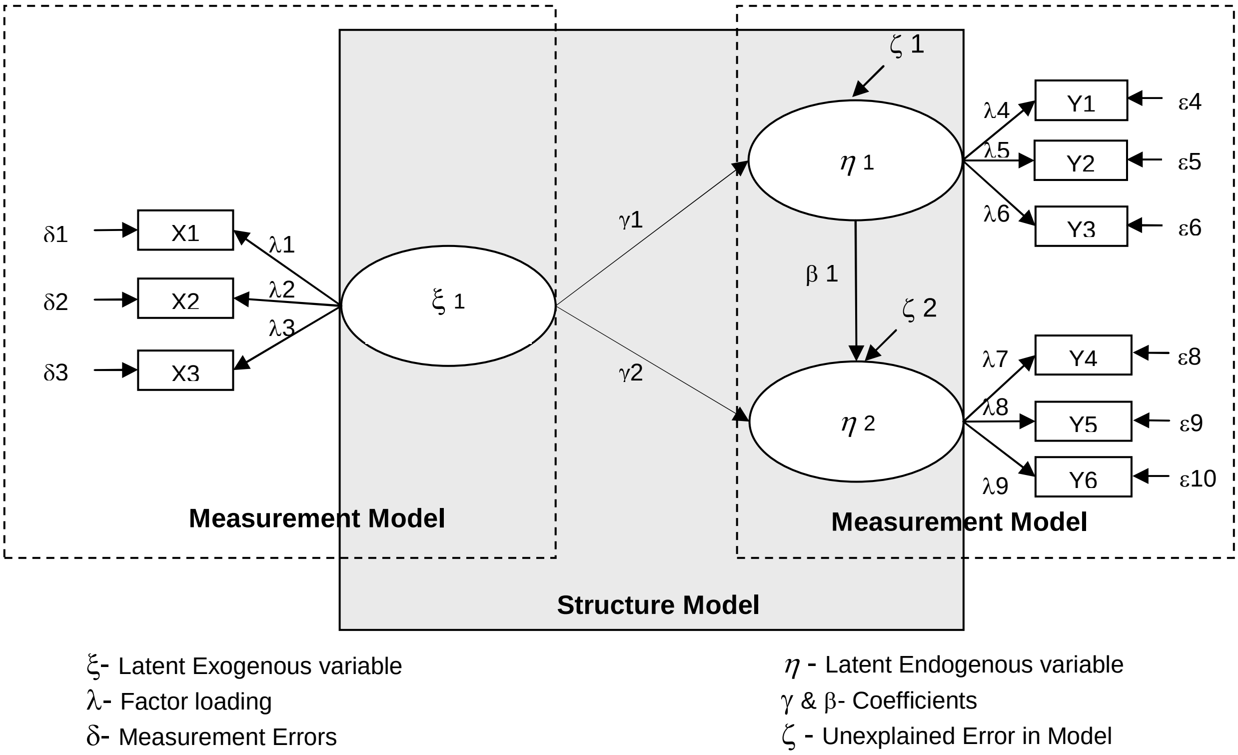


Figure 4-1: Structure Equation Model (Backhaus et al., 2006)

The SEM method is utilized in this study because it allows researchers to, first, research the relationships among the latent constructs, and observed variables, second, test hypotheses, and third, estimate the overall fit of the hypothesized model to the data. SEM has the advantage of a structure model, which provides an accurate picture of the relationship among those constructs. Moreover, SEM is considered to be a useful analytical tool in cross-cultural research (Seror, 1988). It has been previously used in a study assessing measurement equivalence across groups (Drasgow and Kansfer, 1985; Mullen, 1995).

4.1.1 SEM Approach and Measurement Model

To test the hypotheses, a measurement model (baseline model) was established based on theories as shown on the left side and right side of Figure 4-3. This baseline measurement model must be tested to determine whether the model fits with the data and provides adequate validity and reliability of measurements within constructs

[1] http://www.gsu.edu/~mkteer/sem2.html

(Hulland, 1999). Therefore, two steps of testing were conducted based on the methods proposed by Byrne (2001). The first step was to determine if the overall fit (global fit) of the model and data is satisfactory. The second step was to test the validity and reliability of measurements within the constructs to assess the adequacy of the local fit. Criteria used to measure both global fit and local fit indices are explained in the following sections.

4.1.1.1 Global Fit Indices

In order to measure the fit of the structural model and data (Global Fit), a baseline model or measurement model was created, which represents a best fit model of the sample data (Byrne, 2001). This baseline model was established using maximum likelihood (ML) procedure to exhibit the least bias with missing values included (Byrne, 2001). The fit indices ascertain if the covariance matrix derived using the hypothesized model is different from the sample, but these indices have some limitations (Shook, Ketchen, Hult, and Kacmar, 2004). For example, chi-square test, the most common fit measure but it is sensitive with large sample. Therefore, Shook, Ketchen et al., (2004) suggest that researchers should use multiple indices to provide support for their models. With SEM by AMOS 16, a commonly used model fit criteria which are widely used, is a relative chi-square, incremental fit index, and RMSEA as suggested by Byrne (2001) and Hair, Black, Babin, Anderson, and Tatham (2006). These global fit indices are briefly described below.

A. Relative Chi-square

A chi-square in AMOS program is called CMIN. CMIN is a Chi-square statistic comparing the tested model and the independence model with the saturated model. CMIN/DF, the relative chi-square, is an index of how much the fit of the data to the model has been reduced by dropping one or more paths. One rule of thumb is to drop paths if this index exceeds 2 or 3[2]. Several writers have suggested the use of this ratio as a measure of fit (Arbuckle, 2007). In addition, a relative chi-square value is the common fit measure (Shook et al., 2004). Various rules of thumb of CMIN/DF ranking from 2 to 5 have been suggested as cut-offs (e.g., Byrne, 1989). A CMIN/DF value near 2 is considered to be an adequate fit (Arbuckle and Wothke, 2003).

B. Root-Mean Square Error of Approximation (RMSEA)

[2] http://core.ecu.edu/psyc/wuenschk/

Root mean square error of approximation (RMSEA) takes into account the error of approximation in the population and asks the question "how well would the model, with unknown but optimally chosen parameter values, fit population covariance matrix if it were available" (Browne and Cudeck, 1993, p.137-138). Browne and Cudeck (1993) further suggest that values less than 0.05 indicate good fit and values as high as 0.08 represent reasonable error of approximation in the population.

C. Incremental Fit Index

The ***Normed Fit Index (NFI)*** is one of the original incremental fit indices. NFI represents the point at which the model being evaluated falls on the scale from a null model to a perfect fit (Bentler and Bonett, 1980). It is a ratio of the difference in the X^2 value the fitted model and a null model divided by the X^2 value for the null model. It ranges between 0 and 1. The perfect fit would produce an NFI of 1 (Hair et al., 2006).

Comparative Fit Index (CFI) is an incremental fit index that is an improved version of the normed fit index (NFI). CFI has an advantage over other fit indices in that it avoids the underestimation of fit in a small sample (Bentler, 1990). CFI tests how well a proposed model fits relative to the alternative baseline model (Hair et al., 2006). CFI ranges from zero to 1.00 and is derived from the comparison of the hypothesized model with the independent model. A CFI value of over 0.90 is desirable and indicates an acceptable fit of the model to the data (Bentler, 1990).

Tucker-Lewis Index (TLI) is the Tucker-Lewis coefficient. It is also called the Bentler-Bonett non-normed fit index (NNFI). TLI is not guaranteed to vary from 0 to 1. Thus, a model with a good fit will have a value that approaches 1 and a model with a higher value suggests a better fit than a model with a lower value.

In terms of incremental fit indices, this study utilizes CFI more than NFI or TLI. It is because NFI tends to decrease when the sample size is small (Bentler and Bonett, 1980; Hu and Bentler, 1999). CFI is better fit with small sample size. Additionally, in practice, the TLI and CFI generally provide very similar values (Hair et al., 2006).

4.1.1.2 Local Fit Indices

Local fit indices indicate the validity and reliability of the measurement model. In order to see whether the local goodness of fit of the measurement model is adequate, three indices must be considered including: (1) individual item reliability; (2) the convergent validity of the measures linked with individual constructs; and (3) discriminant validity (Hulland, 1999) as shown in Figure 4-2. These local fit indices are briefly described in the following sections.

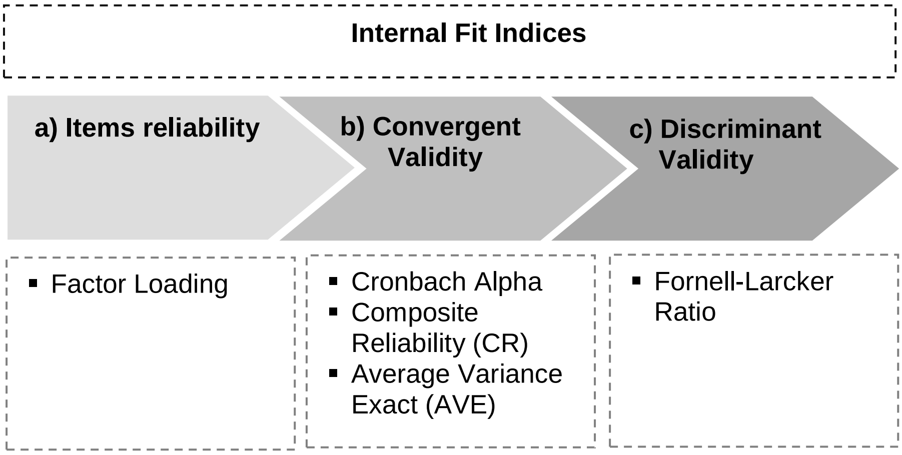


Figure 4-2: Measurement of Internal Fit Indices

A. Individual Item Reliability

Individual item reliability is assessed by examining the loadings (or simple correlations) of the measures with their respective construct. Items that score less than 0.4 should be dropped (Hulland, 1999). Moreover, it is necessary that the loading are significantly related with their respective underlying constructs (t-value >2.0; p<0.05). The significant level of factor loadings provides support for the convergent validity of the respective scales (Anderson and Gerbing, 1988).

B. Convergent Validity

Convergent validity assumes that the items in the specific construct should share a high proportion of variance in common (Hair et al., 2006). For measuring convergent validity, three testing instruments were used: a) Cronbach's Alpha (α), b) construct reliability, and c) average variance extracted (Fornell and Larcker, 1981). Nunnally and Bernstein (1994) suggest 0.7 as a benchmark of high quality Cronbach's Alpha. Composite Reliability (CR) assesses the internal consistency of a measure and is analogous to the coefficient Cronbach's Alpha. CR was calculated using procedures suggested by Fornell and Larcker (1981). The formula is

$$\rho_{vc(\eta)} = \frac{\left(\sum \lambda_i\right)^2}{\left(\sum \lambda_i\right)^2 + \sum \varepsilon_i}$$

Where λ_i is the standardized loading for each observed variable, ε_i is the error variance associated with each observed variable and ρ_η is the measure of construct reliability (Fornell and Larcker, 1981). CR value greater than 0.6 indicates a very good fit (Bagozzi and Yi, 1988). Lastly, Average Variance Extracted (AVE) is the average variance shared between a construct and its measure. Variance extracted can be computed from model estimates using this formula:

$$\rho_{vc(\eta)} = \frac{\sum \lambda_i^{\ 2}}{\sum \lambda_i^{\ 2} + \sum \varepsilon_i}$$

Where λ_i is the standardized loading for each observed variable, ε_i is the error variance associated with each observed variable and ρ_η is the measure of construct reliability (Fornell and Larcker, 1981). Therefore, a value of AVE that is equal to or greater than 0.50 indicates evidence of internal consistency (Fornell and Larcker, 1981).

C. Discriminant Validity

Discriminant validity is determined by demonstrating that a measure does not correlate very highly with another measure from which it should differ (Campbell, 1960) or is the extent to which measures of a given construct differ from measures of other constructs in the same model (Hulland, 1999). The procedures for testing discriminant validity among the constructs suggest that the average variance exacted of one construct (i.e., the average variance shared between a construct and its measures) should be greater than the variance shared between the construct and other constructs in the model (the squared correlation between two constructs) (Fornell and Larcker, 1981). If the value of the Fornell & Larcker ratio is smaller than 1, it indicates good discriminant validity, that is, the given construct differs from the other constructs in the same model (Fornell and Larcker, 1981). The Fornell-Larcker ratio can be computed from this formula.

$$\text{Fornell-Larcker-Ratio}\left(\xi_i\right) = \frac{r^2\ \left(\xi_i, \xi_i\right)}{AVE\ \left(\xi_i\right)} < 1$$

4.2 Assessment of Measures

As shown in Table 4-1, an overall measurement model with 9 constructs and 28 items (without individualism and power distance constructs) was analyzed. The global fit indices of measurement model indicate a good fit (X^2= 446.051, DF = 247, X^2/DF= 1.806, CFI = 0.949, and RMSEA = 0.043) as shown in the bottom of Table 4-1.

Table 4-1 presents the internal fit indices which compose of the factor loading and individual item reliability of all items used in each construct, including Cronbach's Alpha, Composite Reliability (CR), Average variance exact (AVE), and discriminant validity of each of the constructs in the SEM measurement model.

All standard factor loadings were significant ($p < 0.01$), ranking from 0.545 to 0.891 indicating that each item was strongly related to its underlying construct including Cronbach's Alpha, for which greater than 0.70 indicates satisfactory reliability. Moreover, the composite reliability (CR) values are higher than the necessary condition of 0.6 (Bagozzi and Yi, 1988), indicating high internal consistency. In most cases, values of average variance extracted (AVE) are greater than 0.5 except in individualism and power distance constructs. These two constructs are not included in the structure model. Instead they are used to split data into two groups (e.g., high individualism and low individualism) for further multi-group analysis. Thus, most items and constructs had adequate reliability and convergent validity. In addition, Fornell-Larcker's values for testing discriminant validity are less than one indicating discriminant validity of constructs. In summary, the measurement model demonstrated adequate reliability, convergent validity, and discriminate validity as shown in Table 4-1.

Table 4-1: Internal Fit Indices of Measurement Model

Constructs	Items	Standard factor loadings[a]	Individual. indicator reliability	α	CR	AVE	Fornell-Larcker
Autonomy	Freedom in running my part of the project.	0.681	0.464	0.77	0.85	0.65	0.54
	Freedom to explore, discuss and challenge ideas.	0.744	0.554				
	Freedom to make own decisions about problems need to be solved.	0.750	0.562				
Monitoring Progress	Reaching milestones were controlled in the project.	0.842	0.709	0.88	0.88	0.71	0.49
	Tracking process about being on schedule implemented in the project	0.871	0.758				
	Progress about "hard data" (e. g. test results) controlled in the project?	0.818	0.669				

Table 4-1: Internal Fit Indices of Measurement Model (Continued)

Constructs	Items	Standard factor loadings[a]	Individual. indicator reliability	α	CR	AVE	Fornell-Larcker
Process Control	Management monitors the extent to which I follow established procedures.	0.789	0.622	0.86	0.84	0.65	0.54
	Management evaluates the procedures I use to accomplish a given task.	0.891	0.793				
	Management modifies my procedures when desired results are not obtained.	0.726	0.527				
Output Control	I received feedback on how I accomplish my performance.	0.741	0.549	0.77	0.78	0.54	0.65
	Management monitors the extent to which I attain my performance goals.	0.666	0.444				
	I receive feedback from management concerning the extent to which I achieve my goals.	0.792	0.627				
Coordination	The work done on subtasks was closely harmonized.	0.709	0.502	0.82	0.86	0.67	0.52
	There were clear and fully comprehended goals for subtasks within our team.	0.867	0.752				
	The goals for subtasks were accepted by the team members.	0.806	0.502				
Communi-cation	Discussions and controversies have been conducted constructively	0.736	0.542	0.84	0.86	0.67	0.52
	Suggestions and contributions of team members have been respected	0.898	0.806				
	Suggestions/contributions of team members have been discussed and further developed	0.822	0.675				
Individualism	I do work better alone than in groups	0.608	0.369	0.57	0.57	0.31	0.42
	I prefer to be self-reliant rather than depend on others	0.575	0.331				
	It is important to me that I perform better than others on a task".	0.485	0.235				
Power Distance	Lower levels in the hierarchy should carry out the requests of senior people without question	0.633	0.401	0.71	0.72	0.46	0.28
	The supervisor is always right because he or she is the boss"	0.801	0.641				
	You should be quiet when you don't agree with your boss	0.609	0.370				

Table 4-1: Internal Fit Indices of Measurement Model (Continued)

Constructs	Items	Standard factor loadings[a]	Individual. indicator reliability	α	CR	AVE	Fornell-Larcker
Radical Innovation	Offered new/unique features to customers.	0.701	0.491	0.82	0.84	0.57	0.62
	Introduced many completely new features into the market.	0.833	0.693				
	Relied on technology never used in the industry before.	0.678	0.460				
	Highly innovative- totally new to the market.	0.787	0.619				
Incremental Innovation	Updated version of existing products/services/ software solutions.	0.701	0.492	0.74	0.79	0.56	0.63
	Redeveloped product to improve the performance of existing products	0.874	0.763				
	Customization product The based on existing knowledge and technology within firms.	0.636	0.405				
Project Efficiency	Within schedule	0.897	0.836	0.78	0.79	0.57	0.61
	Within budget	0.777	0.583				
	Required a little rework.	0.545	0.289				

Note: [a] All factor loadings are significant (t > 2.0), Global fit of the measurement model (without individualism and power distance constructs): X^2=446.051, DF = 247, X^2/DF= 1.806, CFI = 0.949, and RMSEA = 0.043.

4.3 Structural Model

After the baseline model (measurement model) which is based on assumptions and theories was tested in two stages, the final measurement model composed of all items and constructs from Table 4-1 was postulated into the structural model as shown in Figure 4-3. This measurement model is composed of four exogenous (independent) constructs, which are autonomy, monitoring progress, process control, output control, and six endogenous (dependent) constructs, which are communication, coordination, radical innovation, incremental innovation, and project efficiency. This proposed structural model is estimated via maximum likelihood by using AMOS 16 in the next step for testing hypotheses.

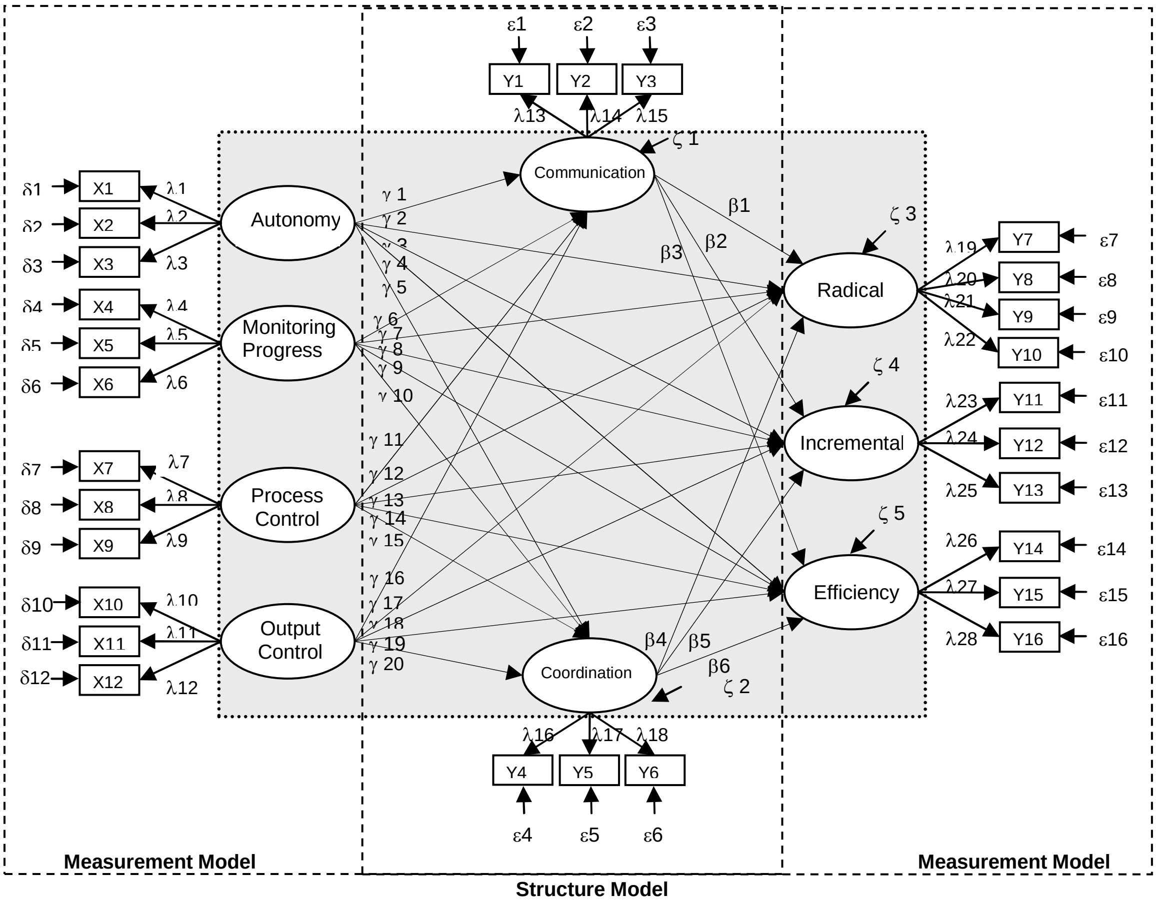


Figure 4-3: Measurement Model and Structure Equation Modeling

4.4 Descriptive Analysis

4.4.1 Characteristics of Firms and Respondents

There were four hundred and thirty three members in this study. The size of the firms in this study ranged from five to more than one thousand employees. Members were dominantly male. Approximately sixty-five percent (65.2%) of respondents are male and thirty-two percent (32.5%) female. The majority of the respondents' ages were between 31 to 40 years old (45.9%). Approximately forty-one percent (40.6%) of respondents had a college level (bachelor degree). Twenty-one percent (21.2%) had a German education system (diploma level) or master degree education. Only three percent (3%) of members had education at postgraduate (PhD.) and around percent (2.3%) had an education at technical/vocational school. The nationalities of the members were Thai (29.3%), German (18.20%), Austrian (8.53%), British (7.14%), American (4.14%), Dutch (3.69%), French (3%), Brazilian (2.07%), Italian (1.84%), Filipino (1.38%), Japanese (1.38%), Korean (1.38%), Russian (1.38%), Turkish (1.38%), Argentinean (1.15%), Indian

(1.15%), Taiwanese (1.15%), Polish (0.92%), Irish (0.69%), Swiss (0.69%), Belgium (0.46%), and Spanish (0.46%).

Table 4-2: Charateristics of Respondents and Industries

	Percent (%)
Gender	
Male	283 (65.2%)
Female	141 (32.5)
Missing	10 (2.3%)
Age	
20-30 years	113 (26%)
31-40 years	186 (42.9%)
41-50 years	86 (19.5%)
51 and above	13 (4.8%)
Missing	25 (5.8%)
Education	
Vocational/technical school	10 (2.3%)
College (Bachelor Degree)	176 (40.6%)
Master (Magister)	92 (21.2%)
PhD	13 (3 %)
Others (Apprenticeship)	8 (1.8%)
Missing	135 (31.1%)
Nationalities	
Thai	126 (29.03%)
German	79 (18.20%)
Austrian	37 (8.53%)
British	31 (7.14%)
American	18 (4.14%)
Dutch	16 (3.69%)
French	13 (3%)
Brazilian	9 (2.07%)
Italian	8 (1.84%)
Filipino, Japanese, Korean, Russian, Turkish	30 (6.9%) (6 people/country)
Argentinean, Indian, Taiwanese	15 (3.45%) (5 people/ country)
Polish	4 (0.92%)
Irish and Swiss	6 (1.38%) (3 people/ country)
Belgium, Spanish	4 (0.92%) (2 people/ country)
Chinese, Chinese (HK), Colombian, Danish, Dominican, El Sawadorian, Indonesia, Kenyan, Malaysian, Pakistani, Romania, South African, Srilangian, Venezuelan, Zimbabwean	15 (3.45%) (1 person/ country)
Missing	23 (5.30%)
Position on the project	
Project manager	156 (35.9%)
Team member	199 (45.85%)
Missing	79 (18.20%)

The study was conducted across-industries. The members consisted of project managers (35.9%) and team members (45.8%) working on projects including new product/service development, existing product/service improvement, and development of technology (R&D) in four main industries. These industries are food & consumer's products, semiconductor, three sub-industries of Technology e.g., Software & IT services, Hardware and Electronics (e.g., computer and peripherals), and other industries, e.g., telecommunication as shown in Figure 4-4.

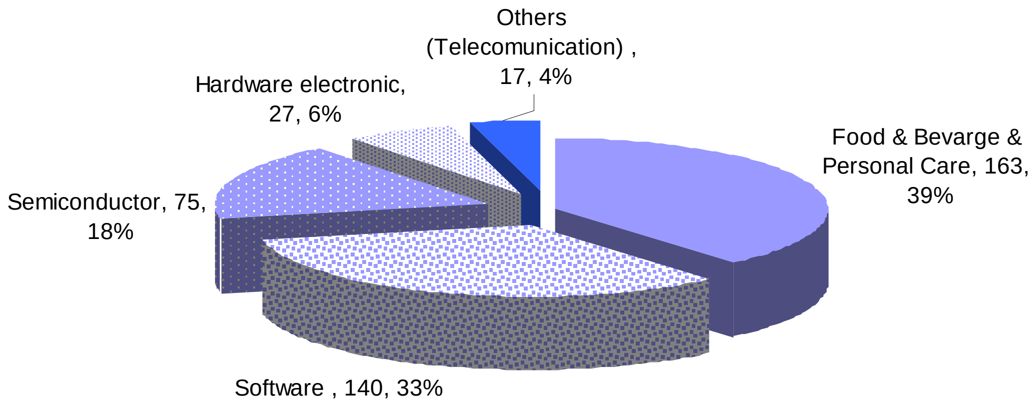


Figure 4-4: Respondents' Profile by Industry

As shown in Figure 4-5, the proportion of male members between the ages of 21-30 years, between 31-40 years, between 41-50 years, and 51 years and above is higher than female. Of the members between the ages of 20 and 30 years, fifty-seven percent (56.6%) are male members and forty–three percent (43.4%) are female. Approximately sixty-five percent (65.2%) of members in the age between 31 to 40 years are male and thirty-five percent (34.8%) are female. Seventy–seven percent (77.1%) of members in the age between 41 and 50 years are male and twenty-three percent (22.9%) are female. Around eighty-eight percent (87.5%) of the members age 51 and older are male, while only thirteen percent (12.5%) are female.

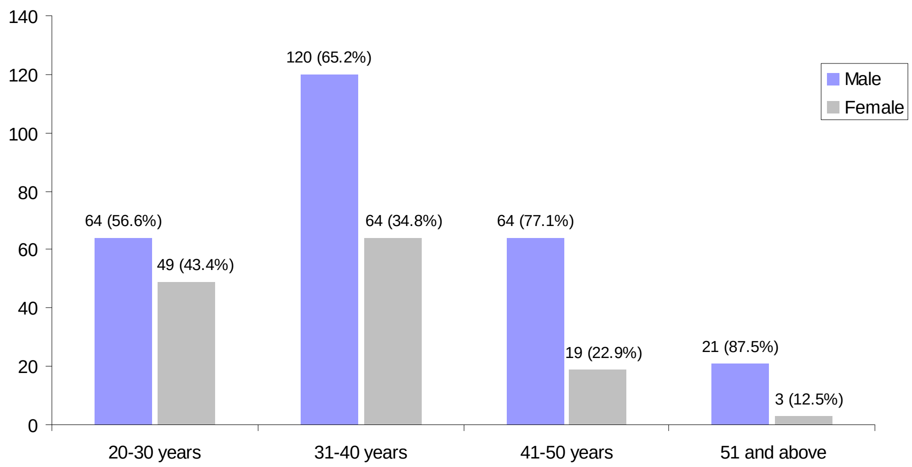


Figure 4-5: Respondents' Profile by Gender and Age

When the gender of members are divided based on their industries, the proportion of male in software industry, hardware & electronics industry, semiconductor industry, and other industries is higher than female. As shown in Figure 4-6, around seventy-five percent (75.4%) of respondents, working in software firms are male and twenty–five percent (24.6%) are female. Eighty-five percent (85.2%) of members working in hardware and electronic peripherals firms are male and fifteen percent (14.8%) are female. Approximately fifty percent (49.7%) of respondents working for food and consumers' products firms are male and half (50.3%) are female. Of the respondents in the semiconductor industry, eighty-one percent (81.4%) are male and approximately nineteen percent (18.6%) are female. Of the respondents in other industries e.g., telecommunication, eighty-eight percent (87.5%) are male and thirteen percent (12.5%) are female.

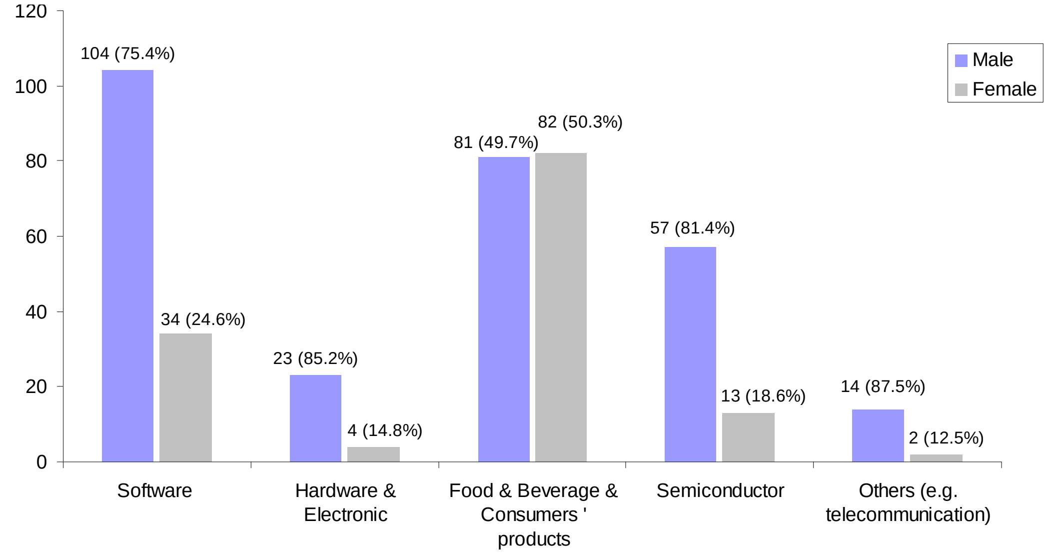


Figure 4-6: Respondents' Profile by Gender and Industries

4.4.2 Descriptive Statistics

Table 4-3 presents the descriptive statistics for all constructs measured in this study including means, and standard deviation and correlation coefficients among the constructs. The inter-correlations among the constructs revealed that there is significant correlation among control mechanisms. Monitoring progress significantly correlates to process control (r = 0.29), and output control (r = 0.38) at a 0.01 significance level as expected. The teamwork processes of communication and coordination also highly correlate to each other (r = 0.65) at a 0.01 significance level. Three constructs under innovation performance have a low correlation to each other. Radical innovation correlates with incremental innovation (r = 0.15) and with project efficiency (r = 0.16) at a 0.05 significance level.

The project management mechanisms have a correlation with communication and coordination and innovation performance. Different project management mechanisms demonstrate different relationships with innovation performance. Autonomy correlates with both communication (r = 0.38) and coordination (r = 0.29) at a 0.01 significance level but it significantly correlates only to project efficiency (r = 0.10) at a 0.05 significance level. Monitoring progress is significantly correlated with communication (r = 0.36), coordination (r = 0.40), and project efficiency (r = 0.34) at a 0.01 significance level. Process control is correlated with communication (r = 0.20) and coordination (r = 0.24) at a 0.01 significance level. Process control shows a slight relationship with radical innovation (r = 0.17), and incremental innovation (r = 0.16) at a 0.05 significance level. Output control is correlated with communication (r = 0.21) and coordination (r = 0.24) at a 0.01 significance level. Additionally, output control is correlated with incremental innovation (r = 0.17) and project efficiency (r = 0.22) at 0.05 and 0.01 significance levels.

Furthermore, communication and coordination demonstrate a positive relationship with innovation performance. Communication positively correlates with radical innovation (r = 0.15), incremental innovation (r = 0.20), and project efficiency (r = 0.24) at a 0.05 significance level. In addition, coordination correlates with radical innovation (r = 0.265), incremental innovation (r = 0.217), and project efficiency (r = 0.304) at a 0.01 significance level.

In relation to cultural values, both individualism and power distance have negative relationships with project management mechanisms (autonomy and control). Individualism has a negative correlation with monitoring progress (r = -0.16), process control (r = -0.14) and output control (r = -0.18) at a 0.01 significance level. In addition, individualism has a negative correlation with communication (r= -0.17), coordination (r = -0.19), and project efficiency (r = -0.10) at 0.01 and 0.05 significance levels. Power Distance has a negative relationship with autonomy (r = -0.15), monitoring progress (r = -0.15), and communication (r = -0.15) at a 0.01 significant level. Power distance also had a positive relationship with process control (r = 0.15) at a 0.01 significant level. Nevertheless, there was no relationship between individualism or power distance and innovation performance with regard to radical innovation and incremental innovation.

4.4.3 Descriptive Analysis of Separated Groups

In order to provide further information related to different groups of respondents, the correlation among all constructs in each group were further analyzed as shown in Table 4-4 and Table 4-5. Among ***high individualist team members***, autonomy significantly associates with communication (r = 0.33) and coordination (r = 0.23) at a 0.01 significance level. However, there is no relationship between autonomy and innovation performance in this group. In addition, control mechanisms have a positive correlation to each other. Monitoring progress has positive correlation with process control (r = 0.31) and output control (r= 0.33) at a 0.01 significance level. All control mechanisms (monitoring progress, process control, and output control) have positive relationships with both communication and coordination at a 0.01 significance level. Furthermore, only monitoring progress and output control have positive relationships with project efficiency (r = 0.26) and (r = 0.15) at 0.01 at 0.05 significance levels in this group. In particular, there are positive relationships between team processes (communication and coordination) and radical innovation and project efficiency in this group.

Among ***low individualist team members***, there is positive correlation between autonomy and monitoring progress (r = 0.22), communication (r = 0.41), and coordination (r = 0.31) at a 0.01 significance level as shown in Table 4-4. However, there are no relationships between autonomy and innovation performance in this group. In addition, all control mechanisms are associated with each other. Monitoring progress correlates with process control (r = 0.24) and output control (r = 0.41) at a 0.01 significant level. Communication and coordination have a highly positive relationship with each other (r = 0.68) at a 0.01 significance level. In addition, project management mechanisms have significant correlation with communication and coordination and innovation performance. Monitoring progress correlates with incremental innovation (r = 0.25) and project efficiency (r = 0.37); process control correlates only with radical innovation (r = 0.29); and output control correlates only with project efficiency (r = 0.25) at 0.01 and 0.05 significance levels. It is interesting to note that communication and coordination have no correlation with radical innovation, but have positive correlations with incremental innovation (r = 0.26; and r = 0.31) and with project efficiency (r = 0.24, and r = 0.31) at a 0.01 significance level.

Table 4-3: Correlation Matrix, Means, and Standard Deviation (S.D)

Constructs	Mean	S.D	1	2	3	4	5	6	7	8	9
1. Autonomy	3.93	0.77	1								
2. Monitoring Progress	3.97	0.83	**0.190****	1							
3. Process Control	3.09	0.96	0.022	**0.287****	1						
4. Output Control	3.49	0.86	0.091	**0.383****	**0.512****	1					
5. Communication	3.91	0.74	**0.382****	**0.364****	**0.202****	**0.212****	1				
6. Coordination	3.63	0.70	**0.286****	**0.397****	**0.240****	**0.236****	**0.650****	1			
7. Radical innovation	3.01	0.94	0.022	0.111	**0.174***	0.124	**0.152***	**0.265****	1		
8. Incremental innovation	3.55	0.91	0.031	0.122	**0.163***	**0.167***	**0.199****	**0.217****	**0.145***	1	
9. Project efficiency	3.42	0.83	0.100*	**0.336****	0.075	**0.218****	**0.244****	**0.304****	**0.163***	0.124	1
10. Individualism	2.54	0.82	-0.079	**-0.166****	**-0.139****	**-0.124***	**-0.177****	**-0.185****	0.023	-0.044	**-0.104***
11. Power distance	1.86	0.77	**-0.150****	**-0.150****	**0.145****	-0.039	**-0.154****	-0.053	0.122	-0.046	0.022

Notes: N =434, **. Correlation is significant at the 0.01 level (2-tailed), *. Correlation is significant at the 0.05 level (2-tailed).

Table 4-4: Correlation Matrix of High and Low Individualism Members

High Individualism members (N = 224)

Constructs	High	Low	1	2	3	4	5	6	7	8	9
1. Autonomy	3.88	4.00	1	0.116	0.120	0.094	**0.327****	**0.225****	0.045	-0.185	**0.022**
2. Monitoring Progress	3.85	4.11	**0.223****	1	**0.307****	**0.330****	**0.274****	**0.377****	0.077	-0.068	**0.264****
3. Process Control	2.96	3.23	-0.077	**0.244****	1	**0.504****	**0.283****	**0.281****	0.026	0.166	-0.019
4. Output Control	3.42	3.57	0.075	**0.410****	**0.516****	1	**0.199****	**0.256****	0.092	0.177	**0.149***
5. Communication	3.77	4.05	**0.409****	**0.403****	0.092	**0.200****	1	**0.581****	**0.261***	0.093	**0.213****
6. Coordination	3.50	3.77	**0.312****	**0.382****	**0.168***	**0.199****	**0.681****	1	**0.425****	0.087	**0.264****
7. Radical innovation	2.97	3.05	0.001	0.131	**0.286****	0.137	0.070	0.139	1	-0.089	0.100
8. Incremental innovation	3.50	3.62	0.183	**0.248***	0.128	0.127	**0.259***	**0.307****	**0.317****	1	0.069
9. Project efficiency	3.28	3.48	0.132	**0.365****	0.137	**0.252****	**0.241****	**0.307****	**0.217***	0.154	1

Low Individualism members (N= 207)

Table 4-5: Correlation Matrix of High and Low Power Distance Members

High Power distance members (N= 242)

Constructs	High	Low	1	2	3	4	5	6	7	8	9
1. Autonomy	3.87	3.98	1	**0.298****	0.026	**0.147***	**0.432****	**0.312****	-0.039	0.075	0.150
2. Monitoring Progress	3.86	4.05	0.075	1	**0.342****	**0.455****	**0.464****	**0.526****	0.089	**0.207***	**0.333****
3. Process Control	3.23	2.98	0.030	**0.271****	1	**0.558****	**0.287****	**0.350****	0.098	**0.226***	**0.148**
4. Output Control	3.47	3.51	0.042	**0.329****	**0.492****	1	**0.335****	**0.376****	0.147	**0.134**	**0.278****
5. Communication	3.79	3.99	**0.325****	**0.261****	**0.166***	0.111	1	**0.699****	0.118	**0.214***	**0.234****
6. Coordination	3.64	3.63	**0.260****	**0.292****	**0.148***	**0.133***	**0.623****	1	0.154	**0.252***	**0.389****
7. Radical innovation	3.11	2.84	0.110	0.150	0.208	0.088	**0.284***	**0.420****	1	**0.226***	0.098
8. Incremental innovation	3.53	3.61	0.005	0.042	0.119	0.213	0.180	0.192	0.141	1	0.141
9. Project efficiency	3.36	3.38	0.054	**0.339****	0.027	**0.181****	**0.260****	**0.245****	0.181	0.177	1

Low Power distance members (N= 182)

Note: ** Correlation is significant at the 0.01 level (2-tailed), *. Correlation is significant at the 0.05 level (2-tailed)

Among ***high power distance members***, there was positive correlation between autonomy and monitoring progress (r = 0.30) and output control (r = 0.15), at a 0.01 significance level. However, there are no relationships between autonomy and the constructs of innovation performance in this group. Additionally, the control mechanisms (monitoring progress, process control and output control) are associated with each other. Monitoring progress correlates with process control (r = 0.34) and output control (r = 0.46) at a 0.01 significance level. Communication and coordination have a positive relationship with each other (r = 0.62) at a 0.01 significance level. The project management mechanisms (autonomy, monitoring progress, process control and output control) also associate with both communication and coordination at a 0.01 significance level as shown in Table 4-5. Furthermore, the project management mechanisms have a positive relationship with innovation performance. Monitoring progress associates with incremental innovation (r = 0.21) and project efficiency (r = 0.33) while process control has correlation with incremental innovation (r = 0.23) and output control has a significant relationship with project efficiency (r = 0.28) at a 0.01 significance level. Moreover, communication and coordination had a positive correlation with incremental innovation (r = 0.21; and r = 0.25) and with project efficiency (r = 0.23; and r = 0.39) at a 0.01 significance level respectively. However, the constructs of project management mechanisms and communication and coordination have no correlation with radical innovation in this group.

For ***low power distance members***, autonomy has correlation only with communication (r = 0.33), and coordination (r = 0.26) at a 0.01 significance level. Autonomy has no correlation with innovation performance. Control mechanisms (monitoring progress, process control and output control) are associated with each other. Monitoring progress correlated with process control (r = 0.27), output control (r = 0.34), communication (r = 0.26), coordination (r = 0.29) at a 0.01 significance level. These constructs of control mechanisms also have correlation with communication and coordination at 0.01 and 0.05 significance levels, except for output control which has no association with communication. In addition, several constructs of project management mechanisms reveal positive relationships with innovation performance. Monitoring progress and output control have significant correlation with project efficiency (r = 0.34; and r = 0.18) at a 0.01 significance level. Interestingly, communication and coordination had a positive correlation with radical innovation (r = 0.28; and r = 0.42) and with project efficiency (r = 0.26; and r = 0.25) at 0.01 and 0.01 significance levels respectively.

4.5 Hypotheses Testing and Results

4.5.1 Direct Effects of Project Management Mechanisms

The multiple global fit indices were assessed to check the overall fit. The calculated indices were CMIN/DF= 2.465, CFI = 0.912, and RMSEA = 0.058 as shown in Figure 4-7. CMIN/DF value lower than a threshold value of 3 indicates a good model fit (Kale, Harbir, and Howard, 2000). Moreover, CFI values that compare the hypothesized model against an independent baseline model (Arbuckle, 2005) were higher than the required values of 0.90, demonstrating good fit model (Byrne, 2001). The RMSEA value is lower than 0.08, indicating a moderate fit (Browne and Cudeck, 1993). Based on all fit measurement values, the proposed model had adequate fit between the model and data. Therefore, all path coefficients from this model can be interpreted.

In order to explain the effect of project management mechanisms on innovation performance with regard to the hypotheses, Table 4-6 summarizes the hypotheses (column 1), specific measured paths (column 2), standard estimate (path coefficient) (column 3), t-value (column 4), and hypotheses' confirmation (column 5). The path coefficient and t-value are used to indicate whether the paths are significant. A t-value higher than 1.96 indicates statistical significance at a 5% level. Additionally, the chi-square difference test can be used to compare the specific path coefficients between two paths in terms of p-value. A p-value less than 0.05 indicates a significant difference between the two paths. Figure 4-7 – Figure 4-10 show the direction and the strength of the estimated paths.

Table 4-6: Path Coefficients of PMMs on Innovation Performance

Hypotheses	Paths	Standard Estimate	t-value [a]	Confirmation
H1: Autonomy→Innovation Performance	*a) Autonomy→Radical* *b) Autonomy →Incremental* *c) Autonomy→Efficiency*	0.064 -0.059 0.073	1.189 -0.979 1.487	*Rejected*
H2: Monitor Progress →Innovation Performance	*a) Monitoring progress →Radical* *b) Monitoring progress →Incremental* *c) Monitoring progress→Efficiency*	0.106† 0.062 0.345***	1.974 1.019 7.010	*Partially Confirmed*
H3*:* Process Control →Innovation Performance	*a) Process Control→Radical* *b) Process Control →Incremental* *c) Process Control →Efficiency*	0.225*** 0.144* 0.018	4.171 2.332 -0.371	*Partially Confirmed*

Table 4-6: Path Coefficients of PMMs on Innovation Performance (Continued)

Hypotheses	Paths	Standard Estimate	t-value	Confirmation
H4: Output Control →Innovation Performance	*a) Output Control → Radical* *b) Output Control → Incremental* *c) Output Control → Efficiency*	0.049 0.197* 0.165***	0.918 3.102 3.359	*Partially Confirmed*
H5: Process Control →Innovation Performance (Process control has stronger effect on innovation performance than output control and Monitoring progress on innovation performance)	▪ ***Radical Innovation*** *a)Process Control > Output Control* *b)Process Control>Monitoring Progress*	Chi-square test: $\Delta\chi 2$ = 17.15 (p<0.000) $\Delta\chi 2$ = 17.29 (p<0.000)		*Partially Confirmed*
	▪ ***Incremental Innovation*** a)*Process Control> Output Control* *b)Process Control>Monitoring Progress*	Chi-square test: $\Delta\chi 2$ = 14.10 (p<0.000) $\Delta\chi 2$ = 45.12 (p<0.000)		
	▪ ***Project Efficiency*** *a)Process Control> Output Control* *b)Process Control>Monitoring Progress*	Chi-square test: $\Delta\chi 2$ = 6.104 (p<0.000) $\Delta\chi 2$ = 7.026 (p<0.0008)		

Note: Standardized path coefficient is significant at ***p<0.0001 **p<0.001 *p<0.05 †p<0.10.

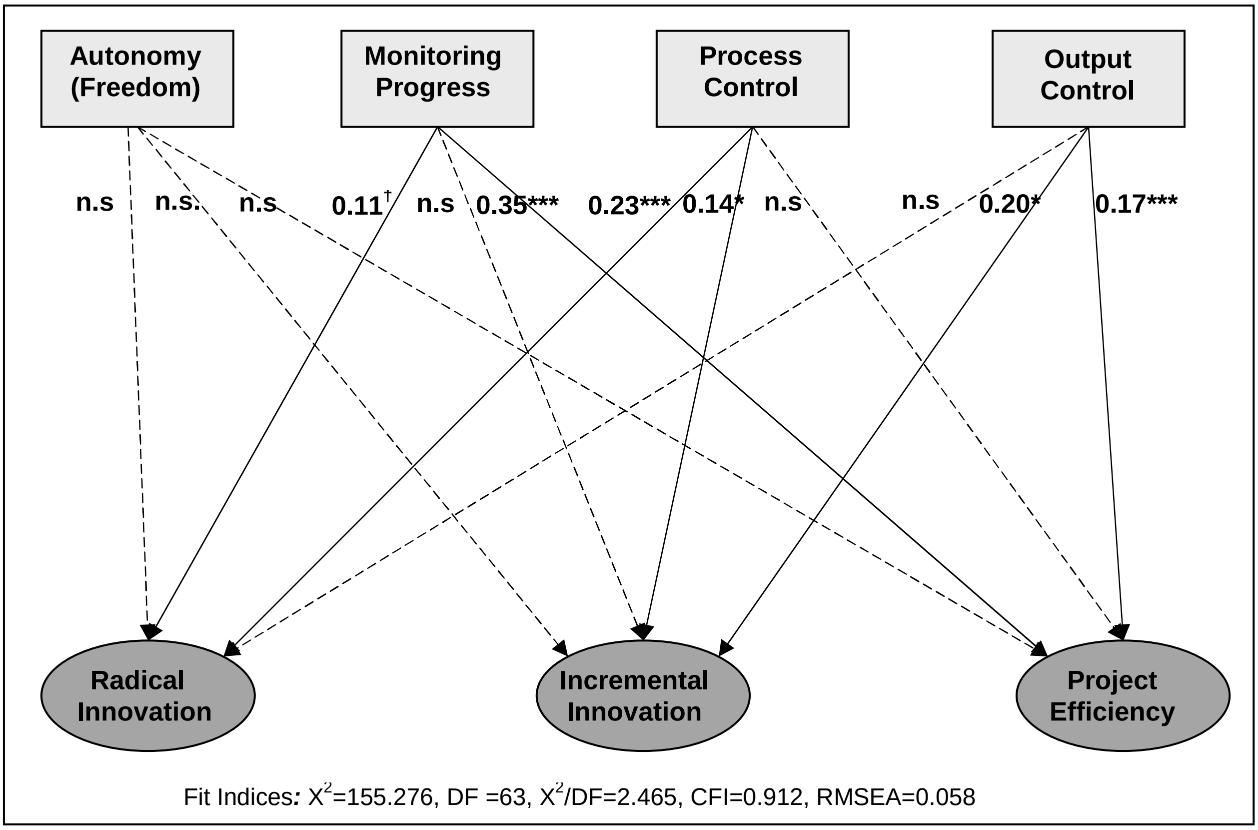


Figure 4-7: Path Coefficients of PMMs and Innovation Performance

Notes: n.s. is non-significant. Standardized path coefficient is significant at ***p<0.0001 **p<0.001 *p<0.05 †p<0.10

Hypothesis 1 *is stated that autonomy increases innovation performance (radical innovation, incremental innovation, and project efficiency).* The results show that granting autonomy does not increase innovation performance as shown in Table 4-6 and Figure 4-7. Giving autonomy to team members is not significantly related to radical innovation with value of 0.064 (t-value = 1.189, p > 0.10), nor is it related to incremental innovation with -0.059 (t-value= -0.979, p>.10), nor to project efficiency with the value of 0.073 (t-value = 1.487, p > 0.10). Thus, hypothesis 1 can be rejected.

Hypothesis 2 *is stated that monitoring progress increases innovation performance (radical innovation, incremental innovation, and project efficiency).* As shown in Table 4-6 and Figure 4-7, the results show that monitoring progress increases radical innovation with 0.106 (t-value = 1.974, p <0.10) and project efficiency with 0.345 (t-value = 7.010, p <0.01). However, monitoring progress has no significant impact on incremental innovation with 0.062 (t-value = 1.019, p>0.10). Therefore, hypothesis 2 is partially supported. It could be said that monitoring progress enhances only radical innovation and project efficiency.

Hypothesis 3 *is stated that process control increases innovation performance (radical innovation, incremental innovation, and project efficiency).* The results illustrate that process control increases only radical innovation with 0.225 (t-value = 4.171, p<0.0001) and incremental innovation with 0.144 (t-value = 2.332, p<0.05). However, there is no significant relationship between process control and project efficiency as shown in Table 4-6 and Figure 4-7. The results suggest that increasing process control promoted both radical innovation and incremental innovation. Thus, hypothesis 3 is partially supported.

Hypothesis 4 *is stated that output control increases innovation performance in terms of radical, incremental innovation, and project efficiency.* The results illustrate that output control had no significant impact on radical innovation with 0.049 (t-value = 0.918, p>0.10). However, output control increases incremental innovation with 0.197 (t-value= 3.102, p<0.05), and project efficiency with 0.165 (t-value= 3.359, p<0.0001) as shown in Table 4-6 and Figure 4-7. With all project members, output control increased only incremental innovation and project efficiency. Therefore, hypothesis 4 is as well partially supported.

Hypothesis 5 *is stated that process control has a stronger effect on innovation performance (radical innovation, incremental innovation, and project efficiency) than the other* two mechanisms *(output control and monitoring progress).* Regarding the effects of control mechanisms on radical innovation, process control and monitoring progress increase radical innovation with 0.225 (t-value = 4.171, $p<0.0001$) and 0.11 (t-value = 1.974, $p<0.10$) respectively. However, output control has no effect on radical innovation. In order to confirm these different effects, the chi-square difference test was performed. The values of chi-square difference test of two paths are 17.15 ($p<0.0001$) and 17.29 ($p<0.0001$) respectively which are higher than the critical value of 3.84 (at 5% level) indicating rejection of the null hypothesis (two path coefficients are equal). Therefore, process control has a stronger effect on radical innovation than output control and monitoring progress as shown in Table 4-6 and Figure 4-8.

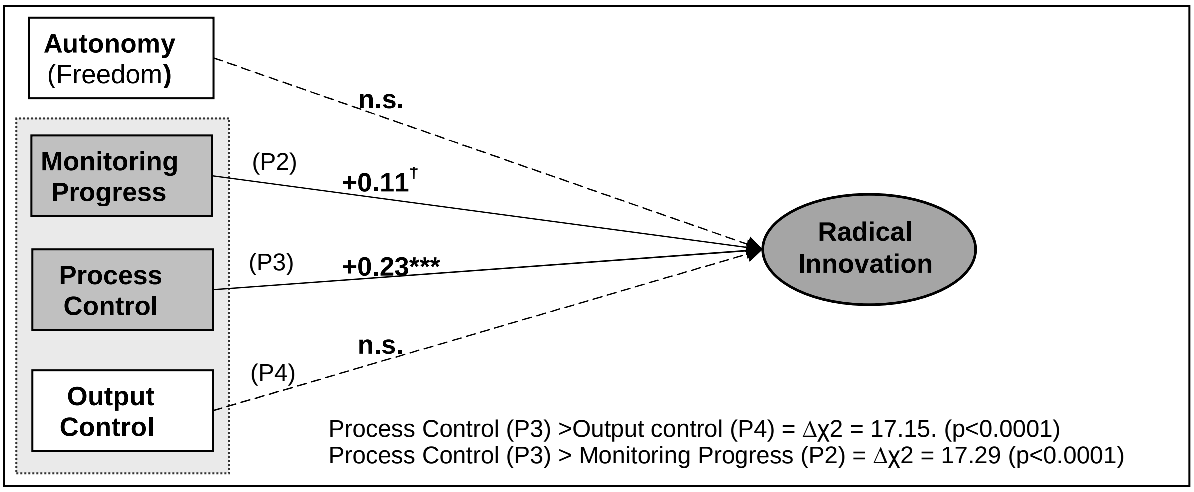


Figure 4-8: Path Coefficients of Control Mechanisms on Radical Innovation

Notes: n.s. is non-significant. Standardized path coefficient is significant at ***$p<0.0001$ **$p<0.001$ *$p<0.05$ †$p<0.10$

Regarding the effects of control mechanisms on incremental innovation, process control and output control increase incremental innovation with 0.14 (t-value = 2.332, $p<0.05$) and 0.20 (t-value = 3.102, $p<0.05$) respectively, but process control has a weaker effect than output control. However, monitoring progress has no effect on incremental innovation. The value of chi-square difference test between process control and output control is 14.10 ($p<0.0001$) and between process control and monitoring progress is 45.12 ($p<0.0001$) indicating the different effects between two paths. Therefore, output control has a stronger effect on incremental innovation than process control and monitoring progress as shown in Table 4-6 and Figure 4-9.

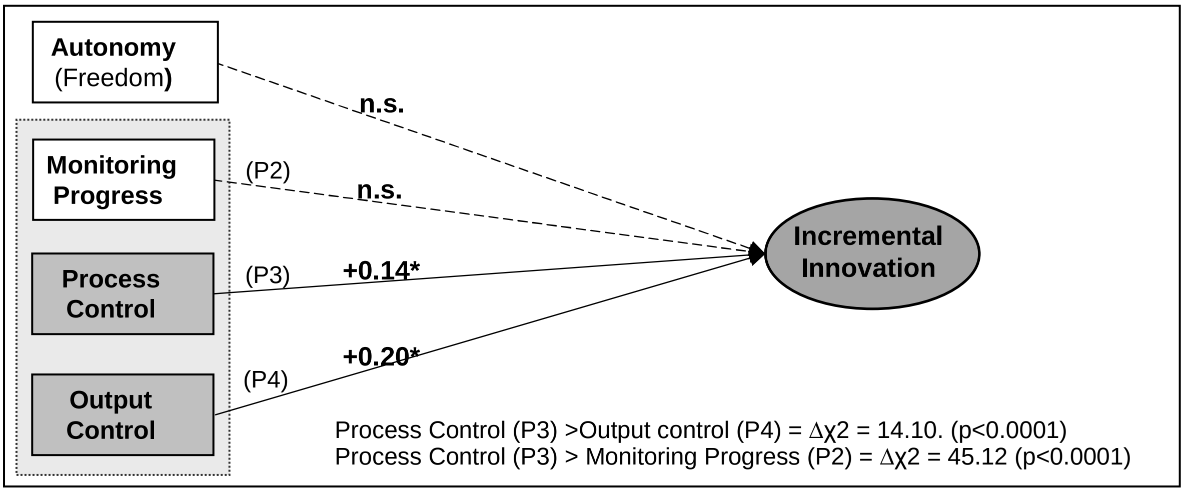


Figure 4-9: Path Coefficients of Control Mechanisms on Incremental Innovation

Notes: n.s. is non-significant. Standardized path coefficient is significant at ***p<0.0001 **p<0.001 *p<0.05 †p<0.10

In relation to control mechanisms and project efficiency, process control has no effect on project efficiency; only monitoring progress and output control have an effect on project efficiency with 0.34 (t-value = 7.010, p<0.0001) and 0.17 (t-value = 3.359, p<0.005) respectively. The chi-square difference test between process control and output control and between process control and monitoring progress are 6.104 (p<0.0001) and 7.026 (p<0.0001) respectively indicating unequal effects of path coefficients. Additionally, the chi-square difference test between the effect of monitoring progress on project efficiency and output control on project efficiency is 46.536 (p<0.0001) demonstrating unequal effect. Consequently, monitoring progress has a stronger effect on project efficiency than output control and process control respectively as shown in Table 4-6 and Figure 4-10.

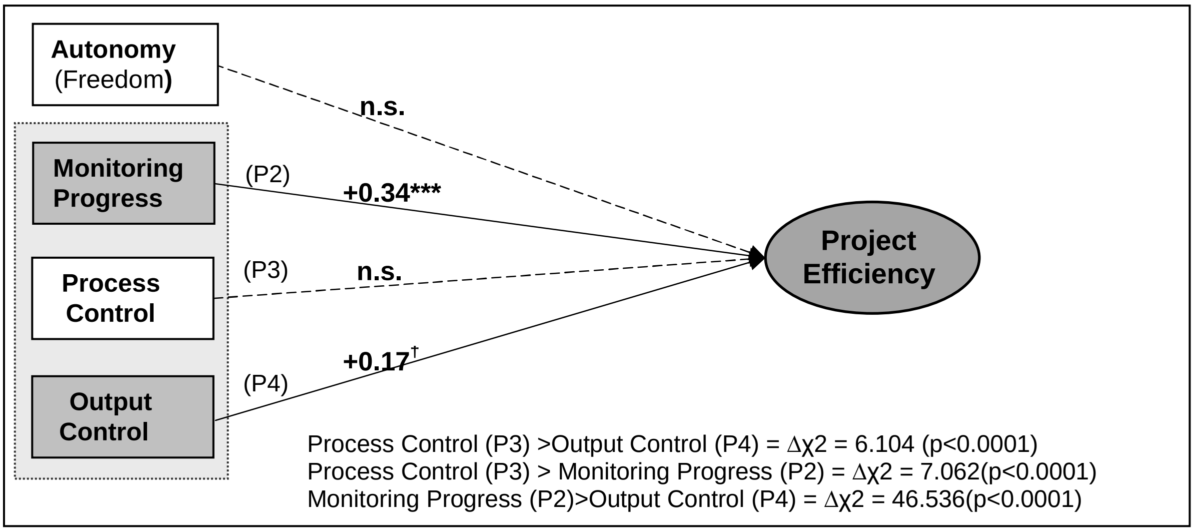


Figure 4-10: Path Coefficients of Control Mechanisms on Project Efficiency

Notes: n.s. is non-significant. Standardized path coefficient is significant at ***p<0.0001 **p<0.001 *p<0.05 and †p<0.10.

In summary, process control has a stronger effect on radical innovation than output control and monitoring progress. Output control has a stronger effect on incremental innovation than process control and monitoring progress. In addition, monitoring progress has a higher effect on project efficiency than output control and process control. Consequently, hypothesis 5 is partially supported as shown in Table 4-6 and Figure 4-8, Figure 4-9, and Figure 4-10.

4.5.2 Mediating Test and Effects

4.5.2.1 Mediating Test Procedures

Regarding hypotheses 6 a, b, c, d and hypothesis 7 a, b, c, and d, this study examines whether coordination and communication mediate the relationships between project management mechanisms (autonomy, monitoring progress, process control, and output control) and innovation performance regarding radical innovation, incremental innovation, and project efficiency. As shown in Figure 4-11, the procedures for testing mediation recommended by Baron and Kenny (1986) indicate that ***full mediation*** is present when the path from independent variable (c') to the dependent variable is non-significant but the remaining paths are significant. ***Partial mediation*** is present when all paths are significant (1) from independent variables to dependent variables; (2) from independent variable to mediator; and (3) from mediator to dependent variable.

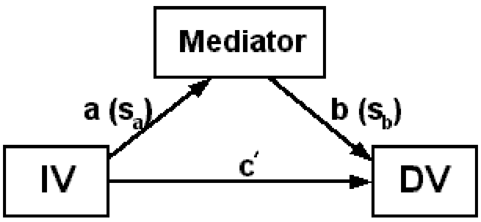


Figure 4-11: Mediation Testing by Baron and Kenny

According to Baron and Kenny (1986), to test the mediating effects of the constructs., the four step of testing mediators are pursued using AMOS. First, a direct path from independent variables (autonomy, monitoring progress, process control, and output control) to dependent variables (innovation performance e.g., radical innovation, incremental innovation, and project efficiency) is established. Second, the direct path from independent variable (autonomy, monitoring progress, process control, and output control) to the mediators is established (communication, coordination). Third, the path from mediator variable (communication or coordination) to dependent variable (e.g., radical, incremental, and project efficiency) is established. The last step is testing the path from independent variable to dependent variable. This path must be significantly reduced (in step 3) when the mediator is added (communication or communication) in the model. Importantly, Sobel's test is conducted to confirm the effects of mediation (Baron and Kenny, 1986). This study employed the Sobel' s test because it confirms the results of a mediation effect with large samples. This study calculates Sobel's test by using the interactive program calculation developed by Preacher and Leonardelli[3].

In order to explain mediating effects of communication and coordination, Table 4-7 – Table 4-14 reports step, paths, standardized estimate (path coefficient), results of mediating test, and Sobel' test. T-value, higher than 1.96, is indicate statistic significant at 5% level. Additionally, Figure 4-12 – Figure 4-19 are developed to show the mediation effect of communication/coordination by using standard path coefficient at different significant level.

4.5.2.2 Mediating Effects of Communication and Coordination

Hypothesis 6a *is stated that communication mediates the relationship between autonomy and innovation performance (radical and incremental innovation, and project efficiency).* As shown in Table 4-7 step 1-1, autonomy is not significantly associated with radical innovation with 0.063 (t-value = 1.133, p>0.10). In step 1-2, autonomy is significantly associated with communication with 0.360 (t-value = 8.009, p<0.001). When communication is added in step 1-3, the results show that communication is significantly associated with radical innovation with 0.170 (t-value = 2.898, p<0.05). In addition, the path coefficient from autonomy to radical innovation significantly reduced from 0.063 (t-value = 1.133, p>0.10) in step 1-1 to 0.003 (t-value = 0.059, p>0.10) in step 1-3, suggesting full mediation of communication. Sobel's test supported that the reduction is statistically significant with Z-value = 2.747 (p< 0.005). Consequently, it could be said that there is an indirect effect of autonomy on radical innovation via communication as shown in Figure 4-12. It could be explained that autonomy may enhance individual creativity and individual innovative thinking. But developing radically innovative products requires not only team members' creativity in their tasks but also integration of many complex sub-components/systems. Therefore, to faster radical innovation, granting only autonomy to individual team may not be enough; it requires integration of each innovative sub components/system through communication among team members.

[3] http://www.people.ku.edu/~preacher/sobel/sobel.htm

In step 2-1 and 2-2 the direct path from autonomy to incremental innovation is non-significant with the value of -0.070 (t-value = -1.128, p>0.10). The path from autonomy to communication is significant with the value of 0.360 (t-value = 8.009, p<0.00). When communication is added into step 2-3, the path from autonomy to incremental innovation has a stronger ranking from -0.070 (t-value = -1.128, p >0.10) to -0.117 (t-value = -1.748, p<0.10). In addition, in step 2-3 the path from communication to incremental innovation is significant with 0.138 (t-value = 2.067, p<0.05). Sobel's test confirms the effect of communication as a mediator in step 2-3 with a significant with Z-value = 1.998 (p<0.05). All path coefficients are significant indicating partial mediation of communication. Therefore, autonomy can cause a negative direct effect on incremental innovation and can have an indirect effect on incremental innovation via communication as shown in Table 4-7 and Figure 4-12. The negative effect of autonomy on incremental innovation could result from the low degree of autonomy required for the development of incremental innovative products (small improvements of sub-components) rather than the development of radical innovative products. The positive indirect effect of autonomy on developing incremental innovative products through communication is stronger. As a result, given high autonomy facilitates communication of the team, which in turn promotes development of incremental innovation products. It could be concluded that communication partially mediates the relationship between autonomy and incremental innovation.

In addition, the direct path from autonomy to project efficiency is insignificant with 0.054 (t-value = 1.006, p>0.10) in step 3-1, whereas the path from autonomy to communication is significant with the value of 0.360 (t-value = 8.009, p<0.0001) in step 3-2. When communication is added in step 3-3, the path from autonomy to project efficiency reduces but is still insignificant with -0.038 (t-value = -0.674, p>0.10). The path from communication to project efficiency is significant with 0.282 (t-value = 4.952, p<0.0001) demonstrating full mediation of communication as shown in Table 4-7 and Figure 4-12. This full mediation of communication is confirmed by the significant reduction of Sobel's test with Z-value of 4.210 (p<0.0001). Therefore, the indirect effect of autonomy on project efficiency via communication is significant.

In summary, hypothesis 6a is supported. Communication fully mediates the relationship between autonomy and radical innovation and project efficiency. However, it partially mediates the relationship between autonomy and incremental innovation as shown in Table 4-7 and Figure 4-12. These results conclude that autonomy has indirect effects on radical innovation, incremental innovation, and project efficiency through communication.

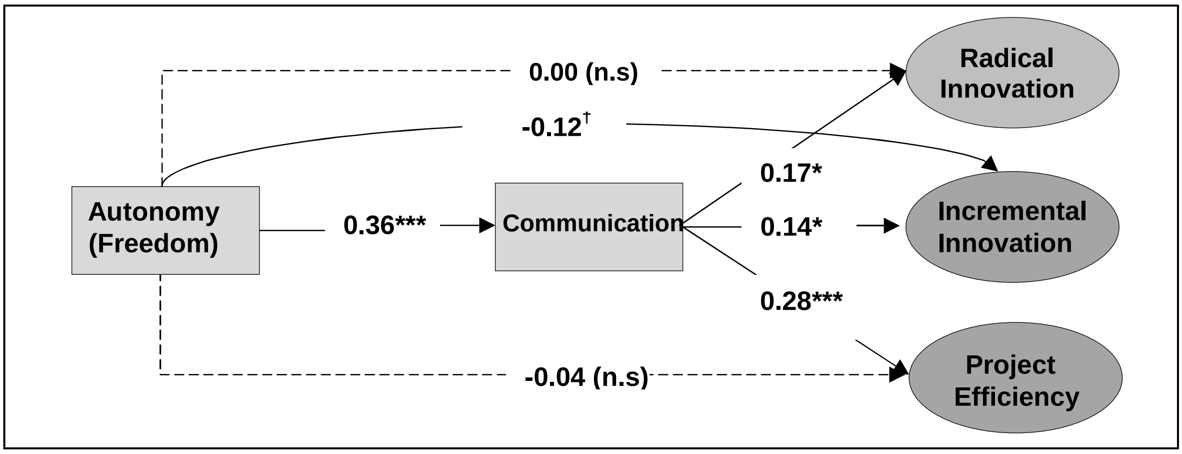


Figure 4-12: Effects of Autonomy and Communication on Innovation Performance

Notes: Numbers are standardized regression weights after the mediator (communication) has been entered in the model. n.s. is non-significant. Standardized path coefficient is significant at ***p<0.0001 **p<0.001 *p<0.05 and †p<0.10.

Table 4-7: Mediation Effects of Communication on the Relationship between Autonomy and Innovation Performance

Step	Path	Standardized Estimate	T-value	Results
1	***Sobel's test = 2.747 (p<0.05)***			
1-1	Autonomy→ Radical Innov.	0.063 (n.s)	1.133	*Full mediation*
1-2	Autonomy →Communication	0.360***	8.009	
1-3	Autonomy→Radical Innov.	0.003 (n.s)	0.059	
	Communication →Radical Innov.	0.170*	2.898	
2	***Sobel' test = 1.998 (p<0.05)***			
2-1	Autonomy→ Incremental Innov.	-0.070 (n.s)	-1.128	*Partial mediation*
2-2	Autonomy →Communication	0.360***	8.009	
2-3	Autonomy→Incremental Innov.	-0.117	-1.748	
	Communication→Incremental Innov.	0.138*	2.067	
3	***Sobel's test = 4.210 (p<0.00001)***			
3-1	Autonomy→ Project Efficiency	0.054 (n.s)	1.006	*Full mediation*
3-2	Autonomy →Communication	0.360***	8.009	
3-3	Autonomy→ Project Efficiency	-0.038 (n.s)	-0.674	
	Communication→ Project Efficiency	0.282***	4.952	

Notes: n.s. is non-significant. Standardized path coefficient is significant at ***p<0.0001 **p<0.001 *p<0.05 and †p<0.10. Innov. is innovation.

***Hypothesis 6b** is predicted that communication mediates of the relationship between monitoring progress and innovation performance (radical innovation, incremental innovation, and project efficiency.* As presented in Table 4-8, step 1-1 and 1-2 indicate that the path from monitoring progress to radical innovation is significant with 0.110 (t-value = 1.993, p<0.05). In addition, the path from monitoring progress to communication is significant with 0.304 (t-value = 6.496, p<0.0001). When communication is added in step 1-3, the effect of direct path coefficient of monitoring progress on radical innovation is reduced from 0.110 (t-value = 1.993, p<0.05) to 0.067 (t-value = 1.162, p>0.10), indicating full mediation by communication. Sobel's test confirmed the significant reduction effect with a Z-value of 2.537 ($p<0.05$). Consequently, monitoring progress has no direct effect on radical innovation but it has an indirect effect on radical innovation through communication as shown in Figure 4-13.

While the effect of the path coefficient from monitoring progress to incremental innovation is non-significant with 0.071 (t-value = 1.147, $p>0.10$) in step 2-1 as shown in Table 4-8, the path from monitoring progress to communication to incremental innovation is significant with 0.304 (t-value = 6.496, $p<0.0001$) in step 2-2. When communication is added into the model in step 2-3, and the effect of monitoring progress on incremental innovation reduces from 0.071 (t-value = 1.147, $p>0.10$) to 0.044 (t-value = 0.681, $p>0.10$), and the path from communication to incremental innovation is not significant with 0.09 (t-value = 1.336, $p>0.10$). In this regard, the results suggest that monitoring progress has either no direct effect on incremental innovation or no indirect effect on incremental innovation via communication. This is confirmed by a non-significant Z-value of Sobel's test of 1.335 ($p>0.10$). Hence, communication is not a mediator between monitoring progress and incremental innovation as shown in Figure 4-13.

In relation to monitoring progress and project efficiency in Table 4-8, the path from monitoring progress to project efficiency and to communication in step 3-1 and 3-2, are significant with 0.355 (t-value = 6.928, $p<0.0001$) and 0.304 (t-value = 6.496, $p<0.0001$), respectively. When communication is added in step 3-3, the path from monitoring progress to project efficiency reduces from 0.355 (t-value = 6.928, $p<0.0001$) to 0.309 (t-value = 5.757, $p<0.0001$) and it is still significant demonstrating partial mediation of communication. These results are confirmed with significant reduction of Sobel's test with Z-value = 3.047 ($p<0.005$). Hence, monitoring progress has both a direct effect on project efficiency and an indirect effect on project efficiency through communication. It could be said that communication partially mediates the relationship between monitoring progress and project efficiency as shown in Figure 4-13.

In summary, hypothesis 6b is partially supported as shown in Table 4-8 and Figure 4-13. Communication fully mediates the relationship between monitoring progress and radical innovation, but it partially mediates the relationship between monitoring progress and project efficiency. However, communication is not a mediator of the relationship between monitoring progress and incremental innovation. Monitoring progress facilitates communication of team members, but communication among team members does not improve performance of developing incremental innovation.

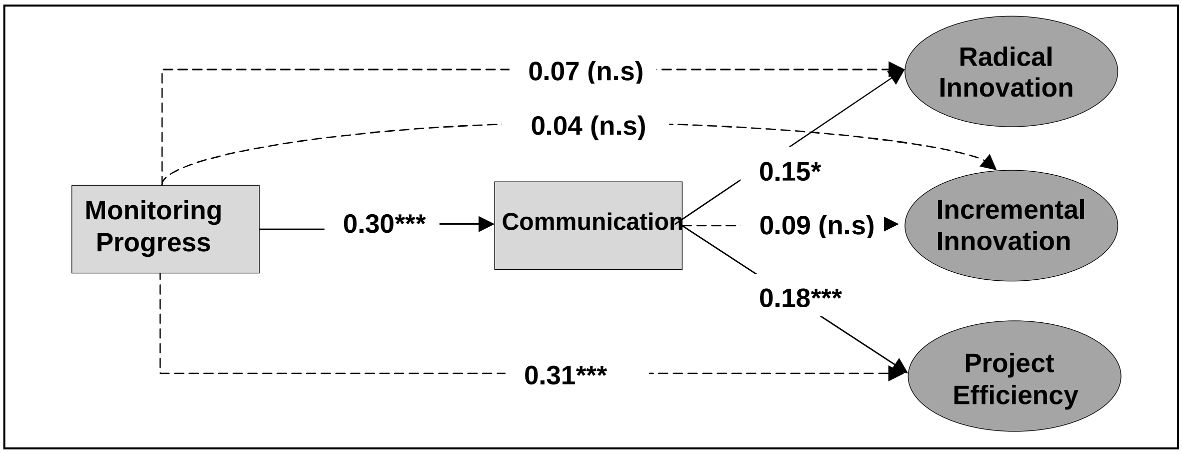


Figure 4-13: Effects of Monitoring Progress and Communication on Innovation Performance

Notes: Numbers are standardized regression weights after the mediator (communication) has been entered in the model. n.s. is non-significant. Standardized path coefficient is significant at ***p<0.0001 **p<0.001 *p<0.05 and †p<0.10

Table 4-8: Mediating Effects of Communication on the Relationship between Monitoring Progress and Innovation Performance

Step	Path	Standardized Estimate	T-value	Results
1	***Sobel's test = 2.537 (p<0.01)***			
1-1	Monitoring Progress → Radical Innov.	0.110*	1.993	*Full mediation*
1-2	Monitoring progress →Communication	0.304***	6.496	
1-3	Monitoring progress →Radical Innov.	0.067(n.s)	1.162	
	Communication →Radical Innov.	0.153*	2.684	
2	***Sobel's test = 1.335 (p>0.10)***			
2-1	Monitoring progress→ Incremental Innov.	0.071(n.s)	1.147	*No mediation*
2-2	Monitoring progress →Communication	0.304***	6.496	
2-3	Monitoring progress →Incremental Innov	0.044(ns)	0.681	
	Communication →Incremental Innov.	0.086(ns)	1.336	
3	***Sobel's test =3.047 (p<0.005)***			
3-1	Monitoring progress → Project Efficiency	0.355***	6.928	*Partial Mediation*
3-2	Monitoring progress →Communication	0.304***	6.496	
3-3	Monitoring progress → Project Efficiency	0.309***	5.757	
	Communication→ Project Efficiency	0.176***	3.333	

Note: S.E. is Standardized path coefficient significant at ***p<0.0001, **p<0.001, *p<0.05 and †p<0.10. Innov. is innovation.

Hypothesis 6c *is stated that communication mediates of the relationship between process control and innovation performance (radical innovation, incremental innovation, and project efficiency.* In Table 4-9, step 1-1 shows that process control is significantly associated with radical innovation with 0.229 (t-value = 4.220, p<0.0001). In step 1-2, process control is significantly associated with communication with 0.134 (t-value = 2.733, p<0.05). In step 1-3, when communication is entered into the model, both paths from process control to radical innovation and from communication to radical innovation are significant with 0.208 (t-value = 3.823, p<0.0001) and 0.139 (t-value = 2.583, p<0.05). The relationship between process control and radical innovation decreases from

0.23 (t-value = 4.220, p<0.0001) in step1-1 to 0.21 (t-value = 3.823, p<0.0001) in step 1-3 and it is still significant demonstrating partial mediation of communication. Sobel's test confirms the small reduction with significant *Z*-value = 1.857 ($p < 0.10$). Therefore, process control has both a direct effect on radical innovation and an indirect effect on radical innovation through communication as shown in Figure 4-14.

In addition, Table 4-9, shows that communication does not mediate the relationship between process control and incremental innovation. Step 2-1 and 2-2 reveal that the path from process control to incremental innovation and to communication are significant with 0.163 (t-value = 2.570, p<0.01) and 0.134 (t-value = 2.733, p<0.05), respectively. In step 2-3, when communication is added into the model, the direct path of process control is significantly associated with incremental innovation with 0.151 (t-value = 2.381, p<0.05). Furthermore, the path from communication to incremental innovation is not significant with 0.080 (t-value = 1.296, p>0.10). This fails to meet mediation's criteria. Sobel's test also indicates that the mediated effect is not statistically significant with Z-value = 1.175 (p>0.10). Therefore, communication is not mediator between process control and incremental innovation because of the strong effect of process control and incremental innovation as shown in Figure 4-14.

In addition, Table 4-9 shows that communication mediates the relationship between process control and project efficiency. In step 3-1 and 3-2, the direct path from process control to project efficiency is non-significant with -0.03 (t-value = -0.610, p>0.10), but the path from process control to communication is significant with the value of 0.134 (t-value = 2.733, p<0.05). In step 3-3, when communication is entered into the model, the effect of process control on project efficiency is still non-significant with -0.06 (t-value = -1.151, p>0.10), but the effect of communication on project efficiency is significant with 0.273 (t-value= 5.169, p<0.0001) indicating full mediation of communication. When Sobel's test is conducted, the results show that the effect of process control on project efficiency when communication is entered is significant with 2.415 (p<0.05). Regarding mediation's criteria, process control has no direct effect on project efficiency, but it has indirect effect through communication as shown in Figure 4-14.

Therefore, hypothesis 6c is partially supported. Communication partially mediates the relationship between process control and radical innovation, but fully mediates the relationship between process control and project efficiency. However, communication does not mediate the relationship between process control and incremental innovation since there is a direct effect of process control on incremental innovation as shown in Figure 4-14.

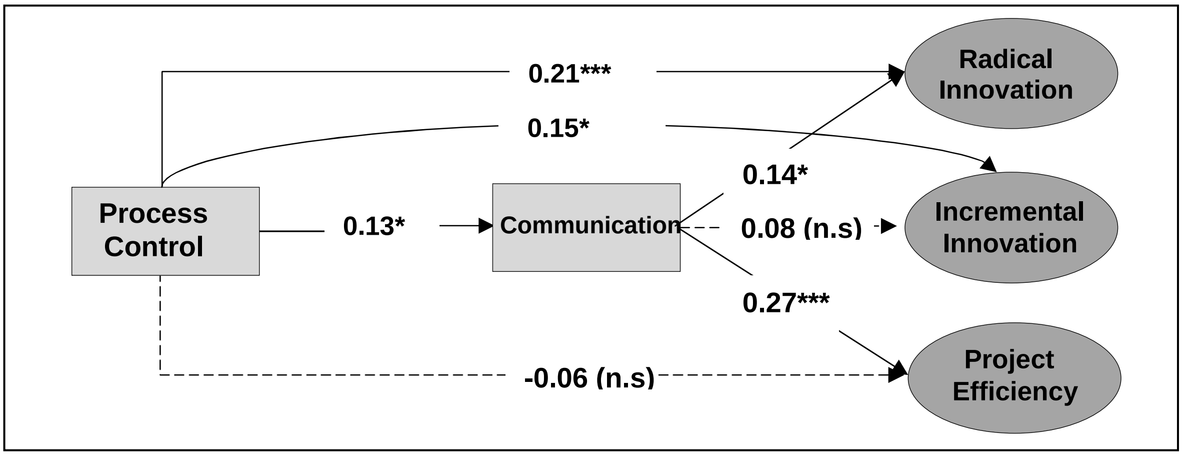


Figure 4-14: Effects of Process Control and Communication on Innovation Performance

Notes: Numbers are standardized regression weights after the mediator (communication) has been entered in the model. n.s. is non-significant. Standardized path coefficient is significant at ***p<0.0001 **p<0.001 *p<0.05 and †p<0.10.

Table 4-9: Mediating Effects of Communication on the Relationship between Process Control and Innovation Performance

Step	Path	Standardized Estimate	T-value	Results
1	***Sobel's test = 1.857 (p<0.10)***			
1-1	Process Control→ Radical Innov.	0.229***	4.220	*Partial mediation*
1-2	Process Control →Communication	0.134*	2.733	
1-3	Process Control →Radical Innov.	0.208***	3.823	
	Communication →Radical Innov.	0.139*	2.583	
2	***Sobel's test = 1.175 (p>0.10)***			
2-1	Process Control → Incremental Innov.	0.163*	2.570	*No mediation*
2-2	Process Control →Communication	0.134*	2.733	
2-3	Process Control →Incremental Innov.	0.151*	2.381	
	Communication →Incremental Innov.	0.080 (n.s)	1.296	
3	***Sobel's test =2.415 (p<0.005)***			
3-1	Process Control → Project Efficiency	-0.032(n.s)	-0.610	*Full mediation*
3-2	Process Control →Communication	0.134*	2.733	
3-3	Process Control → Project Efficiency	-0.064(n.s)	-1.151	
	Communication→ Project Efficiency	0.273***	5.169	

Notes: n.s. is non-significant. Standardized path coefficient is significant at ***p<0.0001 **p<0.001 *p<0.05 respectively †p<0.10. Innov. is innovation.

Hypothesis 6d *is stated that communication mediates the relationship between output control and innovation performance (radical innovation, incremental innovation, and project efficiency.* Table 4-10 shows that the direct path from output control to radical innovation is non-significant in step1-1 with 0.057 (t-value = 1.038, p>0.10), but the path from output control to communication is significant with 0.106 (t-value = 2.163, p<0.05) in step 1-2. When communication is added into the model in step 1-3, the direct effect of output control on radical innovation reduces to 0.04 (t-value = 0.759, p>0.10) but it is still not significant. The path from communication to radical innovation is significant with 0.168 (t-value = 3.063, p<0.05). These results indicate full mediation of communication.

Sobel's test confirms that the effect of output control on radical innovation via communication with Z-value = 1.762 ($p<0.10$). Consequently, output control has only an indirect effect on radical innovation through communication as shown in Figure 4-15.

While communication is not a moderator between output control and incremental innovation, the direct effect of output control on incremental innovation is found with 0.211 (t-value = 3.274, $p <0.001$) in step 2-1. The effect of output control on communication is significant with the value of 0.106 (t-value = 2.163, $p<0.05$) in step 2-2. In step 2-3, communication is added into the model; the effect of output control on incremental innovation increases from 0.211 (t-value = 3.274, $p<0.001$) in step 2-1 to 0.20 (t-value = 3.130, $p<0.05$) in step 2-3, but it is still strongly significant as shown in Table 4-10. However, Sobel's test also confirms a non-significant reduction of output control on incremental innovation with Z-value = 1.120 ($p>0.10$). In addition, the path from communication to incremental innovation is not significant with 0.08 (t-value =1.300, $p>0.10$). These results fail to achieve mediation's criteria indicating no mediation of communication since the direct effect of output control is found on developing incremental innovative products as summarized in Figure 4-15.

Table 4-10, the path from output control to project efficiency and to communication in step 3-1, and 3-2 are significant with 0.195 (t-value = 3.793, $p <0.001$) and 0.106 (t-value = 2.163, $p<0.05$). When communication is added in the step 3-3, the direct path of output control to project efficiency decreases to 0.170 (t-value = 3.269, $p<0.001$). Sobel's test also confirms significant reduction of output control on project efficiency with Z-value = 1.966 ($p<0.10$). The path from communication to project efficiency is significant with 0.243 (t-value = 4.693, $p<0.0001$). As with all significant paths, this is an indication of a partial mediation of communication. Consequently, output control has both a direct effect on project efficiency and an indirect effect on project efficiency through communication as shown in Figure 4-15.

Therefore, hypothesis 6d is partially supported. Communication fully mediates the relationship between output control and radical innovation, but it partially mediates the relationship between output control and project efficiency. However, communication is not a mediator of the relationship between output control and incremental innovation because the direct effect of output control on incremental innovation is found as summarized in Table 4-10 and Figure 4-15.

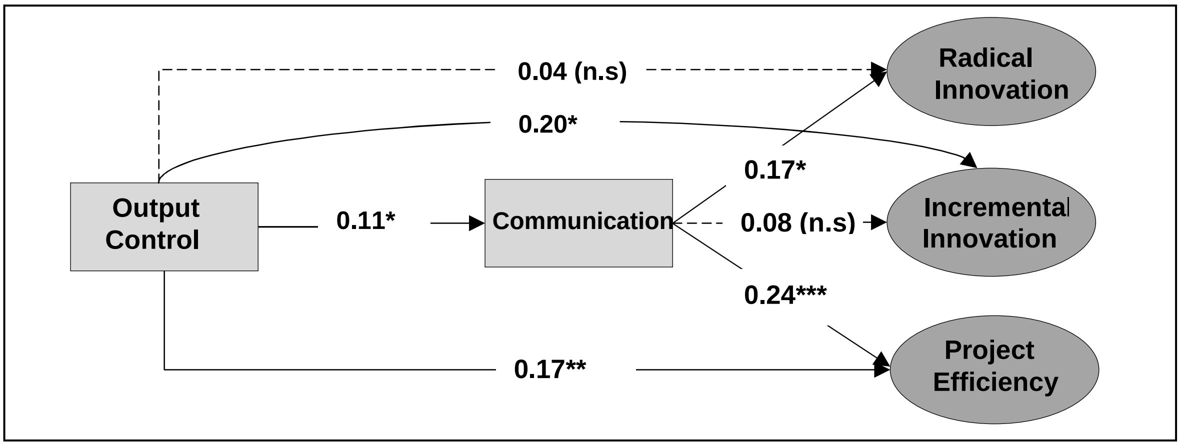


Figure 4-15: Effects of Output Control and Communication on Innovation Performance

Notes: Numbers are regression weights after the mediator (communication) has been entered in the model. n.s. is non-significant. Standardized path coefficient is significant at ***p<0.0001 **p<0.001 *p<0.05 and †p<0.10.

Table 4-10: Mediation Effects of Communication on the Relationship between Output Control and Innovation Performance

Step	Path	Standardized Estimate	T-value	Results
1	***Sobel's test = 1.762 (p<0.10)***			
1-1	Output Control→ Radical Innov.	0.057(n.s)	1.038	*Full mediation*
1-2	Output Control →Communication	0.106*	2.163	
1-3	Output Control →Radical Innov.	0.042(n.s)	0.759	
	Communication →Radical Innov.	0.168*	3.063	
2	***Sobel'l test = 1.120 (p>0.10)***			
2-1	Output Control → Incremental Innov.	0.211**	3.274	*No mediation*
2-2	Output Control →Communication	0.106*	2.163	
2-3	Output Control →Incremental Innov.	0.201*	3.130	
	Communication →Incremental Innov.	0.079 (n.s)	1.300	
3	***Sobel's test =1.966 (p<0.005)***			
3-1	Output Control → Project Efficiency	0.195***	3.793	*Partial mediation*
3-2	Output Control →Communication	0.106*	2.163	
3-3	Output Control → Project Efficiency	0.170**	3.296	
	Communication→ Project Efficiency	0.243***	4.693	

Note: S.E. is Standardized path coefficient significant at ***p<0.0001, **p<0.001, *p<0.05 and †p<0.10. Innov. is innovation.

***Hypothesis 7a** is stated that coordination mediates the relationship between autonomy and innovation performance (radical innovation, incremental innovation, and project efficiency).* In Table 4-11, the results in step 1-1 reveal that the direct path from autonomy to radical innovation is not significant with 0.063 (t-value = 1.133, p>0.10). Furthermore, in step 1-2 the path from autonomy to coordination is significant with 0.263 (t-value = 5.548, p<0.0001). When coordination is entered in step 1-3, the effect of autonomy on innovation is still not significant with 0.037 (t-value = 0.766, p>0.10), whereas the effect of coordination on innovation is significant with 0.205 (t-value = 3.632, p<0.0001). In addition, Sobel's test shows significant reduction of path coefficient of autonomy on radical innovation with Z-value = 3.052 ($p<0.005$). With non-significant direct effect, these results indicate full mediation of coordination. Consequently, autonomy has indirect effect on radical innovation through coordination as shown in Figure 4-16.

Additionally, coordination is found to be a full mediator between autonomy and incremental innovation, as shown in Table 4-11, step 2-1, while the path from autonomy to incremental innovation is non-significant with -0.070 (t-value = -1.128, $p>0.10$). In step 2-2, the path from autonomy to coordination is significant with 0.263 (t-value = 5.548, $p<0.0001$). When coordination is added in step 2-3, the path coefficient from autonomy to incremental innovation increases from -0.070 (t-value = -1.128, $p>0.10$) in step 2-1 to -0.104 (t-value = -1.628, $p>0.10$) in step 2-3. Sobel's test confirms the significant increasing by a Z-value of 2.390 ($p<0.01$) but it is still non-significant. It is found that the indirect effect of autonomy on incremental innovation via coordination is stronger than the direct effect. With regard to the criteria of mediation, it could be said that coordination fully mediates the relationship between autonomy and incremental innovation as shown in Figure 4-16.

Additionally, coordination is full mediator between autonomy and project efficiency as well. As shown in Table 4-11, the direct path from autonomy to project efficiency is not significant in step 3-1 with 0.054 (t-value = 1.006, $p>0.10$), but the path from autonomy to coordination is significant with 0.263 (t-value = 5.548, $p<0.000$) in step 3-2. In step 3-3, coordination is entered in the model. The direct path from autonomy to project efficiency is insignificant with 0.020 (t-value = 0.715, $p>0.10$), but the path from coordination to project efficiency is significant with 0.345 (t-value = 6.246, $p <0.0001$). Furthermore, Sobel's test confirms with a significant p-value with 4.311 ($p<0.0001$) that the path coefficient of autonomy to project efficiency is significantly decreased from step 3-1 to step 3-3. Given the mediation criteria and results of Sobel's test, it could be suggested that coordination is a full mediator between autonomy and project efficiency as shown in Figure 4-16.

In summary, hypothesis 7a is supported. The results reveal that autonomy has no direct effect on radical innovation, incremental innovation, and project efficiency and coordination fully mediates the relationships between autonomy and radical innovation, incremental innovation and project efficiency. It could be suggested that the granting autonomy has no direct effect on innovation performance, but it fosters free coordination of team members, which finally contributes to promote innovation performance.

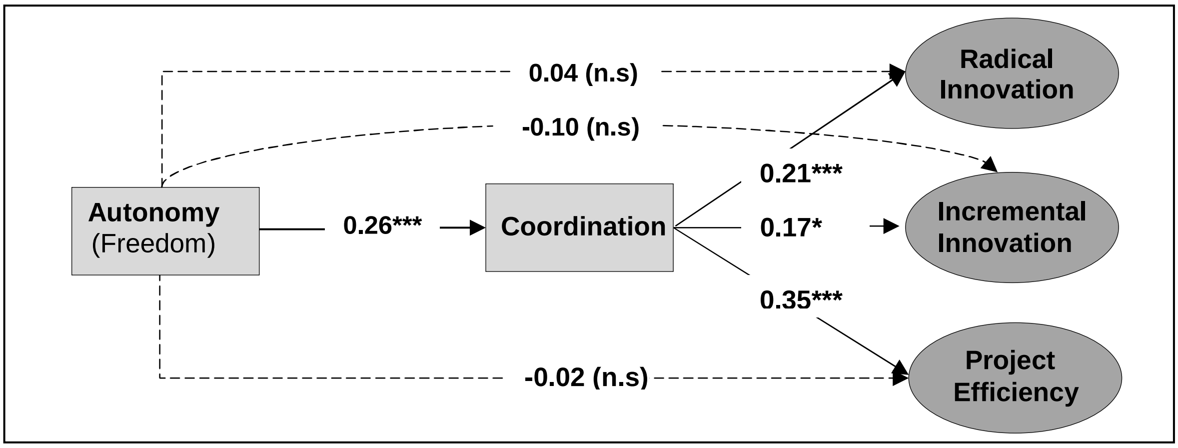


Figure 4-16: Effects of Autonomy and Coordination on Innovation Performance

Notes: Numbers are standardized regression weights after the mediator (communication) has been entered in the model. n.s. is non-significant. Standardized path coefficient is significant at ***p<0.0001 **p<0.001 *p<0.05 and †p<0.10.

Table 4-11: Mediating Effects of Coordination on the Relationship between Autonomy and Innovation Performance

Step	Path	Standardized Estimate	T-value	Results
1	***Sobel's test = 3.052 (p<0.005)***			
1-1	Autonomy→ Radical Innov.	0.063 (ns)	1.133	*Full mediation*
1-2	Autonomy →Coordination	0.263***	5.548	
1-3	Autonomy→Radical Innov.	0.037 (ns)	0.766	
	Coordination →Radical Innov.	0.205***	3.632	
2	***Sobel'l test =2.390 (p= <0.01)***			
2-1	Autonomy→ Incremental Innov.	-0.070 (ns)	-1.128	*Full mediation*
2-2	Autonomy →Coordination	0.263***	5.548	
2-3	Autonomy→Incremental Innov.	-0.104(ns)	-1.628	
	Coordination→Incremental Innovation	0.172*	2.619	
3	***Sobel's test = 4.311 (p<0.0000)***			
3-1	Autonomy→ Project Efficiency	0.054(ns)	1.006	*Full mediation*
3-2	Autonomy →Coordination	0.263***	5.548	
3-3	Autonomy→ Project Efficiency	0.020(ns)	0.715	
	Coordination→ Project Efficiency	0.345***	6.246	

Note: S.E. is Standardized path coefficient significant at ***p<0.0001, **p<0.001, *p<0.05 and †p<0.10. Innov. is innovation.

Hypothesis 7b *is stated that coordination mediates the relationship between monitoring progress and innovation performance (radical innovation, incremental innovation, and project efficiency).* Table 4-12 shows that coordination fully mediates the relationship between monitoring progress and radical innovation. In step 1-1 and 1-2, the direct path from monitoring progress to radical innovation and to coordination are significant with the value of 0.110 (t-value = 1.993, p<0.05) and 0.339 (t-value = 7.345, p<0.0001), respectively. When coordination is entered into the model in step 1-3, the path coefficient of monitoring progress to radical innovation reduces from 0.110 (t-value = 1.993, p<0.05) in step 1.1 to 0.053 (t-value = 0.910, p>0.10) in step 1.3. Furthermore, the path from coordination to radical innovation is significant with 0.192 (t-value = 3.333, $p<0.0001$). To check whether the path coefficient from monitoring progress to radical innovation in step 1-1 and step 1-3 significantly decreased, Sobel' s test was performed. This test reveals a significant Z-value of 3.016 ($p<0.005$) indicating full mediation of coordination. Therefore, it can be concluded that monitoring progress has indirect effect on radical innovation through coordination as shown in Figure 4-17.

In addition, the full mediation of coordination also has been found in the relationship between monitoring progress and incremental innovation. Table 4-12, the results indicate that the direct path from monitoring progress to incremental innovation is not significant with 0.071 (t-value = 1.147, $p>0.10$), but from monitoring progress to coordination is significant with the value of 0.339 (t-value = 7.345, $p<0.000$) in step 2-1 and 2-2. When coordination is entered into the model in step 2-3, the path coefficient of monitoring progress to incremental innovation reduces from 0.071 (t-value = 1.147, $p>0.10$) in step 2-1 to 0.027 (t-value = 0.408, $p>0.10$) in step 2-3. The path from coordination to incremental innovation is significant with 0.139 (t-value = 2.101, $p <0.05$). To check whether the path coefficient from monitoring progress to incremental innovation in step 2-1 and step 2-3 significantly decreases, Sobel' s test was performed and reveals a significant Z-value of 1.996 ($p<0.05$). Consequently, these results indicate that coordination fully mediates the relationship between monitoring progress and incremental innovation as summarized in Figure 4-17.

Coordination also partially mediates the relationship between monitoring progress and project efficiency. In Table 4-12 and Figure 4-17, in step 3-1, and 3-2, the path from monitoring progress to radical innovation and to coordination are significant with values of 0.355 (t-value= 6.928, $p<0.0001$) and 0.339 (t-value = 7.345, $p<0.0001$) in step 3-1 and 3-2. When coordination is entered into the model in step 3-3, the path coefficient of monitoring progress to project efficiency is still significant with 0.285 (t-value = 5.245, $p<0.0001$) and the path from coordination to project efficiency is significant with 0.242 (t-value = 4.501, $p<0.000$). The path coefficient of monitoring to project efficiency decreases from 0.355 (t-value = 6.928, $p<0.0001$) in step 3-1 to 0.285 (t-value = 5.245, $p<0.0001$) in step 3-3 but this path still significantly affects project efficiency. This significant reduction has been confirmed by Sobel's test with a Z-value of 3.783 ($p <0.0001$). With regard to the mediation criteria, all path coefficients are significant indicating partial mediation of coordination. Therefore, it could be concluded that monitoring progress increases project efficiency directly or through coordination.

In summary, hypothesis 7b is supported. Coordination fully mediates the relationship between monitoring progress and radical innovation and incremental innovation. Even monitoring progress does not directly affect radical innovation and incremental innovation, but it affects coordination and finally contributes to radical and incremental innovation. However, it partially mediates the relationship between monitoring progress and project efficiency since monitoring progress has both direct and indirect effects on project efficiency. Therefore, it could be concluded that monitoring progress indirectly affects radical innovation and incremental innovation through coordination. Additionally, monitoring progress may either increase project efficiency directly or increase project efficiency indirectly through coordination.

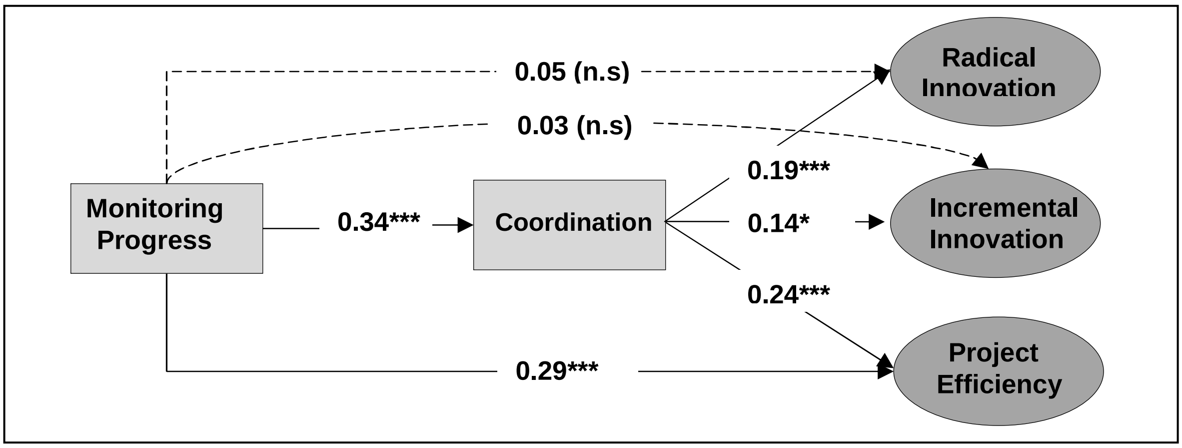


Figure 4-17: Effects of Monitoring Progress and Coordination on Innovation Performance

Notes: Numbers are standardized regression weights after the mediator (communication) has been entered in the model. n.s. is non-significant. Standardized path coefficient is significant at ***p<0.0001 **p<0.001 *p<0.05 and †p<0.10.

Table 4-12: Mediating Effects of Coordination on the Relationship between Monitoring Progress and Innovation Performance

Step	Path	Standardized Estimate	T-value	Results
1	***Sobel's test = 3.016 (p<0.005)***			
1-1	Monitoring progress→ Radical Innov.	0.110*	1.993	*Full Mediation*
1-2	Monitoring progress→Coordination	0.339***	7.345	
1-3	Monitoring progress →Radical Innov.	0.053(n.s)	0.910	
	Coordination →Radical Innov.	0.192***	3.333	
2	***Sobel'l test = 1.996 (p<0.05)***			
2-1	Monitoring progress → Incremental Innov.	0.071(n.s)	1.147	*Full Mediation*
2-2	Monitoring progress →Coordination	0.339***	7.345	
2-3	Monitoring progress →Incremental Innov.	0.027(n.s)	0.408	
	Coordination →Incremental Innov.	0.139*	2.101	
3	***Sobel's test =3.783 (p<0.0001)***			
3-1	Monitoring progress → Project Efficiency	0.355***	6.928	*Partial Mediation*
3-2	Monitoring progress →Coordination	0.339***	7.345	
3-3	Monitoring progress → Project Efficiency	0.285***	5.245	
	Coordination → Project Efficiency	0.242***	4.501	

Note: Note: S.E. is Standardized path coefficient significant at ***p<0.0001, **p<0.001, *p<0.05 and †p<0.10. Innov. is innovation.

Hypothesis 7c *is stated that coordination mediates the relationship between process control and innovation performance (radical innovation, incremental innovation, and project efficiency).* Table 4-13 shows that the coordination partially mediates the relationship between process control and radical innovation. In step 1-1 and 1-2, all paths from process control to radical innovation and to coordination are significant with values of 0.229 (t-value= 4.220, $p<0.0001$) and 0.165 (t-value= 3.400, $p<0.0001$), respectively. When the mediator (coordination) is added into the model (step1-3), all paths from process control to radical innovation and from coordination to incremental innovation are significant with 0.198 (t-value = 3.641, $p<0.0001$) and 0.169 (t-value = 3.138, $p<0.05$) achieving partial mediation. Sobel's test was performed and a Z value of 2.308 ($p<0.05$) revealed a significant reduction in the direct path from 0.229 (t-value = 4.220, $p<0.0001$) in step 1-1 to 0.198 (t-value = 3.641, $p<0.0001$) in step 1-3. Based on the criteria, these findings reveal the partial mediation of coordination. Therefore, it could be concluded that process control has both direct and indirect effects on radical innovation through coordination as shown in Figure 4-18.

With reference to Table 4-13 in step 2-1, the direct effect of process control on incremental innovation is found with the value of 0.163 (t-value= 2.570, $p<0.01$), and path from process control to coordination is significant as well with 0.165 (t-value=3.400, $p<0.0001$). When coordination is entered in step 2-3, the effect of process control on incremental innovation decreases from 0.163 (t-value = 2.570, $p<0.01$) in step 2-1 to 0.142 (t-value = 2.229, $p<0.05$) in step 2-3. The path from coordination to incremental innovation is significant with 0.122 (t-value = 1.945, $p<0.10$). Sobel's test reveals that this reduction is statistically significant with Z-value = 1.699 ($p<0.10$). Based on the criteria, coordination is a mediator the relationship between process control and incremental innovation. Therefore, process control has both a direct effect and indirect effect on incremental innovation through coordination of team members as shown in Figure 4-18.

In addition, coordination full mediates the relationship between process control and project efficiency. As shown in Table 4-13 and Figure 4-18, in step 3-1, process control has a non-significant effect on project efficiency with -0.032 (t-value = -0.610, $p>0.10$). In step 3-2, path from process control to coordination is significant with 0.165 (t-value = 3.400, $p<0.0001$). When coordination is entered in step 3-3, the effect of process control on project efficiency decreases from step 1 and is still not significant with -0.076 (t-value = -1.434, $p>0.10$) but the path from coordination to project efficiency is significant with 0.352 (t-value = 6.535, $p<0.0001$). Sobel's test confirms the significant reduction in direct effect with a Z-value of 3.038 ($p<0.005$). This finding indicates full mediation of coordination based on mediation's criteria and Sobel's test. Consequently, process control has only an indirect effect on project efficiency through coordination of team members.

In summary, hypothesis 7c is supported. The results reveal that process control increases both radical innovation and incremental innovation directly. Process control also directly encourages coordination of team members, thereby contributing to radical innovation and incremental innovation. However, in order to enhance project efficiency, process control needs to be implemented together with encouraging coordination of team members.

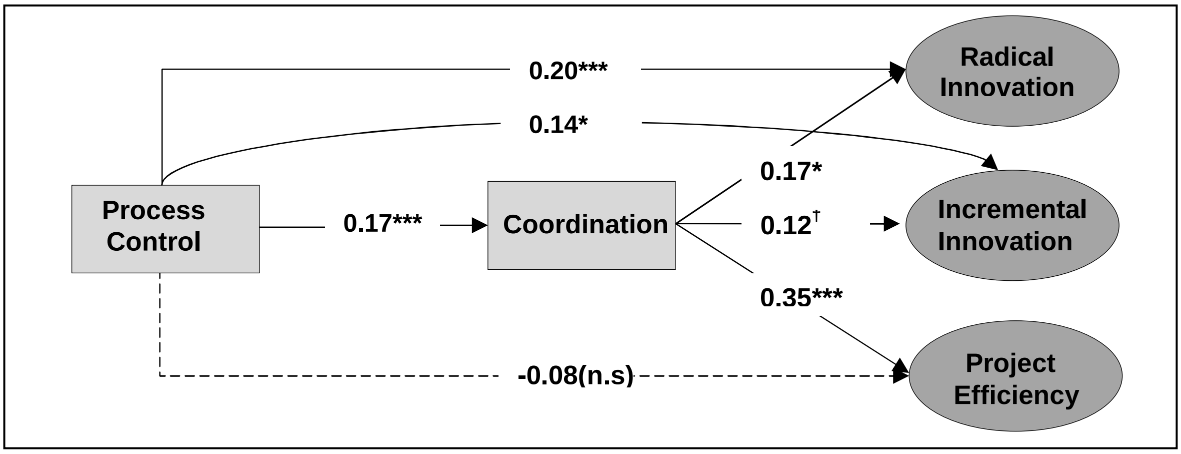


Figure 4-18: Effects of Process Control and Coordination on Innovation Performance

Notes: Numbers are standardized regression weights after the mediator (communication) has been entered in the model. n.s. is non-significant. Standardized path coefficient is significant at ***p<0.0001 **p<0.001 *p<0.05 respectively †p<0.10.

Table 4-13: Mediating Effects of Coordination on the relationship between Process Control and Innovation Performance

Step	Path	Standardized Estimate	T-value	Results
1	***Sobel's test = 2.308 (p<0.05)***			
1-1	Process Control→ Radical Innov.	0.229***	4.220	*Partial mediation*
1-2	Process Control →Coordination	0.165***	3.400	
1-3	Process Control →Radical Innov.	0.198***	3.641	
	Coordination →Radical Innov.	0.169*	3.138	
2	***Sobel'l test = 1.699 (p<0.10)***			
2-1	Process Control → Incremental Innov.	0.163**	2.570	*Partial mediation*
2-2	Process Control →Coordination	0.165***	3.400	
2-3	Process Control →Incremental Innov.	0.142*	2.229	
	Coordination→Incremental Innov.	0.122†	1.945	
3	***Sobel's test =3.038 (p<0.005)***			
3-1	Process Control → Project Efficiency	-0.032(ns)	-0.610	*Full mediation*
3-2	Process Control →Coordination	0.165***	3.400	
3-3	Process Control → Project Efficiency	-0.076(ns)	-1.434	
	Coordination→ Project Efficiency	0.352***	6.535	

Note: S.E. is Standardized path coefficient significant at ***p<0.0001, **p<0.001, *p<0.05 and †p<0.10. Innov. is innovation.

Hypothesis 7d *is predicted that coordination mediates the relationship between output control and innovation performance (radical innovation, incremental innovation, and project efficiency).* As shown in Table 4-14 step 1-1 and 1-2 the path from output control to radical innovation is not significant with 0.057 (t-value = 1.038, $p>0.10$) but the path from coordination to radical innovation is significant with 0.131 (t-value = 2.681, $p<0.05$). In addition, when coordination is entered in step 1-3, the effect of output control to radical innovation reduces from 0.057 (t-value = 1.038, $p>0.10$) in step 1-1 to 0.034 (t-value = 0.614, $p>0.10$) in step 1-3, and path from coordination to radical innovation is significant with 0.205 (t-value= 3.737, $p<0.0001$). Sobel's test was performed to test whether the effect of output control on radical innovation decreases and the Z-value revealed a significant reduction with 2.169 ($p<0.05$). Regarding, mediation criteria, only indirect effects of path coefficients are significant indicating full mediation of coordination. Therefore, these results suggest that output control has an indirect effect on radical innovation through coordination of team members as summarized in Figure 4-19.

Table 4-14 presents the significant paths from output control to incremental innovation, and from coordination to incremental innovation with 0.211 (t-value = 3.274, $p<0.001$) and 0.131 (t-value = 2.681, $p<0.05$) in steps 2-1 and 2-2. When coordination is added in step 2-3, the path coefficient of output control on incremental innovation decreases from step 2-1 but it is still significant with 0.192 (t-value = 3.006, $p<0.05$). The path from coordination to incremental innovation is significant with 0.118 (t-value = 1.925, $p<0.10$) as well. Sobel's test was performed to test whether the effect of output control on incremental innovation decreases and the Z-value revealed an insignificant reduction of the direct effect of coordination with 1.564 ($p>0.10$). Even though all path coefficients are significant, the direct path coefficient of output control on incremental innovation is found to be stronger than the indirect effect through coordination. Hence, coordination does not mediate the relationship between output control and incremental innovation. In other words, output control has stronger direct effect on incremental innovation than the indirect effect on incremental innovation via coordination as shown in Figure 4-19.

In steps 3-1 and 3-2, as shown in Table 4-14, the paths from output control to project efficiency and output control to coordination are significant with 0.195 (t-value = 3.793, $p<0.0001$) and 0.131 (t-value = 2.681, $p<0.05$) respectively. When coordination is added in step 3-3, the effect of the direct path from output control to project efficiency reduces from 0.195 (t-value = 3.793, $p< 0.0001$) in step 3-1 to 0.153 (t-value = 2.917, $p<0.05$) in step 3-3 but this path is still significant. In addition, the path from coordination to project efficiency is significant with 0.314 (t-value = 5.917, $p<0.0001$). With regard to the mediation criteria, this suggests a partial mediation of coordination. Therefore, output control has direct impact and an indirect impact through coordination on project efficiency as shown in Figure 4-19.

In summary, hypothesis 7d is supported. Coordination fully mediates the relationship between output control and radical innovation, but it partially mediates the relationship between output control and incremental innovation and project efficiency. It could be said that output control has an indirect effect on radical innovation, incremental innovation, and project efficiency through coordination. Output control increases directly incremental innovation and project efficiency as well.

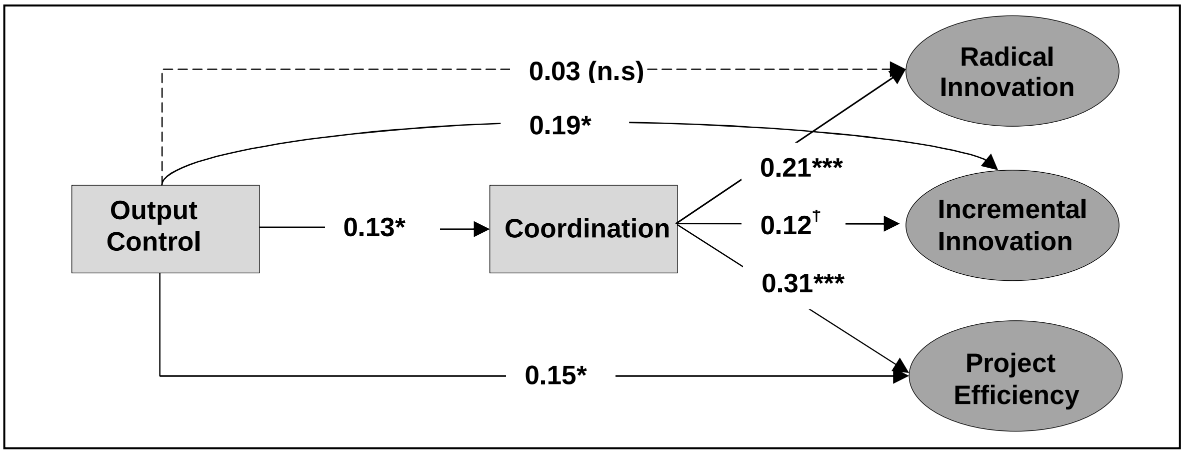


Figure 4-19: Effects of Output Control and Coordination on Innovation Performance

Notes: Numbers are standardized regression weights after the mediator (communication) has been entered in the model. n.s. is non-significant. Standardized path coefficient is significant at ***$p<0.0001$ **$p<0.001$ *$p<0.05$ and $^{\dagger}p<0.10$

Table 4-14: Mediating Effects of Coordination on the Relationship between Output Control and Innovation Performance

Step	Path	Standardized Estimate	T-value	Results
1	***Sobel's test =2.169 (p<0.05)***			
1-1	Output Control→ Radical Innov.	0.057(ns)	1.038	*Full mediation*
1-2	Output Control →Coordination	0.131*	2.681	
1-3	Output Control →Radical Innov.	0.034(ns)	0.614	
	Coordination →Radical Innov.	0.205***	3.737	
2	***Sobel's test = 1.564 (p>0.10)***			
2-1	Output Control → Incremental Innov.	0.211**	3.274	*Partial mediation*
2-2	Output Control →Coordination	0.131*	2.681	
2-3	Output Control →Incremental Innov.	0.192*	3.006	
	Coordination →Incremental Innov.	$0.118^{\dagger}$	1.925	

Table 4-14: Mediating Effects of Coordination on the Relationship between Output Control and Innovation Performance (Continued)

Step	Path	Standardized Estimate	T-value	Results
3	***Sobel's test =2.440 (p<0.01)***			
3-1	Output Control → Project Efficiency	0.195***	3.793	*Partial mediation*
3-2	Output Control →Coordination	0.131*	2.681	
3-3	Output Control → Project Efficiency	0.153*	2.917	
	Coordination→ Project Efficiency	0.314***	5.917	

Note: Note: S.E. is Standardized path coefficient significant at ***p<0.0001, **p<0.001, *p<0.05 and †p<0.10. Innov. is innovation.

4.5.3 Moderator Effects

To test the moderating effects of hypothesis 8 through hypothesis 15, a multi-group analysis was performed which compares the difference or similarly of path coefficients for two groups.

Splitting group process: Four hundred thirty five members (434) were divided into two groups based on members' score on individualism by using a median split (Arnold, 1982).

Invariance Testing Procedures: As there are different sub-groups especially in a cross-national context, items and scales may have unequal values. Because this is a cross-cultural study, the validity of the structure models and scales developed in one group have to be examined and supported in other groups as well. In that, the instrument of measurement has to work in the same way (Byrne, 2004; Drasgow and Kansfer, 1985). Therefore, before conducting a multi-group analysis, the measurement of items, constructs, and path coefficients have to be invariant. This time, testing invariance of the constructs was performed simultaneously across the two groups; in which all parameters were estimated for two groups at the same time.

Invariance testing of the measurement model across two groups by AMOS was applied as described by Byrne (2004). First, the baseline model with free estimation was performed simultaneously across two groups at the same time. Then, all measurement parameters were constrained to be equal in both groups via maximum likelihood. To test the invariance between two groups, the chi-square was checked by comparison to the baseline model, in which all constructs were freely estimated against another model (constrained structure parameters constructs). By doing so, the structural paths are equal across groups, yielding a chi-square value for the "constrained model" (Tabachnick and Fidell, 1996). If the constrained model is worse than the unconstrained model by showing significant p-value in the comparison between unconstrained and constrained model, this means that there are some unequal parameters (Robert, Probst, Martocchio, Drasgrow, and Lawler, 2000).

4.5.3.1 High Individualism and Low Individualism

After splitting all respondents into two groups based on their score on individualism, these two groups were compared. Project team members were classified based on a score of individualism. The first group consisted of high individualism team members with individualism score ranking from 2.33 - 5.00. The second group was low individualism team members with individualism scores ranking from 1.00 - 2.33. Before comparing the differences of path coefficients between these high and low individualism groups of members, testing of invariance approach and criteria across two groups by AMOS as described by Byrne (2004), were conducted.

To check whether the factor loadings were invariant across two groups, the unconstrained model was compared to constrained model in which the factor loading were specific invariance across two groups. Table 4-15 shows the comparison between an unconstrained model, a fully constrained model and a best fit model and their fit indices. The baseline model/unconstrained model (model1) is freely estimated for all parameters. The fully constrained model (model2) is employed to control invariance of all parameters across two groups (high and low individualism). According to the results of invariance testing as shown in Table 4-15, the chi-square value, degree of freedom (DF), CFI, and RMSEA of the fully constrained model are worse than unconstrained model. As reported in Table 4-15, X^2 changes from 207.141 to 220.813, and degree of freedom (DF) changed from 126 to 133, and CFI decreases from 0.914 to 0.907. Importantly, the P-value is significant (p = 0.057) indicating a large chi-square difference between the two groups. Thus, in order to find the best fit model and invariance of all parameters across the two groups, another step was conducted. Byrne (1998) and Marsh (1994) propose the least restrictive model that does not require any of the parameters estimates to be the same in different groups. Some fixed parameters and freed some parameters are employed. With the above procedures of free and fixed parameters, the best-fit model with a small improvement on goodness of fit indices was found as shown in Table 4-15 model 3 (Best model). Importantly, the results are confirmed by the non-significance of the P-value (p = 0.151). Therefore, the measurement model is invariant between high and low individualism members. For this reason, the path-coefficients of the structural model across these two groups could be compared and interpreted.

Table 4-15: Comparison of Unconstrained, Fully Constrained, and Best Fit Model

	Model	X^2	DF	X2/DF	CFI	RMSEA	△X^2	△DF	P-Value
1	Unconstrained	207.141	126	1.644	0.914	0.039			
2	Fully Constrained	220.813	133	1.660	0.907	0.039	13.672[a]	7[a]	0.057
3	Best Model	216.567	132	1.641	0.910	0.039	9.426[b]	6	0.151

Notes: [a] comparing between Model 2 and Model 1, [b] comparing between Model 3 and Model 1

After the invariance model (the best fit model) is developed, then the model can be estimated simultaneously across two groups at the same time. Therefore, paths between two groups can be compared. Table 4-16 summarizes the measured paths (column 1), the standard estimation (path coefficient) and critical ration (t-value) of each group (columns 2 and 3), and a comparison of the differences in specific path coefficient between two groups of respondents (column 4). T-values higher than 1.96 are regarded as significant at a 5% level and p-values less than 0.05 indicate a significant difference in specific path across two groups. Figure 4-20 illustrates the effects of all path coefficients between high and low individualist team members and Figure 4-21 depicts clearly the statistical differences of each path coefficient on innovation performance between high and low individualist team members.

Table 4-16: Path Coefficients Comparing between High and Low Indiv. Members

Paths	1) High Indiv		2) Low Indiv		Chi-square test (Measuring of Difference of Path)
	S.E	t-value	S.E	t-value	
Hypothesis 8: High Indiv. > Low Indiv.					
a: Autonomy→ Radical Innov.	**0.126**†	1.694	0.019	0.238	△X^2 = 0.848 (p =.357)
b: Autonomy →Incremental Innov.	0.022	0.258	-0.142	-1.644	△X^2 = 1.864 (p =.172)
c: Autonomy→Project Efficiency	0.075	1.020	0.035	0.457	△X^2 = 0.079 (p =.779)
Hypothesis 10: High Indiv. > Low Indiv					
a: Monitoring progress→Radical Innov.	0.113	1.532	0.117	1.483	△X^2 = 0.000 (p =.992)
b: Monitoring progress→Incremental Innov	0.127	1.502	-0.008	-0.101	△X^2 = 1.337 (p =.249)
c: Monitoring progress→Project Efficiency	**0.408*** **	6.481	**0.235** **	3.105**	△X^2 = 4.294 (p =.043)
Hypothesis 12: Low Indiv > High Indiv.					
a: Process control→ Radical Innov.	**0.311*** **	3.983	**0.149**†	1.875	△X^2 = 3.697 (p =.055)
b: Process control →Incremental Innov	0.115	1.360	**0.166**†	1.924	△X^2 = 0.023 (p =.879)
c: Process control→Project Efficiency	0.047	0.738	**-0.138**†	-1.828	△X^2 = 3.108 (p =.078)
Hypothesis 14: High Indiv > Low Indiv.					
a: Output control → Radical Innov.	**0.124**†	1.682	-0.039	-0.494	△X^2 = 2.306 (p =.129)
b: Output control →Incremental Innov.	**0.182***	2.132	**0.222***	2.511	△X^2 = 0.051 (p =.821)
c: Output control→Project Efficiency	**0.235*** **	3.743	0.121	1.613	△X^2 = 1.734 (p =.188)

Note: S.E. is Standardized path coefficient significant at ***p<.0001, **p<.001, *p<0.05 and †p<0.10. Indiv. is individualist team members and Innov. is innovation.

Hypothesis 8 *is stated that autonomy is likely to increase innovation performance (radical innovation, incremental innovation, and project efficiency) for high individualist team members rather than low individualist (collectivist) team members.* As shown in Table 4-16, autonomy increases radical innovation with 0.126 (t-value = 1.694, $p<0.10$) for high individualist team members. The same path from autonomy to radical innovation is non-significant for low individualist team members with 0.019 (t-value = 0.238, $p>0.10$). In addition, the effect of path from autonomy to incremental innovation is non-significant with 0.022 (t-value = 0.258, $p>0.10$) for high individualist team members and with -0.142 (t-value = 1.644, $p>0.10$) for low individualist team members. The path from autonomy to project efficiency is non-significant as well in both high and low individualist team members with 0.075 (t-value = 1.020, $p>0.10$) and with 0.035 (t-value = 0.457, $p>0.10$) respectively. Furthermore, the chi–square, computed for testing the difference between the two groups, shows that all paths from autonomy to radical innovation (X^2 = 0.848, $p>0.10$), to incremental innovation (X^2 = 1.864, $p>0.10$), and to project efficiency (X^2 = 0.079, $p>0.10$) are not significantly different indicating no difference between these two groups. Therefore, hypothesis 8 is partially supported. It could be concluded that autonomy increases radical innovation performance only for high individualist team members; however, granting autonomy does not enhance innovation performance for low individualist team members as shown in Figure 4-20 and Figure 4-21.

Hypothesis 10 *is stated that monitoring progress is likely to increase innovation performance (radical innovation, incremental innovation, and project efficiency) for high individualists rather than low individualists.* In Table 4-16, the results show that monitoring progress increases only project efficiency with 0.408 (t-value = 6.481, $p<0.0001$) for high individualists and with 0.235 (t-value = 3.105, $p<0.001$) for low individualist team members. The effect of monitoring progress on radical innovation is not significant with 0.113 (t-value = 1.532, $p>0.10$) for high individualists and with 0.117 (t-value = 1.483, $p>0.10$) for low individualist team members respectively. In addition, the effect of monitoring progress on incremental innovation is not significant for high and low individualist team members with 0.127 (t-value = 1.502, $p>0.10$) and -0.008 (t-value = -0.101, $p>0.10$) respectively. Additionally, the chi-square test shows that paths from monitoring progress to radical innovation (X^2 = 0.000, $p>0.10$) and to incremental innovation (X^2 = 1.337, $p>0.10$) are not significantly different between these two groups.

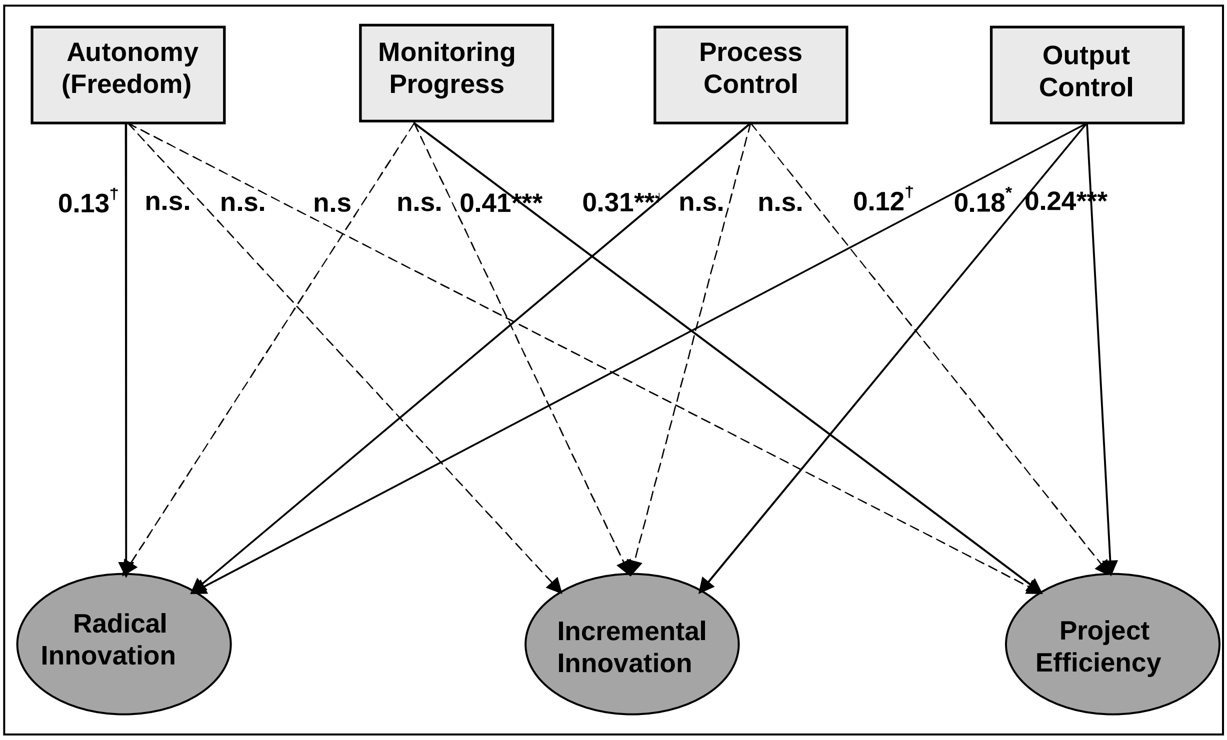
The results in Table 4-16 show that monitoring progress increases project efficiency for both high and low individualist team members, and the chi-square test reveals that the effect of monitoring progress on project efficiency is stronger for high individualists rather than for low individualist team members (X^2 = 4.294, p<0.05) as shown in Figure 4-20 and Figure 4-21. Therefore, hypothesis 10 partially confirmed. The findings revealed the positive effect of monitoring progress on project efficiency in both high and low individualist team members; however, the effect of monitoring progress is stronger for high individualist team members.

Hypothesis 12 *is stated that process control is likely to increase innovation performance (radical innovation, incremental innovation, and project efficiency) for low individualist team members rather than high individualist team members.* The results in Table 4-16 show that the path coefficient of process control increases radical innovation with 0.311 (t-value = 3.983, p<0.0001) for high individualist team members and with 0.149 (t-value = 1.875, p<0.10) for low individualist team members. In addition, the chi-square different test shows a significant p-value (X^2 = 3.697, p<0.10). This indicates that the effect of process control on radical innovation is different between high and low individualism team members. The effect of process control on radical innovation is stronger for high individualists as shown in Figure 4-21 in the first panel. With regard to incremental innovation, the results expose that the effect of the path from process control to incremental innovation is significant with 0.166 (t-value = 1.924, p<0.10) for low individualist team members, but is non-significant with 0.115 (t-value = 1.360, p>0.10) for high individualist team members. The chi-square different test of path coefficients from process control to incremental innovation shows a non-significant p-value (X^2 = 0.023, p>0.10) demonstrating no differences between the two groups. In addition, the effect of process control on project efficiency is not significant with 0.047 (t-value = 0.738, p>0.10) for high individualists but it is negatively significant with -0.138 (t-value = -1.828, p<0.10) for low individualist team members. The chi-square difference test of this path coefficient shows a significant p-value (X^2 = 3.108, p<0.10) indicating a different effect between high and low individualism team members. Consequently, process control decreases project efficiency for low individualist team members but there is no statistical effect for high individualists as shown in Figure 4-20 and in the third panel of Figure 4-21.

These results suggest that process control promotes radical innovation for both high and low individualism team members but the effect is stronger for high individualism team members. In addition, process control also enhances incremental innovation and decreases project efficiency for low individualism team members. Therefore, hypothesis 12 is partially supported.

Hypothesis 14 *is stated that the effect of output control is likely to increase innovation performance (radical innovation, incremental innovation, and project efficiency) for high* *individualist team members rather than low individualist (collectivist) team members.* The results in Table 4-16 show that output control has a direct effect on radical innovation, on incremental innovation, and project efficiency with 0.124 (t-value = 1.682, $p<0.10$), 0.182 (t-value= 2.132, $p<0.05$), and 0.235 (t-value = 3.743, $p<0.05$) for high individualist team members respectively. On the contrary, output control has a non-significant effect on radical innovation with -0.039 (t-value= -0.494, $p>0.10$) and on project efficiency with 0.121 (t-value= 1.613, $p>0.10$) for low individualist team members. However, output control increases incremental innovation with 0.222 (t-value = 2.511, $p<0.05$) for low individualist team members. Furthermore, the results of the chi square difference test comparing the path from output control to radical innovation (X^2 = 2.306, $p>0.10$), incremental innovation (X^2 = 0.051, $p>0.10$) and project efficiency (X^2 = 1.734, $p>0.10$)) shows a non-significant p-value as shown in Table 4-16 indicating no significant differences between high and low individualism team members. Therefore, hypothesis 14 is supported for the high individualism team members. It could be said that output control promotes innovation performance for high individualist team members, but that it promotes only incremental innovation for low individualism team members as shown in Figure 4-20, and Figure 4-21.

High Individualists (N = 224)



Low Individualists (N = 207)

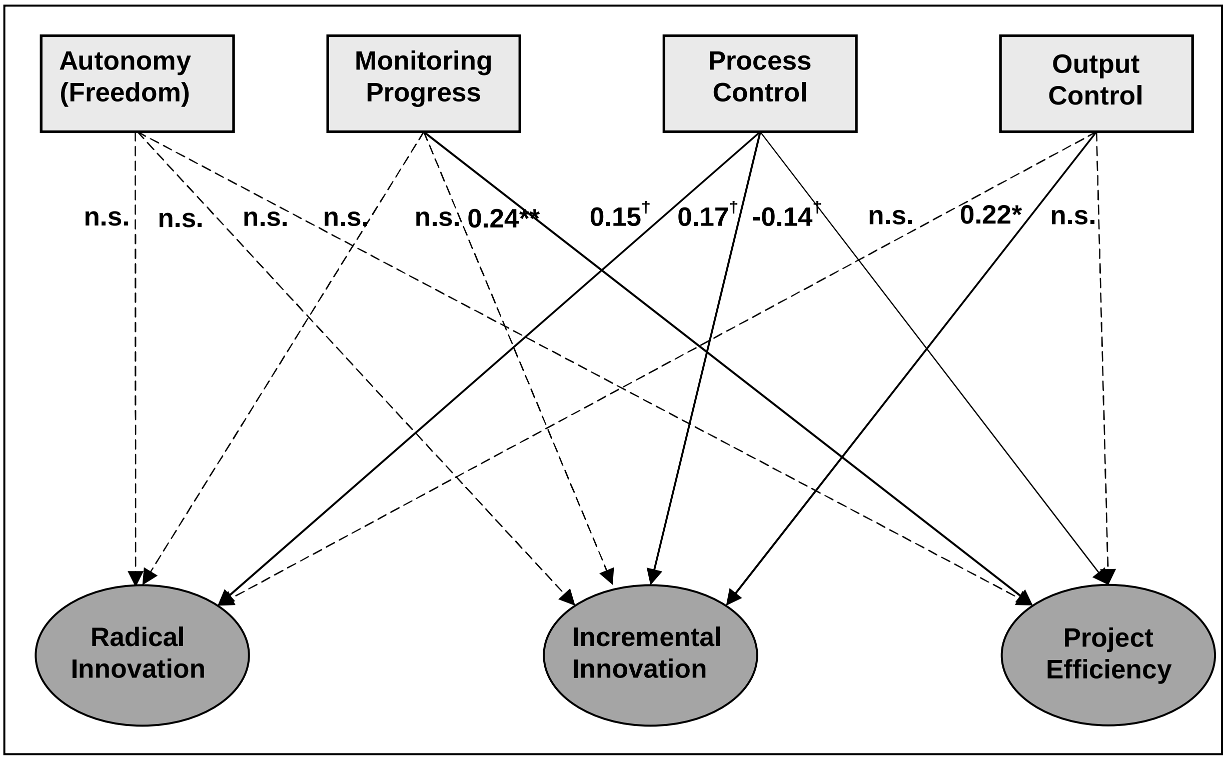


Figure 4-20: Path Coefficients Comparing between High and Low Individualists

Notes: Model Fit with $X^2/DF = 1.641$, CFI = 0.910, RMSEA = 0.039. Solid lines are significant paths at ***p<.0001 **p<.001 *p<0.05 †p<0.10. Dotted lines/ (n.s.) are not significant paths.

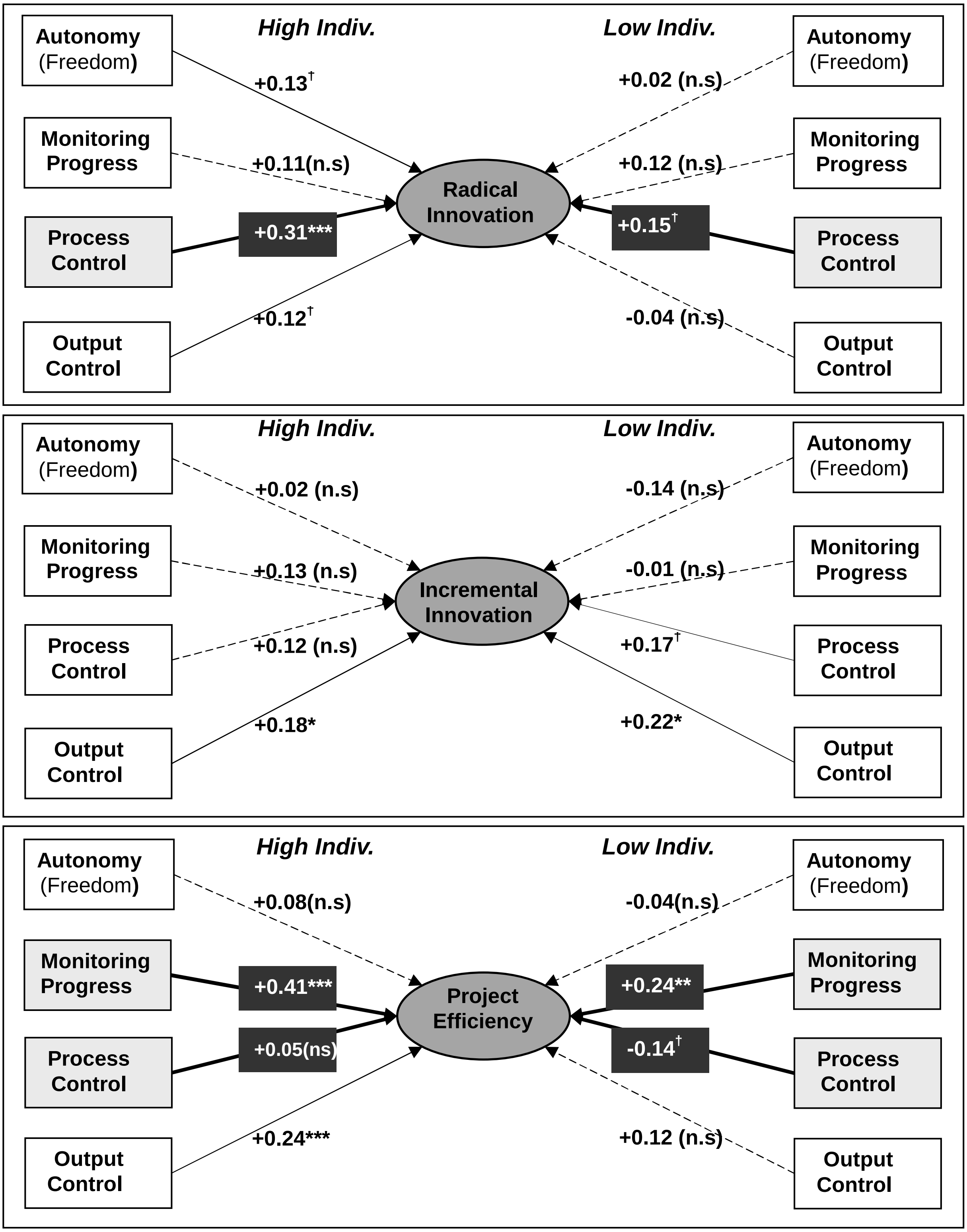


Figure 4-21: Differences of PMMs on Innovation Performance (High and Low Individualists)

Notes: The heavy solid lines are significant difference of path coefficient between two groups. Solid lines are significant paths at ***p<0.0001 **p<0.001 *p<0.05 †p<0.10. Dotted lines/ (n.s) are non-significant paths.

4.5.3.2 High Power Distance and Low Power Distance

Similar to the previous separated groups, all project team members (N= 434) were divided into two groups based on their score on power distance. The first group consisted of high power distance team members with power distance scores ranging from 2.00 – 5.00. The second group was low power distance with scores ranging from 1.00 - 1.67. Before comparing and interpreting the effects of the path coefficients between these two groups, invariance testing approach was conducted as described by Byrne (2004) as mentioned in Session 4.5.3.

To check whether the factor loadings were invariant across the two groups, the unconstrained model was compared to constrained model in which the factor loading was specifically invariant across the two groups. Table 4-17 shows the comparison between the unconstrained model and fully constrained model. The baseline model or unconstrained model (model1) is freely estimated for all parameters. The fully constrained model (model2) employed the procedures of invariance construction for all parameters across the two groups. Consequently, the results of invariance testing show that the chi-square value, degree of freedom (DF), CFI, and RMSEA of the constrained model are better than the unconstrained model as shown in Table 4-17. As reported in Table 4-17, X^2 changes from 226.277 to 229.625, the degree of freedom (DF) changes from 126 to 133, and the CFI value increases from 0.896 to 0.900. Importantly, the P-value is not significant (P-value = 0.851) indicating a small chi-square difference between two groups.

Table 4-17: Comparison of Unconstrained and Fully Constrained Model Fits

	Model	X^2	DF	X2/DF	CFI	RMSEA	$\triangle X^2$	$\triangle$DF	P-Value
1	Unconstrained	226.277	126	1.796	0.896	0.043			
2.	Fully Constrained	229.625	133	1.727	0.900	0.041	3.348[a]	7[a]	0.851

[a] comparing between Model 2 and Model 1

After the invariance model was found, then the model can be estimated simultaneously across two groups at the same time. Consequently, all paths between two groups can be interpreted and compared to test hypotheses. Table 4-18 summarizes the measured paths in column 1, the standard estimation (path coefficient) and critical ration (t-value) of each group in column 2-3, and comparing the differences of specific path coefficient between two groups of respondents in column 4. T-value is higher than 1.96 regarded significant at 5% level and P-value is less than 0.05 indicating significant different of specific path across two groups. Figure 4-22 illustrates the effects of all path coefficients between high and low power distance team members and Figure 4-23 depicts clearly the statistical differences of each path coefficient on innovation performance between high and low power distance team members.

Table 4-18: Path Coefficients Comparing between High and Low PD. Team Members

Paths	**1) High PD**		**2) Low PD**		**Chi-square test (Measuring of Difference of Path)**
	S.E	t-value	S.E	t-value	
Hypothesis 9: Low PD > High PD					
a: Autonomy→ Radical Innov.	**-0.146**†	-1.709	**0.194***	2.698	$\triangle X^2$ = 9.930 (p =.002)
b: Autonomy →Incremental Innov.	-0.029	-0.330	-0.079	-0.897	$\triangle X^2$ = 0.181 (p =.671)
c: Autonomy→Project Efficiency	**0.124**†	1.711	0.02	0.340	$\triangle X^2$ = 0.916 (p =.338)
Hypothesis 11: High PD and Low PD					
a: Monitoring progress→Radical Innov.	**0.154**†	1.799	**0.122**†	1.730	$\triangle X^2$ = 0.002 (p =.996)
b: Monitoring progress→Incremental Innov.	0.045	0.518	0.063	0.714	$\triangle X^2$ = 0.022 (p =.883)
c: Monitoring progress→Project Efficiency	**0.319*****'	4.404	**0.365*****	5.529	$\triangle X^2$ = 0.273 (p =.602)
Hypotheses 12: High PD> Low PD					
a: Process control→ Radical Innov.	0.110	1.305	**0.273****	3.718	$\triangle X^2$ = 3.511 (p =.061)
b: Process control →Incremental Innov	**0.240***	2.649	0.084	0.959	$\triangle X^2$ = 1.506 (p =.220)
c: Process control→Project Efficiency	-0.062	-1.001	-0.023	-0.345	$\triangle X^2$ = 0.243 (p =.622)
Hypotheses 15: Low PD> High PD					
a: Output control → Radical Innov.	0.126	1.490	0.033	0.472	$\triangle X^2$ = 0.666 (p =.415)
b: Output control →Incremental Innov.	0.075	0.859	**0.284***	3.077	$\triangle X^2$ = 2.127 (p =.145)
c: Output control→Project Efficiency	**0.175***	2.424	**0.205***	3.126	$\triangle X^2$ = 0.003 (p =.953)

Notes: S.E. is Standardized path coefficient significant at ***p<.0001 **p<.001 *p<0.05 †p<0.10.
PD is power distance team members and Innov. is innovation.

Hypothesis 9 *is stated that* autonomy is likely to decrease innovation performance *(radical innovation, incremental innovation, and project efficiency) for high power distance rather than low power distance team members.* As shown in Table 4-18 and Figure 4-22 - Figure 4-23, the path from autonomy to radical innovation is negatively significant with -0.15 (p< 0.10) for high power distance members, but the effect is positively significant for low power distance members with 0.19 (p< 0.05). Interestingly, the effect of autonomy on radical innovation between the two groups is different. In addition, the chi square is significant (X^2 = 9.930, p<0.05) which is higher than the critical value of 3.84 (at the 5% level) indicating the difference between two groups as shown in the first panel of Figure 4-23.

In addition, the path from autonomy to incremental innovation is non-significant with -0.029 (t-value = -0.330, p>0.10) for high power distance team members and with -0.079 (t-value = -0.897, p>0.10) for low power distance members. The path from autonomy to project efficiency is significant only for high power distance members with 0.12 (t-value = 1.711, $p<0.10$), but it is not significant with 0.02 (t-value = 0.340, $p>0.10$) for low power distance members. However, the chi-square difference test revealed a non-significant difference in the effects of autonomy on incremental innovation ($X^2 = 0.181$, $p >0.10$) and on project efficiency ($X^2 = 0.916$, $p>0.10$) demonstrating no difference in these effects between the two groups as shown in Table 4-18.

Thus, the results suggest that high power distance members differ from low power distance members in that increasing autonomy is related to the growth of radical innovation for low power distance members but a decrease in the growth of radical innovation for high power distance members. Thus, hypothesis 9 is partially confirmed as shown in Figure 4-22, and Figure 4-23.

Hypothesis 11 *is stated that monitoring progress is likely to increase innovation performance (radical innovation, incremental innovation and project efficiency) for high and low power distance members.* As shown in Table 4-18 and Figure 4-22 and Figure 4-23, the results show that monitoring progress significantly increases radical innovation with values of 0.15 (t-value = 1.799, $p <0.10$) and 0.12 (t-value = 1.730, $p<0.10$) for high and low power distance team members, respectively. The chi-square test reveals that the effect of monitoring progress on radical innovation between high and low power distance members is not different due to a non-significant p-value ($X^2=0.002$, $p>0.10$). Therefore, it could be concluded that monitoring progress enhances radical innovation for both high and low power distance members.

Furthermore, the path from monitoring progress to incremental innovation is insignificant for high and low power distance members with values of 0.045 (t-value= 0.518, $p>0.10$) and 0.063 (t-value= 0.714, $p>0.10$), respectively. The chi-square difference test confirms this based on a non-significant p-value ($X^2= 0.022$, $p>0.10$) indicating no difference between the two groups on this path. The path from monitoring progress to project efficiency is significant for high and low power distance members with values of 0.32 (t-value= 4.404, $p<0.001$), and 0.37 (t-value= 5.529, $p<0.001$) respectively. Again, the chi-square test shows a non-significant p-value ($x^2= 0.273$, $p>0.10$), indicating that there is no difference between high and low power distance team members on this path as shown in Table 4-18 and Figure 4-22 and 4-23.

Thus, hypothesis 11 is partial confirmed. It could be suggested that monitoring progress increases radical innovation and project efficiency for high and low power distance, while it has no effect on incremental innovation for both groups.

Hypothesis 13 *is stated that process control is likely to increase innovation performance (radical innovation, incremental innovation, and project efficiency) for high power distance team rather than low power distance members.* As shown in Table 4-18, the path coefficient from process control to radical innovation is insignificant for high power distance with 0.11 (t-value= 1.315, p>0.10), but it is significant for low power distance with 0.27 (t-value= 3.718, p <0.001). Furthermore, the chi square difference test shows that there is a difference between high and low power distance on this path coefficient due to a significant p-value (X^2= 3.511, p<0.10) as shown in Figure 4-23 in the first panel. This test reveals that the effect of process control on radical innovation is stronger for low power distance team members than for high power distance team members. The results also show that process control increases incremental innovation for high power distance team members with 0.24 (t-value= 2.649, p<0.05), but it is insignificant for low power distance with 0.08 (t-value = 0.959, p >0.10). However, the chi- square test shows that there is no difference in the effect of process control on incremental innovation between high and low power distance members based on a non-significant p-value (X^2= 1.506, p>0.10). In addition, process control does not significantly affect project efficiency for both high and low power distance team members with values of -0.06 (t-value= -1.001, p>0.10), and -0.02 (t-value= -0.345, p>0.10), respectively. In addition, chi square test confirms that there is no difference in the effect of process control on project efficiency (X^2= 0.243, p>0.10) between these two groups.

Therefore, process control has different effects on innovation performance for different groups of members. Process control increases the growth of radical innovation for low power distance members and increases the growth of incremental innovation for high power distance members. However, process control had no effect on project efficiency for either group. Hence, hypothesis 13 is partially supported.

Hypothesis 15 *is stated that output control is likely to increase innovation performance in radical innovation, incremental innovation, and project efficiency for low power distance members rather than high power distance members.* In Table 4-18, the results show that output control has an insignificant effect on radical innovation for high and low power distance members based on values of 0.13 (t-value= 1.490, p>0.10) and 0.03 (t-value= 0.472, P>0.10), respectively. Output control has a significant effect on incremental innovation for low power distance team members with 0.28 (t-value= 3.077, p<0.05) but an insignificant effect on incremental innovation for high power distance team members with 0.08 (t-value = 0.859, p>0.10). Additionally, the path coefficient from output control to project efficiency is significant for both high and low power distance team members with 0.18 (t-value= 2.424, $p < 0.05$), and 0.21 (t-value = 3.126, $p < 0.05$), respectively. As shown in Table 4-18, the chi square test of all paths from output control to radical innovation (X^2 = 0.666, $p > 0.10$), to incremental innovation (X^2 = 2.127, $p > 0.10$), and to project efficiency (X^2 = 0.003, $p > 0.10$) between two groups are insignificant indicating no difference between high and low power distance team members. Therefore, the results suggest that output control increases project efficiency for low and high power distance members. It also promotes incremental innovation for high power distance members as shown in Figure 4-22 and Figure 4-23. Thus, hypothesis 15 is partially confirmed.

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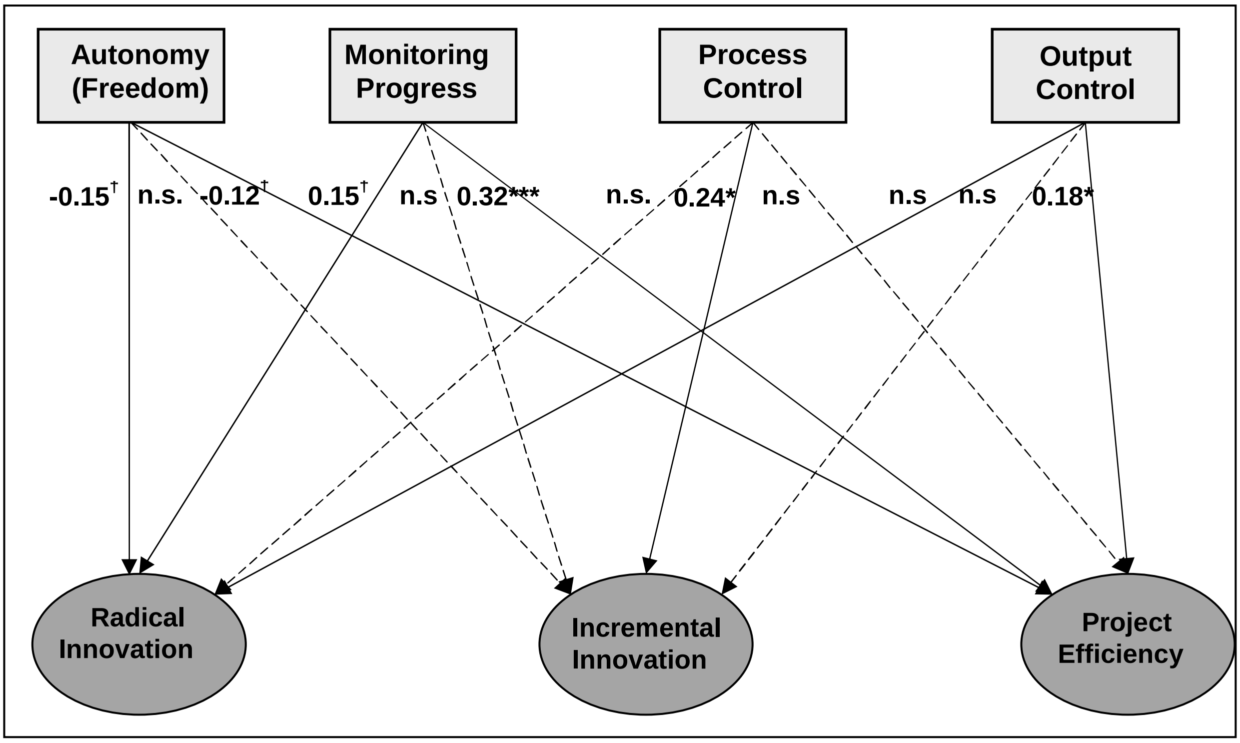
High Power distance team members (n=184)



Low Power distance team members (n=245)

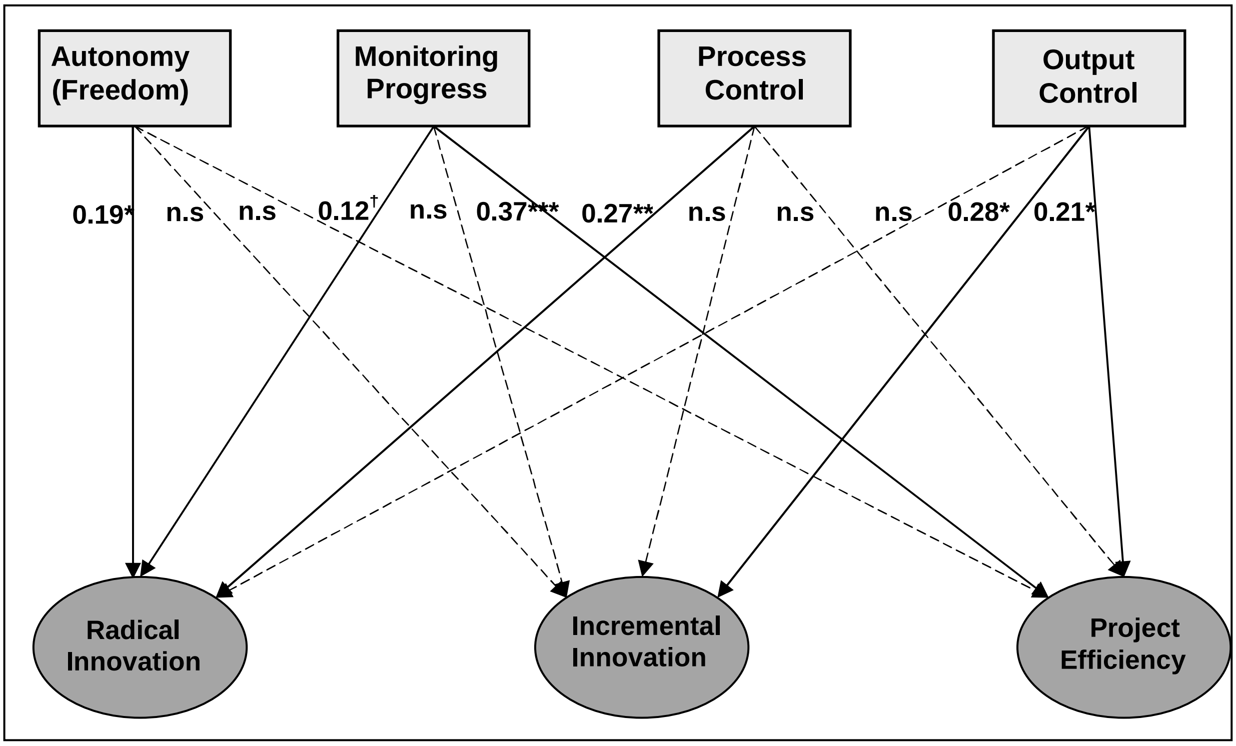


Figure 4-22: Path Coefficients Comparing Path Coefficients (High and Low PD)

Notes: Model Fit with $X^2/DF = 1.727$, CFI = 0.900, RMSEA = 0.041. Solid lines are significant paths at ***p<.0001 **p<.001 *p<0.05 †p<0.10. Dotted lines/ (n.s.) are non-significant paths.

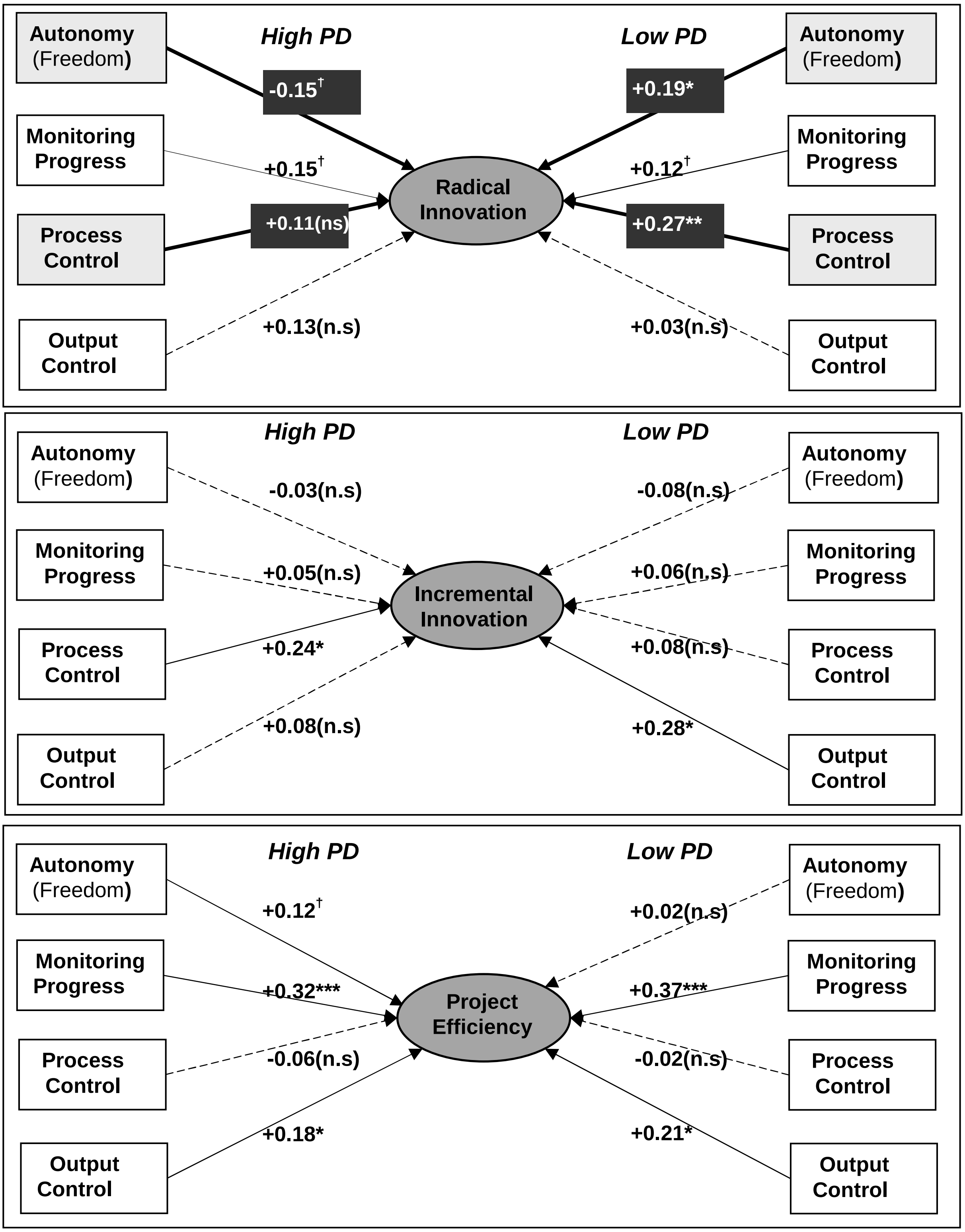


Figure 4-23: Differences of PMMs on Innovation Performance (High and Low PD)

Notes: The heavy solid lines are significant difference of path coefficient between two groups. Solid lines are significant paths at ***p<.0001 **p<.001 *p<0.05 †p<0.10. Dotted lines/ (n.s.) are non-significant paths.

4.6 Summary of this Chapter

The results from the testing of all hypotheses with AMOS are summarized in Table 4-19. Most hypotheses are partially confirmed. The results will be discussed in Chapter 5.

Table 4-19: Summary Direct and Indirect Effects in Hypotheses Testing

Hypotheses		Confirmation
1	Autonomy increases innovation performance (radical innovation, incremental innovation, and project efficiency).	Rejected
2	Monitoring progress increases innovation performance (radical innovation, incremental innovation, and project efficiency).	Partially Confirmed
3	Process control increases innovation performance (radical innovation, incremental innovation, and project efficiency).	Partially Confirmed
4	Output control increases innovation performance (radical innovation, incremental innovation, and project efficiency).	Partially Confirmed
5	Process control has a stronger effect on innovation performance (radical innovation, incremental innovation, and project efficiency) than the other control mechanisms (output control and monitoring progress)	Partially Confirmed
6a	Communication mediates the relationship between autonomy and innovation performance (radical innovation, incremental innovation, and project efficiency).	Confirmed
6b	Communication mediates the relationship between monitoring progress and innovation performance (radical innovation, incremental innovation, and project efficiency).	Partially confirmed
6c	Communication mediates the relationship between process control and innovation performance (radical innovation, incremental innovation, and project efficiency).	Partially confirmed
6d	Communication mediates the relationship between output control and innovation performance (radical innovation, incremental innovation, and project efficiency).	Partially confirmed
7a	Coordination mediates the relationship between autonomy and innovation performance (radical innovation, incremental innovation, and project efficiency).	Confirmed
7b	Coordination mediates the relationship between monitoring progress and innovation performance (radical innovation, incremental innovation, and project efficiency).	Confirmed
7c	Coordination mediates the relationship between process control and innovation performance (radical innovation, incremental innovation, and project efficiency).	Confirmed
7d	Coordination mediates the relationship between output control and innovation performance (radical innovation, incremental innovation, and project efficiency).	Confirmed
8	Autonomy is likely to increase innovation performance (radical innovation, incremental innovation, and project efficiency) for high individualists rather than low individualists.	Partially confirmed
9	Autonomy is likely to decrease innovation performance (radical innovation, incremental innovation and project efficiency) for low PD rather than high PD.	Partially confirmed

Hypotheses		Confirmation
10	Monitoring progress is likely to increase innovation performance (radical innovation, incremental innovation and project efficiency) for high individualist team members rather than low individualist team members.	Partially confirmed
11	Monitoring progress is likely to increase innovation performance (radical innovation, incremental innovation and project efficiency) for both low power distance and high power distance team members.	Partially confirmed
12	Process control is likely to increase innovation performance (radical innovation, incremental innovation and project efficiency) for low individualist team members rather than high individualist team members.	Partially confirmed
13	Process control is likely to increase innovation performance (radical innovation, incremental innovation and project efficiency) for high power distance rather than low power distance team members.	Partially confirmed
14	Output control is likely to increase innovation performance (radical innovation, incremental innovation and project efficiency) for high individualist rather than low individualist team members.	Confirmed
15	Output control is likely to increase innovation performance (radical innovation, incremental innovation and project efficiency) for low power distance rather than high power distance team members.	Partially confirmed

Chapter 5: Discussion

This chapter presents the results and findings of this study in two parts. The first part discusses the direct effects of project management and control mechanisms on innovation performance and the indirect effects of project management mechanisms on innovation performance through teamwork processes of communication and coordination. The second part discusses the effect of project management mechanisms on innovation performance given different cultural values of team members (high/low individualism and high/low power distance).

5.1 Direct and Indirect Effects of Project Management Mechanisms

5.1.1 Autonomy on Innovation Performance

Direct Effect of Autonomy on Innovation Performance. As shown in Table 4-6 and Figure 4-7, autonomy had no effect on radical innovation, incremental innovation, and project efficiency. Surprisingly, these findings differ from the other studies, where highly autonomous environments within a firm drive radical innovation (Chandy and Tellis, 1998), increase organizational innovation (Paolillo and Brown, 1978), speed up radical innovation projects (Kessler and Chakrabarti, 1999), support incremental innovation projects (Bart, 1993), increase effectiveness of innovation projects (Angle, 1989), and are associated with project execution success (Tatikonda and Rosenthal, 2000).

Though there is no statistical support in this study, the results are consistent with the findings of Abbey and Dickson (1983), and Kang and Park (1992) in that autonomy had no-significant relationship with the number of technological innovations or commercialization of new products (as cited in Kim and Lee, 1995). Granting autonomy had no relationship with incremental innovation which is supported by other related research which indicates that incremental innovation is associated with centralized decision making and a formal structure within firms (Cohn and Turyn, 1984; Stamm, 2003) rather than a decentralized structure. In addition, granting autonomy did not have any effect on project efficiency. This is supported by the study of Thamhain (1990) where autonomy had no correlation with R&D team performance. It may be that the development of incremental innovation product or enhancement of project efficiency may not require autonomy as innovation tasks are less complex (e.g., small improvement of projects or redeveloping products). Increasing performance of incremental innovation or project efficiency may need a formal structure within a firm to facilitate cooperation of all members involved in the project.

The lack of statistical support between autonomy and innovation performance in the current study does not mean that autonomy is not important to innovation performance. It could be that providing autonomy for individual team members in executing their tasks, exploring their own ideas, and making decisions on their own might enhance individual creativity, by instilling a sense of ownership and control over their own tasks, which is needed for developing radical innovation products (Amabile, Conti, Coon, Lazenby, and Herron, 1996). However, complex tasks such as developing radical innovation products need not only individuals' creativity, but also the diverse knowledge and perspectives of team members in generating new ideas and linking creative ideas with the abilities of the firm and market needs to develop new products (Nonaka and Takeuchi, 1995). In addition, during radical innovation product development, project team members need to be tuned-in with the other team members through communication and coordination (Souder and Moenaert, 1992). As such, individual team members need not only autonomy for their tasks, but also communication and coordination with other team members to share diverse knowledge and experiences related to tasks and to ensure that developed subsystems are well integrated (Bacon, 1985).

Indirect Effect of Autonomy on Innovation Performance through Communication and Coordination. In order to facilitate a clear picture of mediating effects, the indirect effect of autonomy on innovation performance via communication and coordination are depicted in Figure 5-1. As previously mentioned, autonomy had no effect on innovation performance in this current study. The results of indirect effect testing revealed that: (1) autonomy had both a direct negative effect on incremental innovation and an indirect positive effect on incremental innovation through communication and coordination; and (2) autonomy had an indirect effect on radical innovation and project efficiency through communication and coordination of team members.

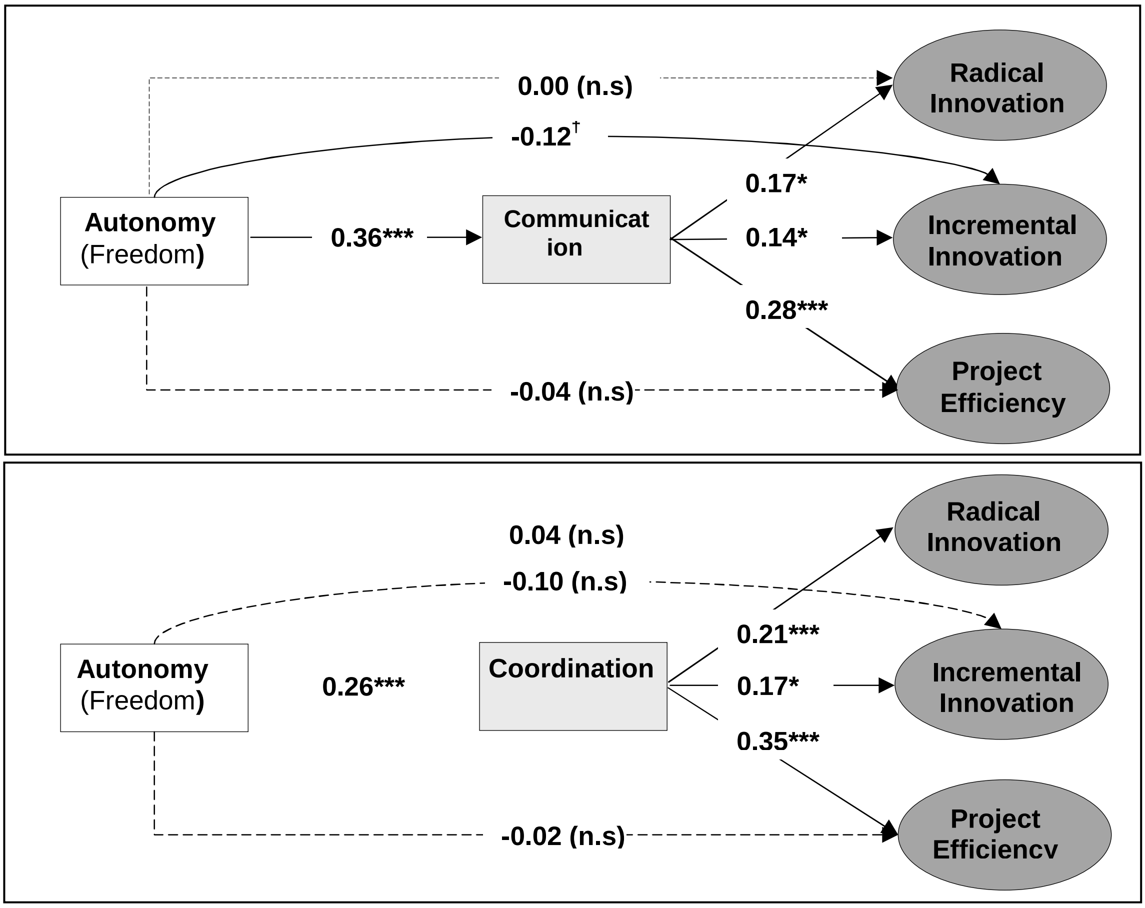


Figure 5-1: Autonomy and Teamwork Processes on Innovation Performance

Notes: The solid lines are significant paths at ***p<0.0001 **p<0.001 *p<0.05 †p<0.10. Dotted lines (n.s.) are non-significant paths.

These indirect effect results are partially supported by several scholars on the subject of autonomy and communication and coordination and the effects of communication and coordination on different types of innovation performance. For example, Bacharach and Aiken (1977), on the subject of decentralized structures and communication of subordinates in organizations, states that given a high level of autonomy, subordinates tend to engage in more communication. In relation to communication and performance, Brown and Eisenhardt (1995), Allen (1971; 1977), and Tushman and Scanlan (1981) found that communication among project team members enhanced the performance of development teams. The results in this study are partially related to Kivimäki et al., (2000) on the issue of communication and coordination and innovation performance. Their study found that a participative climate (i.e., frequent communication) and coordination were associated with perceived organizational innovation. Additionally, Zhang and Gao (2010) found from their simulation experiment that effective communication among the developers of intermodules developing incremental innovation would increase performance of the improvement. In particular, both direct negative and indirect effects of communication on incremental innovation were found in this study, but the direct negative effect was weaker than the indirect effect. A possible explanation for the direct negative effect of autonomy on incremental innovation performance could be that providing high autonomy directly to team members without control of their tasks may lead to many created solutions which are unnecessary for the development of small technical improvement projects. While given autonomy encourages team's communication which in turn drives incremental innovation.

This study is partially supported by previous studies related to autonomy and communication and coordination. In terms of communication and coordination and innovation performance, it could be suggested that providing autonomy does not directly encourage innovation performance, but it enhances communication and coordination of team members. Communication within a project team facilitates the dispersion of ideas and exchange of information among team members, whereas coordination facilitates the correct integration and interaction of sub-systems, modules, and components. As such, given autonomy to the team facilitates communication and coordination, which in turn drives innovation performance as shown in Figure 5-1.

5.1.2 Monitoring Progress on Innovation Performance

Direct effect of monitoring progress on innovation performance. As shown in Table 4-6 and Figure 4-7, the results from this study revealed that monitoring progress had a direct effect on both radical innovation and project efficiency. In addition, the effect of monitoring progress on project efficiency was stronger than the effect of monitoring progress on radical innovation. This finding seems to be consistent with the previous researches in that increasing monitoring progress kept the project on track (Salomo et al., 2007), encouraged creation of technical knowledge and project efficiency (Lewis et al., 2002), accelerated product development (Eisenhardt and Tabrizi, 1995), and sped up radical innovation (Kessler and Chakrabarti, 1999). The above studies further explained that assessment of a project according to milestones forces team members to focus on innovative tasks. Nevertheless, monitoring progress had no direct effect on incremental innovation in this study. It could be argued that overly detailed tasks, scheduling and frequent monitoring by project managers might support tasks related to the development of complex projects (e.g., radical innovation) rather than tasks related to projects developing minor changes (e.g., incremental innovation). A possible explanation for this argument is that project managers and team members are familiar with existing technologies, and improving only some sub-systems or small components of products may not require frequent monitoring from project managers. This is supported by Kessler and Chakrabarti' s study (1999), which found that frequent monitoring encouraged radical innovation rather than incremental innovation. This is because splitting complex tasks into manageable tasks serves radical innovation. Therefore, incremental innovation projects may not benefit from monitoring progress, because frequent monitoring of progress might slow down the development of minor improvement products.

Indirect effect of monitoring on innovation performance through communication and coordination. The indirect effects of monitoring progress on innovation performance are summarized in Figure 5-2.

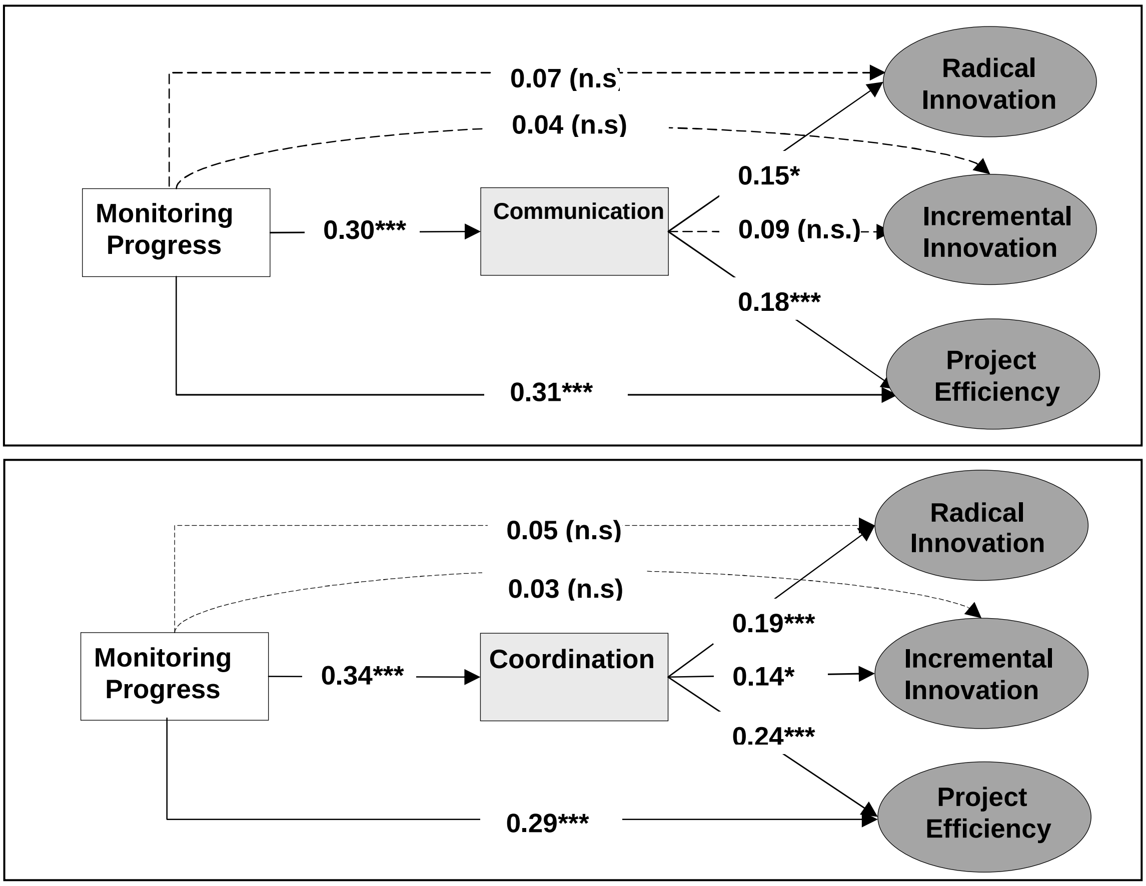


Figure 5-2: Monitoring Progress and Teamwork Processes on Innovation Performance

Notes: The solid lines are significant paths at ***p<0.0001 **p<0.001 *p<0.05 †p<0.10. Dotted lines (n.s.) are non-significant paths.

The findings of this investigation revealed that: (1) monitoring progress had a direct effect on project efficiency, and an indirect effect on radical innovation and project efficiency through communication and coordination; (2) monitoring progress had an indirect effect on incremental innovation only through coordination of team members. These indirect effects are partially supported by the studies of Eisenhardt and Tabrizi (1995) and Hameri and Nihtilä (1997) which indicate that (1) monitoring progress might encourage communication and coordination among different groups within the development team and (2) project milestones play an important role in coordination work on distributed projects. Moreover, the team processes of communication and coordination have been consistently recognized as influential to the success of innovation projects (Griffin and Hauser, 1992; Hoegl and Gemuenden, 2001) and improved performance of incremental innovation products (Zhang and Gao, 2010).

Additionally, the result of this study partially supports the previous studies in that the total effects of monitoring progress and communication had no impact on incremental innovation. This is consistent with Kessler and Chakrabarti (1999), who recommended that monitoring progress might slow down the development of incremental innovation products and frequent communication might introduce unnecessary complexity, and create more interruption in tasks for incremental innovation development. Similarly, Brettel, Heinemann, Engelen, and Neubauer (2010) revealed that team' s coordination between R&D and marketing and between R&D and manufacturing during the development phases positive impact for developing incremental innovation products during the development phase and developing radical innovation during the commercialization phase. Further, monitoring progress as a control mechanism seems to encourage both communication and coordination, but the effects of coordination on innovation performance are stronger as shown in Figure 5-2.

Hence, it could be suggested that project managers consider employing monitoring progress and encourage both communication and coordination in order to promote radical innovation and project efficiency. In order to increase incremental innovation, project managers should consider monitoring progress focusing on coordination of sub-tasks, rather than frequent communication and exchange information among team members.

5.1.3 Process Control on Innovation Performance

Direct effect of Process Control on Innovation Performance. As shown in Table 4-6 and Figure 4-7, the results from this study found that process control has a direct effect on radical innovation and incremental innovation. This is in line with Cardinal's study (Cardinal, 2001), which showed that process control encouraged development of new drugs in pharmaceutical firms. Benner and Tushman (2002) found that process management activities in firms (e.g., ISO) were associated with an increase in both explore and exploit innovation (radical and incremental innovation) in the paint and photography industries.

Generally, the application of process management techniques reduces variance through process control that leads to efficiency, effectiveness, and reduced cost (Benner and Tushman, 2002). However, a surprising finding of this present study was that process control had no relationship with project efficiency which is consistent with Bonner et al., (2002). It might be because process control involves implementation and monitoring of written standardized procedures and adjustment or changing these written procedures by senior managers when outcomes of a project are not achieved. When procedures or processes are continually changed; consequently, NPD projects might be delayed and the cost of development might increase.

Indirect effect of process control on innovation performance through communication and coordination. When process control entered in the model, the indirect effects of process control on innovation performance are summarized in Figure 5-3. The findings demonstrated that: (1) process control had a positive direct effect on radical innovation and incremental innovation, as well as an indirect effect on radical innovation and project efficiency through communication and coordination; and (2) process control had an indirect effect on incremental innovation only through coordination of team members.

Even there is no evidence to support the indirect effects of process control on innovation performance through communication and coordination, the results from this study are partially supported by the study of Griffin and Hauser (1992) where process management (e.g., QFD) enhanced communication among the core design team. Benner and Tushman (2002) also noted that process management approach tightens coordination due to repetition of activities embedded in standardized best practices. Communication and coordination are important factors for innovation projects (Griffin and Hauser, 1992; Hoegl and Gemuenden, 2001; Keller, 2001). However, process control had no indirect effect on incremental innovation through communication in this study. It is because a direct effect of process control on incremental innovation was found as supported by Cardinal (2001) and Benner and Tushman (2002). An explanation could be that the applying process control may drive the team to adhere strictly to the written processes, which inform clearly what to do; therefore, the team may not require a high level communication for developing incremental innovation. This results is consistent with Kessler and Chakrabarti who noted that a high level of communication among team members may support the development of radical innovation products rather than incremental innovation products (Kessler and Chakrabarti, 1999). The finding also revealed that process control promotes both communication and coordination of teamwork processes, but it tends to facilitate coordination more than communication of the team members. At the same time, coordination of the team enhances higher innovation performance, especially project efficiency.

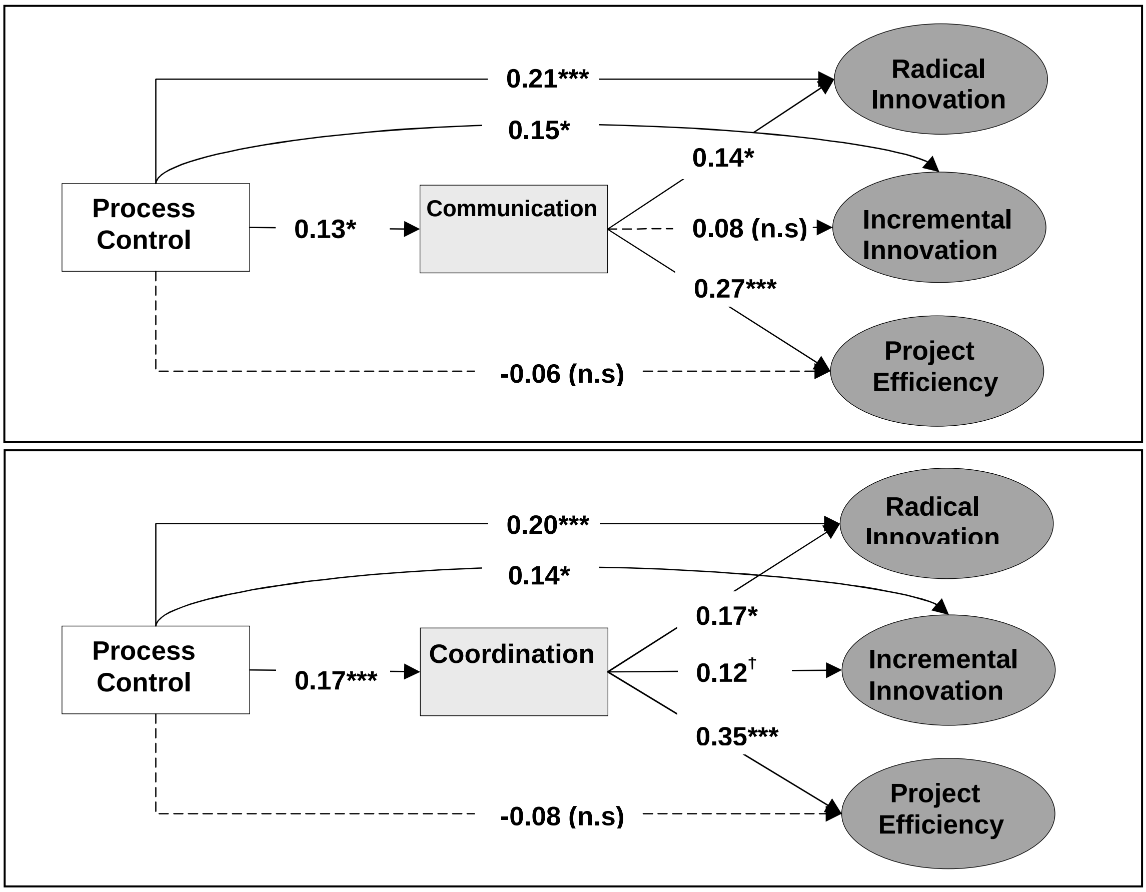


Figure 5-3: Process Control and Teamwork Processes on Innovation Performance

Notes: The solid lines are significant paths at ***$p<0.0001$ **$p<0.001$ *$p<0.05$ †$p<0.10$. Dotted lines (n.s.) are non-significant paths.

In summary, this current finding suggests that process control applied by project managers and senior managers helps to promote both communication and coordination of project team members. Project managers should consider employing process control and encourage both communication and coordination in order to promote radical innovation and project efficiency. In addition, to increase performance of incremental innovation projects, project managers should apply process control and encourage coordination rather than frequent communication among team members.

5.1.4 Output Control on Innovation Performance

Direct effect of output control on innovation performance. Based on this study, the direct effects of output control were found to be enhancement of incremental innovation and project efficiency (as shown in Table 4-6 and Figure 4-7). These findings were similar to Cardinal's study (2001), which revealed that output control increased drug enhancement development (incremental innovation) and Jaworski, Stathakopouaus, and Krishnan's study (1993) which found that output control influenced job performance in strategic business units (SBUs). Additionally, this study showed that output control had no effect on radical innovation. This differs from Cardinal's study, which noted that output control enhanced new drug development (radical innovation) in the pharmaceutical industry in the US. The reason for the lack of statistical support for an effect of output control on radical innovation in this study could be that the assigned targets/goals for team members (output control) for implementing NPD projects may be vague and unclear. As a result, these unclear performance goals are difficult for team members to implement or achieve. This is supported by Fang et al.,(2005) and Snell (1992) who found and noted that output control increased performance when the output control (performance goals) was clear and specific. Another explanation could be that the development of radical innovation products includes working with complex systems, sub systems, and various components might be risky for teams to develop radical innovation without any directions from project managers or senior managers. This is consistent with Cardinal (2001) who noted that output control would be beneficial for developing incremental innovation products due to short development time and clearer assigned targets/goals for project implementation. Hence, it could be concluded that output control promoted only incremental innovation and project efficiency rather than radical innovation.

Indirect effect of output control on innovation performance through communication and coordination. The indirect effects of process control on innovation performance through communication and coordination are summarized in Figure 5-4. The findings demonstrated that: (1) output control had direct effect on incremental innovation and project efficiency; (2) output control had indirect effects on radical innovation and project efficiency through communication and coordination; and (3) output control had an indirect effect on incremental innovation only through coordination of team members.

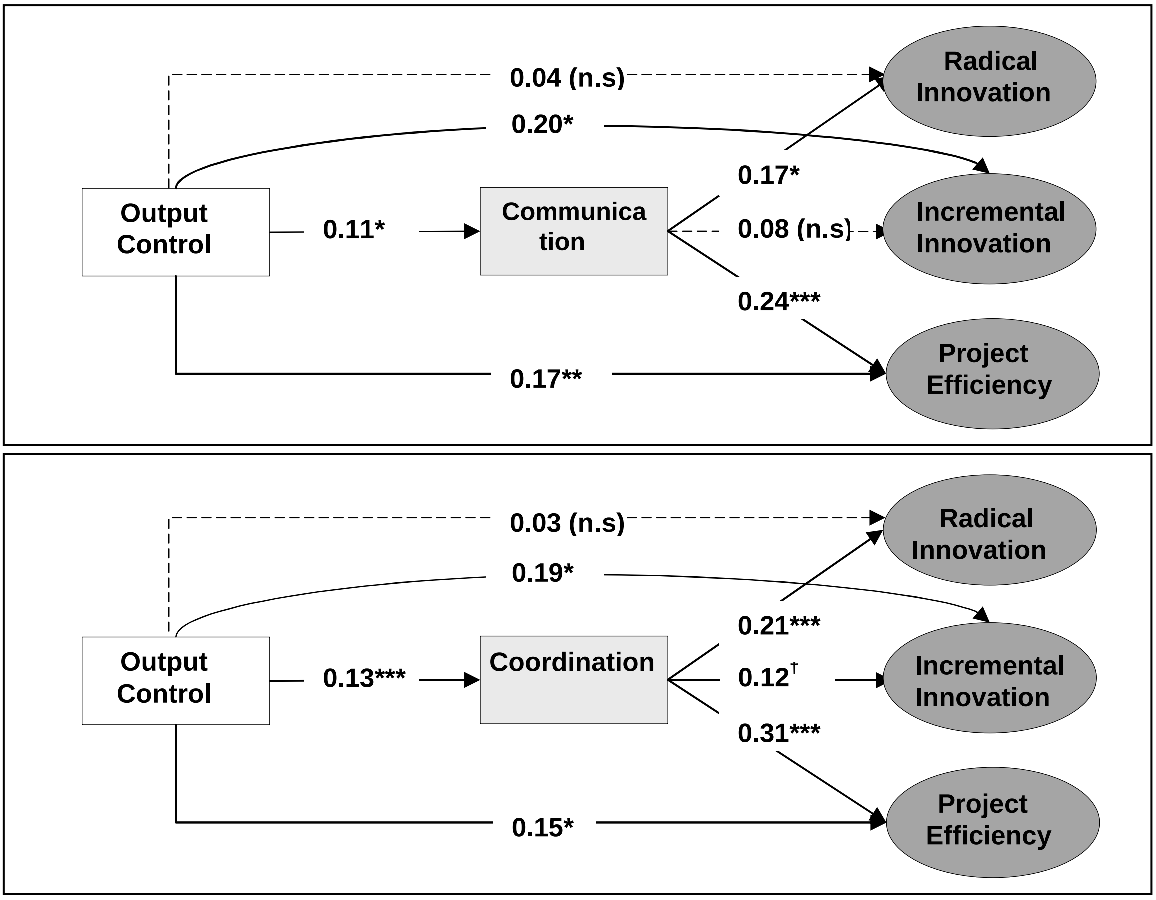


Figure 5-4: Output Control and Teamwork Processes on Innovation Performance

Notes: The solid lines are significant paths at ***p<0.0001 **p<0.001 *p<0.05 †p<0.10. Dotted lines (n.s.) are not significant paths.

There is no prior study related to the issue of output control and communication and coordination. However, it could be assumed that output control encourages both communication and coordination because assigning project goals/targets to team members forces them to discuss how they can proceed with innovative tasks in order to achieve these performance goals. Another explanation could be that output control directly relates to tasks and performance assessment to earn reward. In order to achieve innovative tasks and earn their reward, team members need to exchange information and coordinate in order to integrate their sub-tasks. The total effects of output control and communication/ coordination of the team promote higher innovation performance except the one between communication and incremental innovation. The result of this study shows no statistically significant relationship between communication and incremental innovation as shown in Figure 5-4. It could be explained that a high level of communication and exchange of information (mean score of communication in Table 4-2 = 3.91) is not necessary for developing incremental innovation products which require integration of existing internal firm knowledge rather than generation of new ideas (Un, 2010). Furthermore, the finding revealed that output control, which is one of control mechanisms, seems to enhance coordination of tasks rather than communication. At the same, coordination of the team enhances stronger innovation performance.

Therefore, it could be suggested that project managers consider applying output control and encourage both communication and coordination of team members in order to enhance radical innovation and project efficiency. Alternatively, project managers should apply output control and facilitate coordination of team members rather than communication in order to enhance incremental innovation.

5.2 Moderating Effects of Different Cultural Values

This study revealed that the effects of autonomy and control mechanisms have different consequences on types of innovation performance under the varying cultural background of team members. To facilitate the discussion of moderating effects of cultural values between the relationships of project management mechanisms and innovation performance, the empirical results in chapter 4 are summarized in Figures 5-5 through 5-7.

5.2.1 Autonomy and Innovation Performance

As showed in Figure 5-5, the results of this study revealed that ***autonomy increase radical innovation for high individualists and low power distance respondents. Autonomy also decreased radical innovation for high power distance and had no effect on radical innovation for collectivists.*** Among these findings, the effect of autonomy on radical innovation was different between high and low power distance team members. The more autonomy granted to low power distance team members, the higher the degree of radical innovation. On the contrary, autonomy granted to high power distance team members decreased radical innovation. Another finding was that high individualism team members did not differ significantly from low individualism team members with regard to the issue of autonomy and innovation performance; these findings revealed that granting autonomy is essential for high individualism team members and low power distance team members for developing radical innovation products. Even there is no directly related previous study supporting these findings. These significant statistical results seem to be related to the characteristics of people in individualism societies; individualists have a great sense of autonomy and value personal achievement (Hofstede, 1980) which is necessary for creativity (Herbig and Dunphy, 1998, p.15). These findings are partially supported by Shane (1992) who found that people in individualistic and low power distance societies were more inventive in terms of number of patents granted than the others. Another study by Kedia, Keller, and Julian (1992) demonstrated that people from low power distance societies generally had greater R&D productivity. Therefore, providing autonomy to high individualism team members and low power distance team members motivates and allows them to be creative for developing radical innovation products.

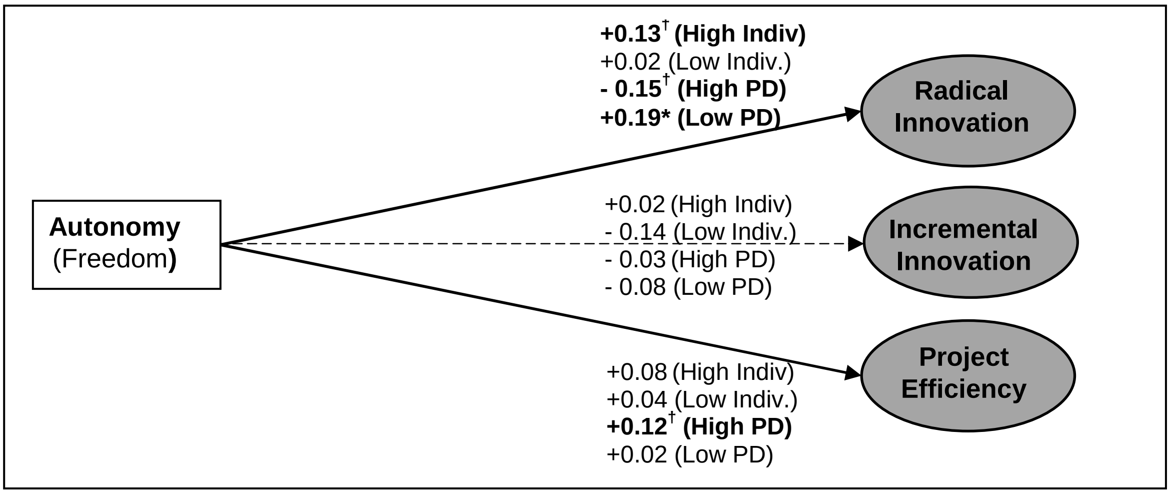


Figure 5-5: Impact of Cultural Values on the Relationship between Autonomy and Innovation Performance

Notes: The solid lines indicate at least one group has a significant path at ***p<0.0001 **p<0.001 *p<0.05 †p<0.10. Dotted lines (n.s.) are non-significant paths.

Another finding in this study revealed that ***autonomy enhanced project efficiency for high power distance team members.*** This finding seems to be different from the previous study by Hofstede (1980) who noted that people from high power distance countries are used to being under control and expect their manager to tell what to do. It could be assumed that autonomy without guideline or direction may cause indecisiveness for high power distance team members who are used to be under control during development of radical innovation products. This assumption corresponds with the negative effect of autonomy on radical innovation for high power distance team members found in this study as previously noted. Surprisingly, autonomy enhanced project efficiency only for high power distance team members. Even though an additional t-test analysis revealed that there were not significant differences between high and low power distance members on their mean score for autonomy (high power distance group = 3.86 and low power distance group = 3.98 in Table 4-4). However, it could be argued that autonomy is beneficial to high power distance people in the case of developing less complex products (e.g., operation projects). Since they already know how to proceed with their tasks without guidelines, autonomy enhanced project efficiency in this case. In contrast, granting autonomy to high power distance team members in developing radical innovation may not be an appropriate solution. This is because they may need some guidelines and support from project managers to implement complex projects composing of many systems and sub-systems. Therefore, granting autonomy without guidelines may decrease radical innovation for high power distance team members.

The current study also revealed that ***autonomy had no relationship with innovation performance in terms of radical, incremental innovation, and project efficiency for collectivist team members.*** Although there is no statistical evidence of the relationships between autonomy and innovation performance under different cultural groups, the findings seem to imply that collectivist team members may not benefit from the of granting autonomy in developing new products. As they prefer a decision based on the group's consensus and compromise, as supported by Westwood and Low (2003) in a study that examined innovation processes of Japan as a collectivist country. This centralized or group decision making of NPD team in collectivist countries may diminish individual creativity, which is important for developing radical innovation products. Assigned autonomy to collectivism team members might not be appropriate for their preferred group decision making; therefore, it may not motivate them to achieve radical innovation performance as well as other mechanisms.

Another finding of the current study showed that ***autonomy had no effect on incremental innovation regardless of the cultural background of team members.*** An explanation of these findings could be that granting autonomy allows individualist and low power distance team members to explore their own ideas freely and search for new knowledge or new methods for developing new products. Consequently, granting autonomy to team members in searching for new knowledge and experiences may not be beneficial for developing incremental innovation which emphasizes the use of existing knowledge of team members (Kessler and Chakrabarti, 1999). This finding is also supported by Sonnenburg (2004), who noted that projects with well-defined problems with expected solutions and advance knowledge of how to solve these problems requires low autonomy. While projects with new problems and expected radical solutions require high autonomy to gain relevant knowledge (Sonnenburg, 2004).

Autonomy also had no effect on project efficiency for high and low individualist team members, and low power distance team members. An explanation for the non-significant result may be that when high individualist team members and low power distance team members have high autonomy, they may perceive having choices and time to develop a product. This may allow them to create many solutions (for high individualists) and to participate with others (for low power distance members) to achieve the project's goals. While collectivists wait for team's decision making for every stage of NPD process. As a result, new product development may take longer time, thereby leading to unachieved project efficiency.

Therefore, the findings suggest that providing autonomy encourages radical innovation for high individualist team members and low power distance team members, whereas autonomy decreases radical innovation when it applied to high power distance members. Additionally, providing autonomy may increase project efficiency when applied to high power distance members in developing familiar projects.

5.2.2 Monitoring Progress and Innovation Performance

Monitoring progress was found to encourage project efficiency for all team members regardless of their cultural backgrounds. Interestingly though, the effect of monitoring progress on project efficiency was stronger for high individualist team members. When monitoring progress was employed, a higher level of project efficiency was achieved for high individualists than for low individualists. However, this finding is both similar and different from the statements of Hofstede (1993) and Kim et al., (1994) in that people in individualism societies tend to focus more on individual goals and task orientation than collective goals and building relationships which are the focus of people in collectivism societies. Monitoring progress tends to support high individualists who are task and time oriented more than collectivists. However, it could be argued that monitoring progress regarding milestones demonstrates the interrelatedness of tasks. These interrelated tasks may implicitly motivate relationship-focused for collectivist members to complete their tasks on time in order to avoid project delays and damages and maintain a harmonious relationship within the team. Another reason could be that people from collectivism countries may relate to the high power distance value (Hofstede, 1980), thus they tend to be task and time oriented as well, under the orders of project managers. Monitoring progress is a motivating agent for discussing tasks for low power distance members and in forcing high power distance members to focus on their innovation tasks. Therefore this study confirmed that use of monitoring progress by project managers, encourages project efficiency, regardless of the cultural background of team members.

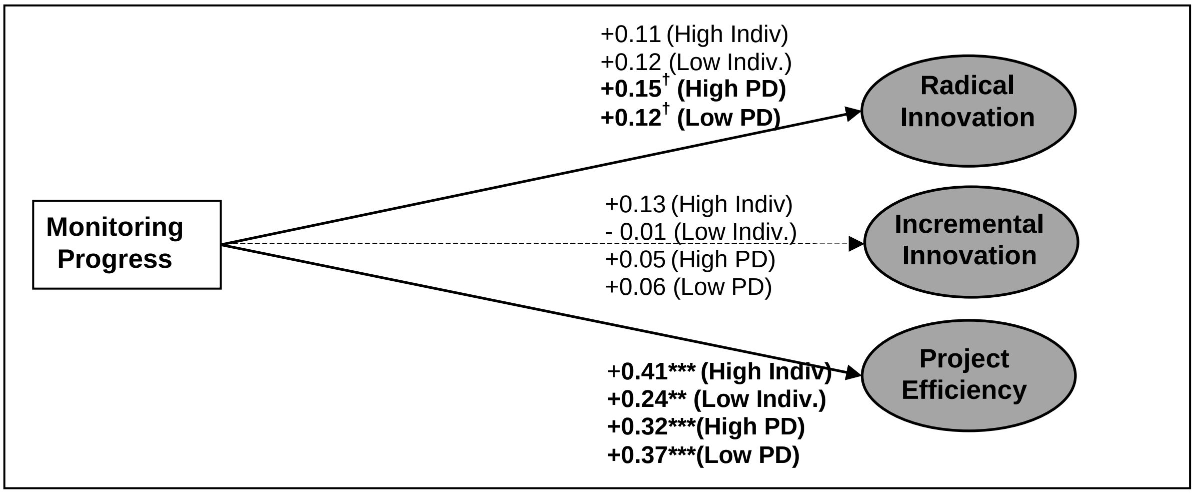


Figure 5-6: Impact of Cultural Values on the Relationship between Monitoring Progress and Innovation Performance

Notes: The solid lines mean at least one group has a significant path at ***p<0.0001 **p<0.001 *p<0.05 †p<0.10. Dotted lines (n.s.) are non-significant paths.

Another result demonstrated ***that monitoring progress increased radical innovation for high and low power distance members but not for high and low individualist team members.*** Because of a perception of equal distributed power among people in low power distance societies, team members may perceive that monitoring progress is a tool, which allows them to express their opinions, and share idea and information between project managers and team members. Monitoring progress encourages them to discuss problematic tasks to help generate new ideas/solutions for delivering radical innovation products. Whereas, a perception of unequal distributed power in high power distance societies, team members may perceive project managers' monitoring progress with regard to milestones as an assessment of project forcing them to focus and be creative on their innovative tasks. Regardless of their perception, monitoring progress drives both high and low power distance team members to develop their innovative tasks and improve project efficiency.

From this study, it was found that ***monitoring progress had no effect on developing radical innovation for high and low individualist team members.*** This could be explained by the fact that monitoring progress itself, which is one control mechanism, may force high individualist team members to focus on tasks and schedule rather than allowing individualists to explore their own ideas, thereby limiting the generation of ideas for development radical innovation products. This is partial consistent with Cardinal (2001) who argued that frequent monitoring may limit R&D activity due to extra effort by the team to demonstrate productivity to the project manager. In addition, focusing on tasks and schedule limits collectivist team members in developing relationships with others. For these reasons, monitoring progress may not directly encourage radical innovation for high individualists and low individualists.

Monitoring progress also had no effect on incremental innovation in all groups of members. The reason that monitoring progress had no effect on incremental innovation for all groups of respondents could be because monitoring progress provides details related to systems/components/sub-tasks, time to finish, and tasks' owners which are important for high uncertainty, highly technical projects but not as important for projects involving a lower level of technology and less uncertainty (Shenhar, Tishler, Dvir, Lipovetsky, and T., 2002).

Therefore, it is suggested that monitoring progress encourages project efficiency regardless of the cultural background of team members and enhances radical innovation for high and low power distance members.

5.2.3 Process Control and Innovation Performance

As summarized in Figure 5-7, the use of ***process control enhanced only radical innovation for high individualist, low individualist, and low power distance team members.*** The results are partially similar to the previous results in that process control increased both radical innovation and incremental innovation for collectivist respondents. This is in line with Westwood and Low's finding (2003) that innovation process control is based on consensus and compromise in Japan, a collectivist society. Process control is more conductive to incremental innovation (Lampikoski and Emden, 1996), and it is claimed that it is an antecedent for radical innovation (Herbig and Jacobs, 1998).

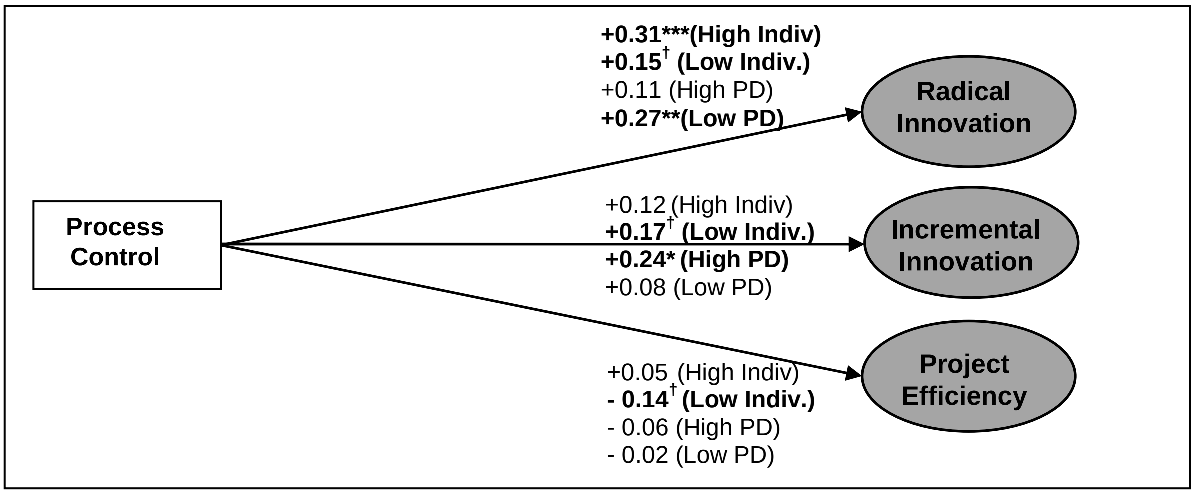


Figure 5-7: Impact of Cultural Values on the Relationship between Process Control on Innovation Performance

Notes: The solid lines mean at least one group has a significant path at ***p<0.0001 **p<0.001 *p<0.05 †p<0.10. Dotted lines (n.s.) are non-significant paths.

Surprisingly, in this study, process control also enhanced radical innovation for individualists and low power distance team members, which is contrary to hypotheses. It is different from a study by Cristiano, Liker and White (2000) who revealed that more than half of U.S.(46.7%) and Japanese (40.5%) respondents disagreed on increasing innovativeness (in terms of the number of design alternatives) when the process control (QFD) was applied. Benner and Tushman (2003) noted that process control allows for a hands-off innovation process, and adjustment of processes based on discussion and decision between senior management and team members during the process before moving to the next gate. This may help individualist and low power distance team members in integrating the demands of customers into a sequential process. Because of these frequent adjustments and the integration of customers' requirements, process control can turn incremental improvements into radical innovation. Surprisingly, process control had no effect on radical innovation for high power distance team members in this study, who prefer to be given direction by project managers or senior managers. Process control is assumed to motivate or support high power distance members' preferences. It could be in that high power distance team members may simply modify functions and components within the processes to meet standard processes and customers 'needs without adding high technical knowledge for their customers. This leads to developing incremental innovation rather than radical innovation.

An additional finding from this study is that ***process control enhanced incremental innovation for low individualists and high power distance respondents.*** Process control itself is an incremental improvement of redevelopment products. Process control may be appropriate for low individualist team members and high power distance members, because high power distance people tend to stick to defined processes, procedures, and follow managers' decisions and will not engage in activity that is not supported by project managers. This finding provides support for the argument made in multinational firms that high power distance members will spur the development of incremental innovation, if a clear decision structure and tight control provided with top management involvement as cited by Ambos and Schlegelmilch (2008). Additionally, process control is indicative of collective work among senior managers, project manager and team members; it may drive and support collectivist team members to achieve common goals (Lampikoski and Emden, 1996).

The results of this study also indicate ***a negative effect of process control on project efficiency for low individualists, and no effect on project efficiency for high individualists, or high and low power distance members.*** Process control applied to an innovation/a NPD project signals some sense of incremental improvement and correction of problems by senior managers. When the team members cannot achieve a NPD project's outputs, predefined processes are reviewed and changed by senior managers. Consequently, this revision process by senior managers may cause a delay in the project. This may be particularly true for low individualists who agree on group decision making and through group consensus allow a change in process, thereby decreasing project efficiency. While process control had no effect on project efficiency for high individualists, high and low power distance members. It seems possible that they may perceive revisions to processes do not improve project efficiency.

All in all, this finding suggests that process control promotes radical innovation for high individualism, low individualism, and low power distance team members, while at the same time it promotes incremental innovation for low individualism and high power distance members. However, process control also decreased project efficiency for low individualists.

5.2.4 Output Control and Innovation Performance

As summarized in Figure 5-8, the findings revealed that ***output control increased radical innovation for high individualists but not for low individualists or high and low power distance team members***. This finding is partially supported by Atuahene-Gima and Li (2002) who noted that an individualist sales person is likely to cherish the autonomy and opportunities afforded by output control to achieve high individual performance. Additionally, output control was shown to increase radical innovation in pharmaceutical firms in US (Cardinal, 2001). Based on this evidence, it could be argued that output control provides a sense of autonomy for individualist members in selecting their own ways to implement tasks and increase performance. However, measures of individual performance based on output control can vary depending on the goals of the project (e.g., technical performance, market success, or sales volume). In some cases, the goals for developing radical innovation projects might be unclear and ambiguous for team members, but individualist team members may find this a challenge and be motivated to develop a new product. There is no statistically significant relationship between output control and radical innovation for low individualists (collectivists), high power distance, and low power distance members. This might be because unclear and ambiguous performance goals increase risk for them. If they achieve these performance goals, their team will earn rewards. If they cannot achieve these performance goals, their team may be penalized. It could also be that output control, which provides freedom on how to complete tasks, does not promote the preferences of team members who prefer team decisions (collectivist team members), directions by senior managers (high power distance team members), and discussion and participation with project managers before implementation (low power distance team members). Therefore, applying output control may be unmotivating for these team members.

Another result showed that ***output control enhanced incremental innovation for high individualists, low individualists (collectivists) and low power distance members.*** These findings are supported by several studies. A study by Li et al., (2006) found that output control encouraged incremental innovation in Chinese high technology firms (collectivist country). Cardinal (2001) also revealed that output control increased incremental innovation in pharmaceutical firms in the US (individualism country). He further reasoned that specifying output for team to achieve (output control) is likely to increase incremental innovation because outputs of incremental innovation projects (e.g., improving technical performance of sub-system/components) are easier to achieve than outputs of radical innovation projects (e.g., developing totally new systems of new products), which requires a long time to implement. Similar results could be explained by the fact that that high individualists, low individualists and low power distance members may perceive that output control used for developing incremental innovation projects is clearly specified for them and therefore they may decide how to implement their tasks on their own without intervention, direction, and discussion with project managers/ senior managers. Thus, the clearer goals for development of incremental innovation projects might drive team members to control their tasks better, thereby increasing incremental innovation performance.

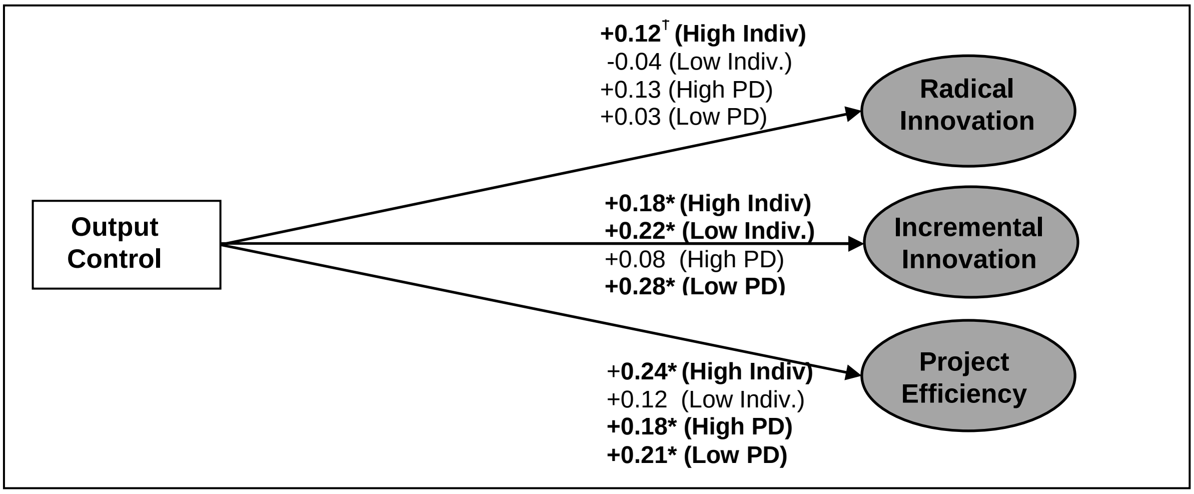


Figure 5-8: Impact of Cultural Values on the Relationships between Output Control and Innovation Performance

Notes: The solid lines mean at least one group has a significant path at ***p<0.0001 **p<0.001 *p<0.05 †p<0.10. Dotted lines (n.s.) are not significant paths.

The results also revealed that ***the increasing the application of output control promoted higher project efficiency for all team members.*** There is no study, which exactly supports in this finding, but it could be argued that output control is used to specify individuals' performance related to goals of projects. The higher the clarity of goals, and outputs (e.g., reducing cost of production or increasing sale volume) the higher project efficiency will be.

Therefore, this finding suggests that a specific ambiguous target without direction for the team to implement might be motivating and challenging for some team members e.g., high individualists, thereby promoting radical innovation. While, the same ambiguous target without direction could increase stress for some team members such as low individualists, high power distance and low power distance members rather than motivating them. Specified goals without directions (output control) tend to be successful in the case of developing incremental innovation products and project efficiency for all team members.

Chapter 6: Conclusion and Recommendations

The purpose of this chapter is to summarize the empirical findings, provide contributions and implications, and address research limitations and future research opportunities.

6.1 Conclusion

Using project management mechanisms, teamwork processes, and cultural values' frameworks, this study aimed to investigate the effects of project management mechanisms on different types of innovation performance and the impact of project management mechanisms on the teamwork processes of communication and coordination. It also compared the effects of project management mechanisms on different types of innovation performance under several backgrounds of team members as related to their cultural values, in terms of high/low individualism and high/low power distance. Responses from four hundred-thirty four (434) project team members from 37 countries in high technology industries were investigated by employing Structural Equation Model (SEM) using AMOS16. To facilitate a discussion of the conclusions of this study, the statistical findings of Chapter 4 are summarized into positive effects (+) and negative effects (-) as shown in Tables 6-1, 6-2 and 6-3. The results provide insight into the project management mechanisms as described in the following sections.

6.1.1 Direct Effects

The first objective of this study was to investigate and compare the impact of project management mechanisms on innovation performance. Both autonomy and different control mechanisms (monitoring progress, process control, and output control) were examined in this study to compare their effects on innovation performance. Previous studies revealed that autonomy sped up radical innovation projects (e.g., Kessler and Chakrabarti, 1999). In this study however, only control mechanisms, not granting autonomy, were found to have an effect on innovation performance. Previous studies found that providing autonomy to project team members had an effect on innovation performance (Bisbe and Otley, 2004; Cardinal, 2001). In this study, it was found that the control mechanisms had dissimilar effects on the different types of innovation performance, and only one control mechanism encouraged several types of innovation performance as summarized in Table 6-1. For example, monitoring progress regarding milestones promoted both project efficiency and enhancement of radical product innovation. However, monitoring progress had a stronger effect on project efficiency than radical innovation. While process control encouraged both radical and incremental innovation, it provided a stronger effect on radical innovation than incremental innovation. In addition, output control promoted both incremental innovation and project efficiency.

Among the control mechanisms, it could be suggested that standardized processes of process control better enhance the development of radical innovation products than other mechanisms. Specifying performance goals for team members through output control tends to enhance performance for redevelopment of a product (incremental innovation product). Monitoring progress stimulated the project schedule (efficiency) which is essential for launching a new product into the market.

Table 6-1: Direct Effects of Project Management Mechanisms

	Innovation Performance		
	Radical Innovation	**Incremental Innovation**	**Project Efficiency**
Direct Effects	Monitoring progress (+) Process control (++)	Process control (+) Output control (++)	Monitoring progress(++) Output control (+)

Note: (+) = positive effect, and (++) = strong effect

6.1.2 Indirect Effects

The second objective was to examine whether teamwork processes (communication and coordination) mediate between project management mechanisms and innovation performance. The results in this study confirmed that project management mechanisms have an indirect effect on innovation performance through communication and coordination as hypothesized and summarized in Table 6-2. Nevertheless, not all types of innovation performance were affected by communication and coordination as mediators. Results showed that the impact of autonomy, monitoring progress, process control, and output control on radical innovation and project efficiency was mediated through communication and coordination, as partially confirmed by prior studies (e.g., Pinto et al., 1993). But these mechanisms had indirect impact on incremental innovation only through coordination (e.g., how to integrate sub-tasks) not through communication (e.g., exchange information and data). In other words, applying project management mechanisms together with coordination of team members promotes incremental innovation.

The findings suggest that a high level of communication is needed for developing radical product innovation which is supported by Tushman (1978), in that complex tasks (e.g., R&D projects) require more communication than low complex tasks. It should also be noted that a low level of communication and coordination might not generate enough exchange of information and coordination of team members, thereby decreasing innovation performance. A high level of communication could decrease creativity of team members due to social distraction or reduction in the use of cognitive ability to generating solutions before choosing the appropriate one (Leenders et al., 2003). Therefore, project management mechanisms should be implemented with the appropriate level of communication and coordination in order to encourage innovation performance.

Table 6-2: Indirect Effects of PMMs through Communication and Coordination

Project Management Mechanisms	**Innovation Performance**		
	Radical Innovation (R.I.)	**Incremental Innovation (Incre)**	**Project Efficiency (P.E.)**
Autonomy (Auto)	Auto→Comm→R.I. Auto→Coord→R.I.	Auto→Incre (-) Auto→Coord→Incre	Auto→Comm→P.E. Auto→Coord→P.E.
Monitoring progress (M.P.)	M.P.→Comm→R.I. M.P.→Coord→R.I.	M.P.→Coord→Incre.	M.P.→P.E M.P.→Comm→P.E. M.P.→Coord→P.E.
Process Control (P.C.)	P.C.→R.I. P.C.→Comm→R.I. P.C.→Coord→R.I.	P.C.→Incre. P.C.→Coord→Incre.	P.C.→Comm→P.E. P.C.→Coord→P.E.
Output Control (O.C.)	O.C.→Comm→R.I. O.C.→Coord→R.I	O.C.→Incre. O.C.→Coord→Incre.	O.P.→P.E O.C.→Comm→P.E. O.C.→Coord→P.E.

Notes. R.I. is Radical Innovation, Incre. is Incremental Innovation and P.E. is project efficiency.

6.1.3 Moderating Effects of Individualism & Power Distance

The third objective of this study was to investigate which project management mechanisms have impacts on innovation performance, and the fourth objective of this study was to investigate and compare whether different project management mechanisms (autonomy or control mechanisms) have effects on innovation performance under different NPD team members' cultural backgrounds. With the testing invariance processes of AMOS by Byrne (2001), this study has provided evidence indicating the differences and similarities of preferred project management mechanisms in encouraging higher innovation performance with respect to team members' cultural values as summarized in Table 6-3.

Table 6-3: Effects of PMMs and Innovation Performance under Different Cultural Values

Project Management Mechanisms	Innovation Performance		
	Radical Innovation	Incremental Innovation	Project Efficiency
Autonomy	High Individualists (+) Low PD (+) High PD (-)		High PD (+)
Monitoring progress	High PD (+) Low PD (+)		High Individualists (++) Low Individualists (+) High PD (+) Low PD (+)
Process Control	High Individualists (++) Low Individualists (+) Low PD (+)	Low Individualists (+) High PD (+)	Low Individualists (-)
Output Control	High Individualists (+)	High Individualists (+) Low Individualists (+) Low PD (+)	High Individualists (+) High PD (+) Low PD (+)

Notes: This table summarizes all findings of moderating effects (between high and low individualism of team members and between high and low power distance (PD) of team members into negative effect (-) and positive effect (+)

High Individualism and low individualism. It was found that the higher the level of individualism of the team member, the higher the level of ***autonomy*** required for developing radical innovation products and providing autonomy to team members with low individualism was not significant in encouraging radical innovation. In relation to control mechanisms, applying ***process control*** tends to enhance incremental innovation, but it decreased project efficiency for collectivist members. Additionally, ***output control*** enhanced radical innovation, incremental innovation and project efficiency for team members with high individualism, whereas it promoted only incremental innovation for collectivist team members. However, there were several similarities in project management mechanisms' preferences between high and low individualism team members as well. ***Monitoring progress*** enhanced project efficiency both high and low individualism team members, but the effect was stronger for high individualists. Process control enhanced radical innovation, and output control promoted incremental innovation for both high and low individualist team members. From these findings it could be suggested that project managers should apply both autonomy and control mechanisms (monitoring progress, process control and output control) to high individualists for increasing all types of innovation performance while only control mechanisms (monitoring progress, process control and output control) are likely to increase all types of innovation performance for collectivist team members. However, it should be noted that applying process control to team members with low individualism could lead to project delay.

High Power Distance and low Power Distance. There was a significant difference in the impact to radical innovation when autonomy is granted to high and low power distance team members. The more ***autonomy*** granted to low power distance team members, the higher the level of radical innovation, whereas autonomy granted to high power distance team members decreased radical innovation. Moreover, providing autonomy to high power distance team members increased project efficiency. In relation to control mechanisms, both process control and output control were found to have different effects when it applied to different cultural groups of team members. ***Process control,*** with specified processes for team to follow, was found to promote radical innovation for low power distance members while it promoted incremental innovation for high power distance members. ***Output control***, specified targets for team to follow, enhanced both incremental innovation for low power distance team members and enhanced project efficiency for high and low power distance team members. There were several similarities in project management mechanisms' preferences between high and low power distance team members as well. For example, ***monitoring progress*** regarding milestones tends to increase radical innovation and project efficiency and output control promoted project efficiency for both high and low power distance team members. From these findings, it could be suggested project managers should employ both autonomy and control mechanisms (monitoring progress, process control and output control) for low and high power distance team members to positively enhance all types of innovation performance. However, for high power distance team members to maximize innovation performance, all control mechanisms (monitoring progress, process control and output control) should be employed, and providing of autonomy should be avoided.

These differences of project management mechanisms' preferences under different cultural groups (e.g., providing autonomy to high individualists and low power distance) found in this study suggest that matching/employing project management mechanisms with the appropriate cultural background could enhance innovation performance, and mismatch of project management mechanisms with some cultural backgrounds (e.g., providing autonomy to low power distance team members) could decrease the innovation performance of cross cultural innovation teams. Additionally, several similarities between project management mechanisms' preferences under different cultural groups could suggest that general mechanisms, such as monitoring progress, could be applied to all team members of any cultural group, to achieve project efficiency. All in all, project managers should consider employing project management mechanisms to fit with team members' cultural backgrounds and project goals, in order to achieve better and higher innovation performance than current management practices.

6.2 Contributions and Management Implications

Based on the above conclusions, this study contributes to the literature by providing several theoretical and practical implications for future project management in cross cultural study in several ways.

6.2.1 Theoretical and Academic Implications

First, this study developed three sub-frameworks composed of: (1) different project management mechanisms from high autonomy to low autonomy (control mechanisms) and different types of innovation performance; (2) different project management mechanisms' relationship to the teamwork processes of communication and coordination and the impact on innovation performance; and (3) these project management mechanisms affect on innovation performance under different cultural values of team. These frameworks were developed from literature, namely, Tatikonda and Rosenthal's conceptual model of project execution methods in product development projects (Tatikonda and Rosenthal, 2000), Cardinal's conceptual model of organizational control in managing R&D (Cardinal, 2001), Lewis et al.,'s conceptual model of contrasting project management styles (Lewis et al., 2002), Bonner et al.,'s conceptual model of formal control mechanisms and NPD project performance (Bonner et al., 2002), and Pinto, Pinto and Prescott's conceptual model of antecedents of cross-functional cooperation (Pinto et al., 1993). ***This study not only investigated both autonomy and control mechanisms on different types of innovation performance concurrently, but also it examined extensively the impacts on communication and coordination between these project management mechanisms and innovation performance, as well as the application of these mechanisms to different cultural groups of team members.*** The framework of this study has added to the growing area of project management mechanisms/project management styles, NPD context, teamwork processes, and cross cultural issues in project management.

Second, ***the study can be extended into the issue of the "fit"*** between project types (e.g., high complex projects and low complex projects), project management styles, and project effectiveness which is required in project management organization (Shenhar and Dvir, 1996). In addition, this "fit" could increase the understanding of the different effects of project management mechanisms, which mechanisms influence innovation performance, and which mechanisms should be applied to whom (team members with different cultural backgrounds) in developing very new products, small improvement products, and in achieving project efficiency.

Third, this study has also confirmed that ***most project management mechanisms have indirect impacts on innovation performance through communication and coordination.*** In general, communication and coordination have been proved by previous studies including this study to be essential processes for team members in assimilating their diverse knowledge and experience among team members leading to acceleration and enhancement of new product development. The results of this study provide a better understanding of the issue of communication and coordination as intervening variables between the project management mechanisms and innovation performance.

Finally, ***this study has broadened project management research into the utilization of contingency approach in applying the proper project management mechanisms to the cultural background of team members in cross cultural context***. With contingency approach, this study has provided more than one contingent variable/situation (e.g., applying project management mechanisms to high and low individualism and high and low power distance' team members) in order to deeply understand the application of different project management mechanisms to different cultural groups. The findings of contingency approach provide insight into selecting the appropriate management tool for specific cultural groups/situations (Sauser, Reilly, and Shenhar, 2009). This could help project managers in applying/matching the right project management mechanisms to the project's goals and cultural backgrounds of team members, before implementing their projects.

6.2.2 Practical Implications

Most international firms implement multiple projects at the same time and are increasingly using team members from different countries to reap the benefits of cross cultural teams. ***The findings provide suggestions for project managers to motivate their team members to work innovatively through application of these control mechanisms.*** These findings suggest that project managers, when developing very radical innovation products, should emphasize the use of control mechanisms. However, applying only a single control mechanism may not impact an increase in all types of innovation performance; an approach composed of a combination of control mechanisms to be applied in the NPD project will achieve overall innovation performance. For example, *enhancing radical innovation* requires pre-defined processes of process control and monitoring progress regarding milestones which both allow team members to improvise based on real-time demands of customers and close monitoring of sub-tasks by project managers (Eisenhardt and Tabrizi, 1995). Whereas, successful development of *an incremental innovation product* requires specifying standard processes of process control for team members to follow and less ambiguous goals for team members to implement. In order to achieve *project efficiency* (e.g., less technical product development), monitoring progress, and output control are required. These findings also recommend that project managers use caution in selecting and applying the appropriate management mechanisms for different types of projects or project goals.

The findings of this study also suggest that project managers should use project management mechanisms together with communication and coordination of team members, to achieve higher innovation performance. However, it should be noted that a high level of communication among team members might decrease performance for incremental innovation product development, but medium level of coordination based on the tasks of team members promoted all types of innovation performance. Therefore, project managers should be concerned with both applying project management mechanisms and encouraging appropriate level of communication and coordination to avoid a decrease in innovation performance.

The findings reveal that different cultural groups' team members tend to differ with regard to preferred project management mechanisms. For example, managers should provide autonomy to low power distance members to encourage radical innovation, but should emphasize monitoring milestones for high power distance members instead of providing autonomy. Such examples demonstrate the preferences of project management mechanisms based on different team members' cultural backgrounds. These findings could help project managers, senior managers, and executives of international firms to understand the different cultural backgrounds of members as well as better organize and manage people in different geographic and cultural environments. A mechanism may motivate one team member in enhancing innovation performance, but may limit innovation performance for another team member with a different cultural background. Therefore understanding cultural differences and management practices can help project managers avoid conflicts due to misunderstandings with regard to team members' behaviors which are related to their cultural background, and motivate them, thereby enhancing overall success of a NPD project (Song and Thieme, 2006). This leads to a suggestion for human resources management managers of international firms in preparing cross-cultural training for project managers and team members of cross cultural projects or global projects, in how to deal/work with cultural differences and cultural diversity of team members in order to reap the benefit of their cross cultural teams in developing better and faster new products.

6.3 Limitation and Future Research

There are some limitations associated with this study and it is noteworthy to address these limitations for future study. First, this study was conducted utilizing individual team members working on innovative projects across countries; however, only a few respondents per project were examined and the number of team members from some participating countries was limited. For example, there were only 1 or 2 participants from Srilanka, Russia, Venezuela and others. Consequently, the differences among team members were measured based on individual cultural characteristics rather than on a national basis. Hence, cultural dimensions measured in this study could vary depending on an individual's cultural background related to their national culture. In that, cultural values of individuals from European countries might be different or similar to individuals from Asian countries. For example, some people in Asian countries might have a higher individualism score than some people in western countries (Ramamoorthy, Gupta, Sardessai, and Flood, 2005). This is, however, in line with a study indicating a cultural value shift in individualism since Hofstede's 1980 study (Bouncken, Zagvozdina, and Golze, 2006). Thus, the results of cultural values at an individual level might not be generalizable to the national level. Another limitation is that this study measured innovation performance based on self-rating of project managers and team members' perspectives during project implementation or at the end of project. This self-rating by project managers and team members on their own projects might have some bias regarding radical innovation, incremental innovation, and project efficiency. In addition, this study has investigated project management mechanisms in use within particular high-tech firms (e.g., food, IT, semiconductor), thus these findings may not be appropriately generalized to other industries (e.g., transportation, or banking industry).

Given these limitations, future research may investigate project management mechanisms impact on innovation performance in the larger scale by applying the same framework, collecting more data, and investigating at a national level (e.g., from collectivism countries and low collectivism countries) based on Hofstede's national cultures. The results at national level may yield the same or different results from the current study (at an individual level), but it would extend cross cultural project management research into an area that is still required in order to understand cultural differences and management practices for the international firms. It may be interesting to examine cultural diversity of project team members (at the team level) and its effects on radical innovation and incremental innovation product development as it is noted that cultural diversity of teams leads to greater creativity and innovation (Cox, 1991). Additional research may explore communication and coordination as mediators between project management mechanisms and innovation performance under different situations (e.g., high or low individualism at individual level or national level). This may provide some insight on how well these project management mechanisms, and communication and coordination encourage people from individualism countries or people from collectivism countries in achieving innovation performance. Additional research may minimize bias from measuring innovation performance, which was rated by project managers and team members in this study, by instead using the perspective of project managers and senior managers. In addition, future research may include clients or customers' perspectives in measuring innovation performance, since direct users/customers can accurately judge the innovation and performance of these products better than firms' judgement (by senior managers/project managers/ team members) (Danneels and Kleinschmidt, 2001). It is also worth knowing how well these new products contribute to a firm's success in terms of market share by collecting data from customers' perspectives, and new product sales volume and profit from team members who were responsible for marketing of this product.

Even though this study has several limitations, indicating required future research, the empirical findings of this study have provided both theoretical and practical implications for project managers and senior managers of international high technology firms. With high competition in this global age and an increase in diversity in the workforce, acknowledgement of management practices of autonomy and control, communication and coordination, and their effect on innovation performance, including an awareness of cultural differences and similarities of team members, can help international high tech firms to better manage their team members with the right project management mechanisms and project goals to enhance innovation performance

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Appendix 1: Questionnaire

Dear Sir/Madam,

This research study is about **"how the impact of management styles, and teamwork quality within team on the innovation performance"**. Results will provide some answers and explanations how firms can enhance their innovativeness. It will take only 30 min. Your data will be **treated confidentially** and **not passed to a third party**. If you are interested in the research report, please leave an email address at the end of this questionnaire.

Thank you for your contribution & participation!

Aim-Orn Imcharoen

Personal Information		
1) Age:______	2) Gender : ☐ Male ☐ Female	3) Nationality : _
4) Highest Education: ☐ High School	☐ Diploma / High vocational certificate ☐ Master/Diplom (German System) _	☐ Bachelor (please specify) _ ☐ PhD. (please specify) _
Firm's Information		
1) Type of business	1.1 ☐ Hardware (please specify)	1.2 ☐ Software (please specify).
	1.3 ☐ Others (please specify)	
2) How many people were employed in your company in the last business year?		
☐ 1-25 ☐ 26-50 ☐ 51-100 ☐ 101-250 ☐ over 250 ☐ over 500 ☐ over 1,000		

Instruction: Please rate how strongly you agree or disagree with the following statements	
Part A: Culture(① strongly disagree and ⑤ strongly agree)	
1) It is better to work alone than in groups.	1☐ 2☐ 3☐ 4☐ 5☐
2) If you want something done right, you have to do it yourself.	1☐ 2☐ 3☐ 4☐ 5☐
3) I prefer to be self-reliant rather than to depend on others.	1☐ 2☐ 3☐ 4☐ 5☐
4) I tend to do my own thing, and others should act the same.	1☐ 2☐ 3☐ 4☐ 5☐
5) It is important for me that I perform better than others on a task.	1☐ 2☐ 3☐ 4☐ 5☐
6) Subordinates should carry out the requests of senior people without question.	1☐ 2☐ 3☐ 4☐ 5☐
7) The supervisor is always right because he or she is the boss.	1☐ 2☐ 3☐ 4☐ 5☐
8) You should be quiet when you don't agree with your boss.	1☐ 2☐ 3☐ 4☐ 5☐
9) People should maintain status differences between superiors and themselves.	1☐ 2☐ 3☐ 4☐ 5☐
10) People at lower levels in the organization should not have much power in the organization.	1☐ 2☐ 3☐ 4☐ 5☐
11) Instructions for operations are important.	1☐ 2☐ 3☐ 4☐ 5☐
12) Standardized work procedures are helpful.	1☐ 2☐ 3☐ 4☐ 5☐
13) Instructions should be spelled out in detail so everyone knows what he/she is expected to do.	1☐ 2☐ 3☐ 4☐ 5☐
14) Everyone should closely follow instructions and procedures.	1☐ 2☐ 3☐ 4☐ 5☐
15) Rules are important because they inform of what is expected.	1☐ 2☐ 3☐ 4☐ 5☐
16) Discussion should be based on tightly focused information.	1☐ 2☐ 3☐ 4☐ 5☐
17) People should articulate clearly each aspect to prevent misunderstandings.	1☐ 2☐ 3☐ 4☐ 5☐
18) To get a person's arguments clear, it is not important to understand his/her background.	1☐ 2☐ 3☐ 4☐ 5☐
19) You need not spell out all the details to understand a person's message.	1☐ 2☐ 3☐ 4☐ 5☐

20)	I like to juggle several activities at the same time.	1 2 3 4 5
21)	People should try to do many things at the same time.	1 2 3 4 5
22)	It is best for people to be given several tasks and assignments to perform.	1 2 3 4 5
23)	It is best to complete one task before beginning another.	1 2 3 4 5

Instruction: Please think about **your project/product development that already launched recently,** and circle the answer that best represents your judgment about each aspect on *"***how things actually were during development of this project"** rather than "*it should be*" Please choose only **one answer** for each question.

Project/product' name:__	**Duration (start-End):** __year __month
In this project, you were ☐ Project leader ☐ Team's member	**Position/responsibility** : __

Part B: Diversity: My teammates and I are similar in terms of their orientations…? (① strongly disagree and ⑤ strongly agree)

1)	to the self and their individual achievements.	1 2 3 4 5
2)	towards caring and identification with their in-group.	1 2 3 4 5
3)	to acceptance of differences in hierarchy and in inequality of power.	1 2 3 4 5
4)	towards the acceptance of uncertainty and risk in life and work.	1 2 3 4 5
5)	towards articulating directly and by means of detailed facts.	1 2 3 4 5
6)	towards working on tasks sequentially; first finish one then the other.	1 2 3 4 5

Part C: Project Management Components (① strongly disagree and ⑤ strongly agree)

1)	Each person's comprehension of team goals was monitored.	1 2 3 4 5
2)	Team members' comprehension of technical goals was monitored.	1 2 3 4 5
3)	Team members' awareness of project details was monitored.	1 2 3 4 5
4)	Personal understanding of team members was monitored.	1 2 3 4 5
5)	Reaching milestones was monitored in the project.	1 2 3 4 5
6)	Progress about being on schedule was tracked in the project.	1 2 3 4 5
7)	Progress about "hard data" (e. g. test results, reports) was controlled in the project.	1 2 3 4 5
8)	The project procedures and rules were defined.	1 2 3 4 5
9)	Rules and standard procedures stating how to perform normal daily activities were defined.	1 2 3 4 5
10)	The standard procedures for individual tasks were defined.	1 2 3 4 5
11)	There was a strict enforcement of written rules and procedures.	1 2 3 4 5
12)	I had freedom in running my part of the project.	1 2 3 4 5
13)	I had decision authority regarding resource allocation.	1 2 3 4 5
14)	I had freedom to explore, discuss, and challenge ideas on my own.	1 2 3 4 5
15)	I had freedom to make own decisions about what problems had to be solved.	1 2 3 4 5
16)	I had freedom to make my own decisions about what tasks to undertake.	1 2 3 4 5
17)	The management monitored the extent to which I followed established procedures.	1 2 3 4 5
18)	The management evaluated the procedures I used to accomplish a given task.	1 2 3 4 5
19)	The management modified my procedures when desired results were not obtained.	1 2 3 4 5
20)	I received feedback on how I accomplish my performance goals.	1 2 3 4 5
21)	Specific performance goals were established for my job.	1 2 3 4 5
22)	The management monitored the extent to which I attained my performance goals.	1 2 3 4 5
23)	When my performance goals were not met, I needed to explain why I could not achieve them.	1 2 3 4 5

24)	I received feedback from senior management concerning the extent to which I achieved my	1 2 3 4 5
25)	The increases of my pay were based upon how my performance compared with my goals.	1 2 3 4 5
	Part D: Teamwork Quality (① strongly disagree and ⑤ strongly agree)	
1)	There was intensive communication within our team.	1 2 3 4 5
2)	Team members were happy with the accuracy of information received from co-members.	1 2 3 4 5
3)	Team members were happy with the timing of received information from co-members.	1 2 3 4 5
4)	Team members openly shared project relevant information.	1 2 3 4 5
5)	Discussions and controversies were conducted constructively in the team.	1 2 3 4 5
6)	Suggestions and contributions of team members were respected in the team.	1 2 3 4 5
7)	Suggestions/contributions of team members were discussed and further developed.	1 2 3 4 5
8)	If conflicts came up, they were resolved easily and quickly in the team.	1 2 3 4 5
9)	There was a cooperative work atmosphere in our team.	1 2 3 4 5
10)	The works done on subtasks were closely harmonized.	1 2 3 4 5
11)	There were clearly and fully comprehended goals for subtasks within our team.	1 2 3 4 5
12)	The goals for subtasks were accepted by the team members.	1 2 3 4 5
13)	Our team avoided duplication of tasks.	1 2 3 4 5
14)	Every team member fully pushed the project.	1 2 3 4 5
15)	Every team member gave the project his/her highest priority.	1 2 3 4 5
16)	Every team member fully felt responsible for the common team goals.	1 2 3 4 5
17)	Every team members equally engaged in the achievement the common goals.	1 2 3 4 5
18)	All members fully integrated in our team.	1 2 3 4 5
19)	Our team sticked together.	1 2 3 4 5
20)	The members of our team were proud to be part of the team.	1 2 3 4 5
21)	The team members complemented one another as best they could.	1 2 3 4 5

Part F: Project Efficiency & Product Performance (① Strongly disagree … ⑤ very strongly agree)

1)	This project was within schedule.	1 2 3 4 5	2)	This project was within budget.	1 2 3 4 5
3)	This project was cost-efficient.	1 2 3 4 5	4)	This project was time-efficient.	1 2 3 4 5
5)	This project required little rework.	1 2 3 4 5	6)	This project was successful.	1 2 3 4 5
7)	The product from this project was high quality.	1 2 3 4 5	8)	All project goals were achieved.	1 2 3 4 5
9)	With this product, all demands of the customers were satisfied.				1 2 3 4 5
10)	The product from this project advanced our image to customers.				1 2 3 4 5
11)	The team was satisfied with the project's result.				1 2 3 4 5
12)	The project contributed to our company's world leadership image.				1 2 3 4 5

	Part G: Product Innovativeness (① strongly disagree and ⑤ strongly agree)	
13)	The product/software/service from this project relied on technology never used in the industry before.)	1 2 3 4 5
14)	This product/software/service was one of the first of its kind introduced into the market.	1 2 3 4 5
15)	This product/software/service was highly innovative and totally new to the market.	1 2 3 4 5
16)	Compared to competing products, this product/software/service offered some unique features or attributes to the customers.	1 2 3 4 5
17)	This product/software/service had superior technical performance relative to than competing	1 2 3 4 5

18) This product/software/service had higher quality than competing products: tighter specification, stronger, lasted longer, and more reliable.	1 2 3 4 5
19) This product/software/service was clearly superior to competing products in meeting customers’	1 2 3 4 5
20) The product/software/service from this project was similar to our main competitor’s products.	1 2 3 4 5
21) The applications of this product/software/service were totally different from our main competitor’s	1 2 3 4 5
22) The benefits this product/service/software offers were new to customers.	1 2 3 4 5
23) The technology in this product/service/software incorporates was new to customers.	1 2 3 4 5
24) Product/service/software features were novel/ unique to customers.	1 2 3 4 5
25) Customers will need to learn how to use this new product.	1 2 3 4 5
26) Customers need to change their behavior in order to adopt this product. Innov5)	1 2 3 4 5
27) This product/software/service introduced many completely new features for product/software into	1 2 3 4 5
28) This product/ software/service introduced into a market that is new to us.	1 2 3 4 5
29) This product/software/service offered dramatic improvements in existing product features.	1 2 3 4 5
30) This product/software/service was a repositioning of existing products/services/software	1 2 3 4 5
31) This product/software/service was an updated version of existing products/services/ software	1 2 3 4 5
32) This product/software/service relied on existing technology.	1 2 3 4 5
33) This product/software/service represented minor improvements of existing product/service/softwa	1 2 3 4 5
34) This product/software/service was redeveloped to improve the performance of existing	1 2 3 4 5
35) This product/software/service was customized based on existing knowledge and technology withi	1 2 3 4 5
36) This product/software/service was changed based on an existing design.	1 2 3 4 5

Contact Data		
Mr./Mrs.		Company :
If you are interested in a report, please leave your E-Mail Address**:**		

--***Thank you for your assistance***--

Aim-Orn Imcharoen