An Unstable Balance: Exploration, Exploitation, and Innovation
Decline during Development

Craig Randall

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The Dissertation Committee agrees with the above designation by signing below:

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Date: 4/26/12

The Dissertation Chair is satisfied that the student has completed any required amendments appropriately:

Dissertation Chair: Robert D. Galliers, PhD

Signature: [Signature]
Date: 5/4/12
An Unstable Balance:
Exploration, Exploitation, and Innovation Decline during Development

Craig Randall

A dissertation
submitted in partial fulfillment of the
requirements for the degree of
Ph.D. in Business

2012

Program Authorized to Offer Degree:
Department of Management
Bentley University
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Craig Randall
Abstract

An Unstable Balance: Exploration, Exploitation, and Innovation Decline during Development
Craig Randall

Chair of the Supervisory Committee:
Dr. Robert D. Galliers, The University Distinguished Professor
Information & Process Management Department and Sociology Department

The ability to innovate is considered central to firm performance and the consensus is that firms should balance exploration and exploitation innovation to succeed. Studies using an exploration/exploitation perspective have gained increasing interest, and have generally concluded that exploration innovation rates are too low. Researchers have concentrated on the early aspects of the innovation planning process: the Search, Portfolio Selection, and Design Phase, and have also studied the benefits of pursuing a serial or parallel pursuit of exploration and exploitation. Largely missing from exploration/exploitation innovation literature, however, is the development phase – which is among the longest and resource intensive phases of innovation.

This dissertation studies the exploration innovation that firms are able to finish complete through development. As such it concentrates on development and how the initial exploration exploitation plan is accomplished. It focuses specifically on the changes to the planned balance of exploration/exploitation that occur after the plan enters the Development (R&D) phase.

The research comes to five overall conclusions. First, regardless of the plan for balance in exploration/exploitation that is determined during the Search, Portfolio Selection, and Design phases, exploration innovation declines from plan materially in the Development phase. Second, management regularly make decisions to add new unplanned projects to the Development schedule, which alter the original Development plan. Third, explorative innovation is disproportionately “crowded out”. Development manpower is systematically removed from exploration innovation during the development phase and is diverted to exploitation projects. The result is a lower rate of exploration innovation and increased exploitation. Fourth, the findings run
counter to conventional scholarship that places Resource Based View tenets (skills and capabilities) and project team dynamics in the forefront of explaining development and innovation results. Instead, firm-wide Agency forces (opportunism) as well as Resource Dependencies were found to account for a majority of the decline in exploration innovation. Finally, these dynamics were found to originate from outside the extended project and development team.

This dissertation begins as a qualitative theory building investigation, using interviews at multiple software firms to expose and gain an understanding of innovation patterns and constructs. The resulting interview data are used to build hypotheses around two theoretical models (Agency Theory and Resource Dependence Theory) to explain the same DV of exploration innovation performance. Next, the theory-based IV’s of each model are operationalized based on tenets arising from the extant literature. The hypotheses are subsequently tested via a population study using a mail questionnaire sent to all U.S.-based commercial software SME’s. Statistical analysis follows, including regression, providing support for the hypotheses and the models of Agency Opportunism and Resource Dependence. Limitations and new research directions are identified.
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Chapter One. Introduction

Firms make plans on how much innovation they will do, and then they work to accomplish these plans. The focus of this dissertation is twofold. First, to understand the degree that innovation outcome – how much innovation is accomplished – diverge from the original objective, and second to discover the potential mechanisms that explain or predict any shortfall that is found. The research focuses on this innovation issue – the divergence between plans and accomplishment - from within the exploration/exploitation context. It addresses a narrow, yet important facet of innovation research; the amount of exploration innovation that firms produce (that they actually finish/complete/deliver). Specifically, the research questions center on changes to the firm’s plan for innovation – the intended balance between exploration and exploitation – that occur during development (the R&D phase). It studies the extent to which the exploration innovation plan that enters Development, differs from what is accomplished. It also finds antecedents that can help explain and predict any change.

Central to the long-term success of firms is the ability to produce innovation. For example, in a 2006 survey by Boston Consulting Group (BCG), 72% of those surveyed ranked innovation as a top-three strategic priority, 91% of them considered innovation critical to being competitive in their industry, and 74% indicated that their firms would be increasing their investment in innovation. However, innovation processes are difficult to manage. In the same survey, BCG found that over half of the executives in the sample were unsatisfied with the return on their innovation spending. This response is significant because research indicates that between 30 and 50% of firms’ sales and profits come from products introduced within in the previous five years.
(Griffin, 1997; Hauser, Tellis & Griffin, 2005). Therefore, while innovation is critical to organizational success and managers prioritize it, firms still struggle with managing and creating successful innovation processes. In other words, what firms accomplish does not equal what they report as their original intent.

In 1991, in a well-regarded article, James March introduced the two concepts of exploration and exploitation as a means to distinguish certain planned activities, and initiated a strong innovation literature stream. He viewed exploration and exploitation as choices that are potentially – and usefully – complementary, rather than being always in opposition. The concepts were defined as; “exploration includes things captured by terms such as search, variation, risk taking, experimentation, flexibility, discovery, and innovation. Exploitation includes such things as refinement, choice, production, efficiency, selection, implementation, and execution” (March, 1991: 71). Since 1991, the concept of exploration and exploitation has become widely used in many areas of business research (e.g., Tushman & O’Reilly, 1996). Many studies have researched the concepts of exploration and exploitation in strategic renewal and technological innovation (see Medcof, 2010 for an overview). A strong stream of innovation research now exists with a focus on explaining low rates of exploration, the impact of these low rates on firm performance, and the inability of leading firms to respond to changes or disruptions in their industry (Li, Lin, & Chu, 2008).

An industry disruption is a period of time when vital changes in technological underpinnings, competitive contexts, or both, occur that fundamentally change the marketplace. A considerable proportion of the literature finds that dominant firms respond unsuccessfully and lose their market position because their existing knowledge, resources, and capabilities limit their ability to adapt. Tushman and
Anderson (1986) concluded, over 25 years ago, that disruptions could render the capabilities, processes, and assets of dominant firms obsolete. Henderson and Clark (1990) added that effective response requires firms to acquire new competencies and information that are difficult and expensive to obtain. The literature generally concludes that firms with the ability to engage in exploration and then innovate will thrive, and those unable to do so will decline. Yet the problem of low exploration innovation, and firm weakness in responding to disruption in their industry, has not been resolved in research or practice (Belderbos, et al., 2010). Even with decades of concentrated academic study and guidance for practitioners, the phenomenon of sub-optimal exploration remains.

Thus, additional insight into the inability of firms to deliver innovation that equals its original plan, and more specifically, insight on issues that impact the development of an innovation plan may yield significant contributions for academics and practitioners. When studying the amount of exploration innovation and exploitation that firms generate, researchers have largely concentrated on the pre-development stages – search, portfolio selection and design – for their insight (Lavie & Rosenkopf, 2006; Li et al., 2008; Medcof, 2010). The first pre-development phase, search, is the firm’s problem solving activity and attempts to find new knowledge under ambiguous conditions. The second phase, portfolio selection, is the process of determining worth of prospective paths or projects, and then selecting the right combination of development projects in order to meet objectives given the firm’s resource limitations. The last pre-development phase, design, is when feature sets or requirements are chosen prior to the commencement of development. Conversely, virtually no literature has focused on the development phase within exploration.
research. This is an odd omission, given the considerable time and resources this phase requires when compared to other phases, and the centrality of development success to any outcome (Greve, 2007; Lavie, Stettner & Tushman, 2010; Medcof, 2010). If the plan is not accomplished (does not finish development), then any observed outcomes in the market place have little to do with the plan.

In light of these issues, this dissertation pursues research questions that pertain to investigating how the development phase affects the balance of exploration and exploitation. The questions were designed with the hope of contributing to the innovation and the exploration/exploitation literature.

1. What is the attainment of exploration innovation projects, especially when compared to other projects (exploitation), during the development phase?
2. What processes (antecedents) influence any difference in these development performance outcomes?

Therefore, the dissertation focuses on the “black box” of project development in seeking explanatory and predictive insight into exploration innovation deficiencies. The intent is to extend theory by studying the decision processes from an open systems perspective – which considers influences external to the project and the development team - that might affect exploration project performance differently than other types of development projects.

In two distinct phases of research, the development of exploration and exploitation was investigated. The first was qualitative theory building via multiple case interviews. The second was qualitative theory testing via a population census. The research progressed in the following steps:
1. A theory-building phase - qualitative case interviews - was initiated with the intent of building conjectures and establishing theoretical models to understand innovation in the development phase. Interviews were conducted, the data was transcribed and then coding was done by multiple raters. Analysis was performed on the data to expose patterns and constructs.

2. A literature review guided the commencement of the research, and began before interviews were started. The depth and breadth of the literature search continually expanded as the interview phase of the research progressed, since multiple domains and multiple theoretical bases were needed to underpin the emergent findings.

3. Based on the analysis and results of the case interview data and on the literature studied, the theoretical framing and the modeling of constructs and relationships emerged. Based on this work, hypotheses were formed that laid the basis for the theory-testing phase of the dissertation.

4. Next, constructs and interactions were operationalized for statistically valid testing. A population census of SMEs in the software industry was the next step.

5. The population census phase commenced in three parts. First, a questionnaire was constructed, then field-testing was been done via face-to-face interviews along with an academic review. Then an initial postal mailing was performed to test the efficacy of the selected population as well as to perform analysis and reliability tests on the constructs.

6. Finally, the full census was done, and the resultant data were subjected to statistical analysis.
Layout of the Research

In the bulk of the dissertation, summaries of the literature review and the qualitative research are presented, while noting how the research extends the extant literature. Then, an explanation of the research framework and hypotheses is provided, with an overview of the population chosen for the census and the methodology.

The research has specific boundaries. It only researches the development phase of innovation, and is focused on software intensive, non-consumer SMEs. It does not focus on skills and capabilities of project teams, but rather takes an open system approach to look at the key decisions that change development priorities regardless of their origination. It seeks to find the genesis of these decisions and their impact on exploration and exploitation project attainment, relative to the plan that entered the Development organization. Using a mail questionnaire census of SME software firms, the dissertation tests for the existence of the constructs developed during the interview phase, including the dependant variable of development project attainment (to plan). A series of theory-based regression models for the observed innovation performance variance are performed against multiple independent variables. My contribution to literature and practice then follow.

This study demonstrates that the plan for exploration/exploitation balance that firms decide in the pre-development stages is not accomplished during development – largely because of processes that originate outside the development organization. These processes work to change development manpower allocations during the development stage. The results of this study show that exploration innovation declines
significantly after the plan for development enters the Development department. Specifically, the decline in exploration innovation during development, in the population studied, averaged over 40%. Thus, an explanation for the low rates of innovation observed in the literature may well be materially determined after any strategy, portfolio planning and project selection phases are completed. Firms may plan sufficient exploration, but fail to deliver it.

This research finds that ongoing agency dynamics and resource dependencies conspire to “crowd out” exploration innovation. New exploitation projects for customers, prospects and partners squeeze development manpower from exploration innovation. The research finds strong support for the following arguments:

1. A combination of agency dynamics and resource dependencies act uniquely on certain types of exploration innovation projects while they are in the development phase. As a result, these exploration projects generally have more delay, feature deficiencies, and interruptions than do other development projects.

2. The development performance of exploration projects contributes to a divergence between firms’ exploration/exploitation plans that enter development, and to the outcomes.

3. This divergence helps explain both the limited innovation of firms, as well as the inadequate responsiveness of incumbent firms to disruptive innovations in their markets.

This study placement into the current literature can be viewed by comparing it to extant literature. The study has a focus on how much exploration and exploitation is
accomplished by firms, compared to the extant literature’s focus on how much exploration and exploitation is planned, or the method of this planning, or whether exploration and exploitation should be pursued in parallel or sequentially. Practitioners have reported dissatisfaction with the amount of innovation that their firms actually deliver, while scholarly research has significant focus on issues related to exploration/exploitation planning or timing.

The study contributes to earlier innovation research by more precisely explaining the dynamics of ongoing management decision-making that appears to impede innovation during the project development phase. While the many studies seeking resource-based antecedents to strong innovation have been important, they may only tell part of the story. The Resource Based View antecedents might be a necessary but insufficient condition for strong innovation outcomes.

Two models are used (an Agency Theory-based model and a Resource Dependence Theory-based model) to test three hypotheses. Each model includes a set of IVs based on a single theoretical premise, and each uses the same DV. The premises are Agency opportunism and resource dependence. The DV is based on change to exploration/exploitation plans after the plan enters development. Strong support is found for the models and the hypotheses.

This dissertation is structured in six sections. First, the research is placed into the relevant scholarly domains, and a distinction is made between different kinds of technological activities by relying on the existing exploration/exploitation and innovation literature. Second, the process of scientific inquiry and theory building is laid out by describing the methods and results from the qualitative phase of the dissertation. To this end, a series of interviews encompassing management and owner
levels at numerous software firms is reported on. Next, based on the qualitative theory building exercise, hypotheses are formulated regarding the performance of exploration and exploitation plans and their linkage to the theory based predictor variables that were observed. Subsequently, the methodology of the quantitative phase is discussed. This includes the theoretical models and specific theoretical tenets to be tested; the operationalization of the constructs; the population census methodology for data gathering, and the statistical analysis applied to the census results. Next, a detailed discussion of the results of the statistical analysis is given. Finally, the results of the analysis with the theoretical and managerial implications of the inquiry are discussed, along with the limitations of the research, and future research paths.
Chapter Two. Review of the Literature

The objective of chapter two is to position the dissertation into the broader domain of scholarly research; to introduce and define key concepts; to show where and how well-known theoretical frameworks are used in this study; and to expose current relevant research streams.

The literature review is segmented into two broad areas: Domain/Field and Theoretical Frameworks. The Domain/Field section covers innovation-related literature. It proceeds first because this literature is used to explain and define the phenomenon under study as well as the setting, and also because it was referenced prior to the commencement of field research and guided much of the initial inquiry. Following the domain section is a review of the two major theoretical perspectives that were ultimately applied as the data emerged. This is done in order to construct strong conceptual models. Those two theories are Agency Theory and Resource Dependence Theory (RDT).

Table 1 outlines the main domain and theoretical lenses this dissertation uses. It highlights the approaches that have been traditionally and mostly used by each of these perspectives, and then distinguishes the gaps that this dissertation hopes to address as it makes its contribution to scholarship.
Table 1. The four Domain literature streams at the center of this review are shown first. Four parameters (Theory used, Phase of development, Level of analysis, Research orientation) are listed for each, and the most prevalent orientation indicated. The gaps that this dissertation works to address are then highlighted. Gaps in the two theoretical frameworks of this dissertation are then listed lower.

<table>
<thead>
<tr>
<th>Domain Literature</th>
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<th>Orientation</th>
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<td>Firm Performance</td>
<td>Senior Management Strategic Plan</td>
<td>Agency &amp; RDP Development Phase Project performance Operations</td>
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<tr>
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</tr>
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<td>RBV, RDT</td>
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<td>Agency &amp; RDP Open System</td>
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<tr>
<td>Resource Dependence</td>
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Exploration/Exploitation

Since 1991, the concept of exploration and exploitation has become widely used in business research to distinguish certain planned activities. The definitions used by March (1991) are “Exploration includes things captured by terms such as search, variation, risk taking, experimentation, flexibility, discovery, and innovation. Exploitation includes such things as refinement, choice, production, efficiency, selection, implementation, and execution” (March, 1991: 71). Central to March’s framework is the inherent tradeoff between exploration and exploitation. Resource allocation constraints necessitate decisions and tradeoffs that determine whether projects intended to exploit current paths versus projects intended to explore new ones move
ahead (Lavie & Rosenkopf, 2006). Exploitation and exploration has become a powerful underlying theme in both strategic management (e.g., Hoang & Rothaermel, 2010; Voss, Sirdeshmukh & Voss, 2008), and in innovation research (e.g., Li et al, 2008). Exploration is cast as having higher risk and uncertainty; “experimentation with new alternatives whose returns are uncertain, distant, and often negative”, while exploitation is seen as less so; “the refinement and extension of existing competencies, technologies, and paradigms” (March, 1991: 71).

Organizations make conscious choices to pursue exploration or exploitation, trading off such things as shorter-term productivity gains for long-term innovation (Greve, 2007; March, 1991). Mechanisms by which exploitation takes precedence over exploration, are described by O’Reilly and Tushman (2008) as inertial: variation is reduced due to a firm’s structure; rewards; culture; competences; identity, and experience of the senior team. Furthermore, ongoing operational activity impedes anything but internally consistent change (Siggelkow, 2001; Simester & Zhang, 2010; Sroufe & Curkovic, 2008).

All the tradeoffs and mechanisms, however, result in a ratio of exploitative to explorative pursuits. Most research concludes that firms do an insufficient amount of exploration innovation - for new markets and new opportunities - in order to support firm longevity or bring sustained superior performance (Benner & Tushman, 2003; Rosenkopf & Almeida, 2003), despite the benefits of being able to do both with “ambidexterity” (Rothaermel & Alexandre, 2009; Tushman & O’Reilly, 1996).

The basic differences between exploration and exploitation generate tensions, and then they must compete for limited resources such that firms must trade-off between them (Van Looy, Martens, & Debackere, 2005). However, since research has
shown that firms need both for superior results (He & Wong, 2004), finding a ‘proper’ balance between the two is essential to management.

There is consensus that properly balancing exploration and exploitation brings long run performance benefits to the firm, but there is little agreement on how organizations should achieve this balance (Adler et al., 2009), and even less on or what a good balance is. Descriptions are mostly non-exact, such as “sufficient exploitation to ensure its current viability and, at the same time, devote sufficient attention to exploration in order to ensure the organization’s future viability” (Levinthal & March, 1993: 105). Or “a positive interaction effect between explorative and exploitative innovation strategies” (He & Wong 2004: 484). After years of study, the matter of balance is largely unsettled.

The exploitation and exploration concept is not universally consistent in its use and has been defined in numerous ways, even when used to frame research into innovation. Definitions are based mostly on the intent of the research. For instance, research into the earliest phase of innovation - search - has defined path-creating search as exploration: the broader the search, the greater degree of exploration (Ahuja & Katila, 2004; Nerkar, 2003). Other definitions attempt to embrace the concept of newness. For instance, Bierly & Daly (2007) define exploration as following radical new ideas or methods, while exploitation refines and uses existing knowledge for improving current products or the efficiency of current processes. Generally, exploration entails a shift away from an organization’s current knowledge base and skills.

In general, two dimensions have emerged that are broadly accepted for the definition of exploration and exploitation for innovation (Figure 1). They are largely
related to new technical skills or to market expertise (Lavie & Rosenkopf, 2006; Smith & Tushman, 2005). Explicitly, one dimension focuses on the novelty of the technology being developed, while the other dimension focuses on the novelty of the market to be served. Danneels’ (2002, 2007) efforts to refine the classifications further defined product innovation exploration and exploitation along these two dimensions of technology novelty and market novelty. Pure exploration is new technology developed to serve new customers or new markets, while pure exploitation is intended to strengthen existing technology to serve existing customers (Figure 1).

The two dimensional portrayal of innovation is foundational to this dissertation and is embodied in the dependent variable construct. The emphasis of this dissertation research, however, is on the market exploration component (within the lower two quadrants of Figure 1). For purposes of this dissertation, any development for a novel market is market exploration. As long as the development is being done for a market that is new to the firm, it is market exploration innovation and the extent of the technology component of the innovation is not a factor. The technology could be breakthrough or it could be mundane.
Figure 1. Two dimensions of exploration/exploitation in product innovation. This dissertation studies all exploration projects with a market exploration component, regardless of any technical novelty.

There is a considerable body of academic support for the definition of exploration as used in this dissertation; exploration as comprising a new market which can also include a new technology component (see Table 2).

Table 2. Literature for the market dimension of exploration innovation in extant research.

<table>
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<tr>
<th>Author</th>
<th>Year</th>
<th>Title</th>
<th>Journal</th>
<th>Definitions</th>
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<tr>
<td>Danneels</td>
<td>2002</td>
<td>The Dynamics of Product Innovation and Firm Competences</td>
<td>Strategic Management Journal</td>
<td>Exploration as new technology developed to serve new customers or new markets. Exploitation strengthens existing technology to serve existing customers.</td>
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<td></td>
<td>2007</td>
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<tr>
<td>He &amp; Wong</td>
<td>2004</td>
<td>Exploration vs. Exploitation: An Empirical Test of the Ambidexterity Hypothesis</td>
<td>Organization Science</td>
<td>Technological innovation aimed at emerging new product market is exploration. Those aimed at improving existing product market is exploitation.</td>
</tr>
<tr>
<td>Jansen, Van Den</td>
<td>2006</td>
<td>Exploratory Innovation,</td>
<td>Management Science</td>
<td>Exploration as searching for new knowledge on customers/markets,</td>
</tr>
<tr>
<td>Authors</td>
<td>Year</td>
<td>Title</td>
<td>Journal</td>
<td>Summary</td>
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<tr>
<td>Bosch &amp; Volberda</td>
<td>2007</td>
<td>Exploitative Innovation, and Performance: Effects of Organizational Antecedents &amp; Environmental Moderators</td>
<td>Journal of Management Studies</td>
<td>Exploration is searching for new possibilities in product, service, or markets (requires new skills or knowledge). Exploitation is serving existing customers with existing products (requires present knowledge and experience).</td>
</tr>
<tr>
<td>Mom, Van Den Bosch &amp; Volberda</td>
<td>2007</td>
<td>Investigating Managers’ Exploration and Exploitation Activities: The Influence of Top-Down, Bottom-Up, and Horizontal Knowledge Inflows</td>
<td>Strategic Management Journal</td>
<td>The further afield the technology and market pursued the more explorative. New market or technology is explorative. Same market and technology is exploitation.</td>
</tr>
<tr>
<td>Nerkar &amp; Roberts</td>
<td>2004</td>
<td>Technological and Product-Market Experience and the Success of New Product Introductions in the Pharmaceutical Industry</td>
<td>Journal of Operations Management</td>
<td>Exploration is development for a future market demand while exploitation is development that addresses a current market.</td>
</tr>
</tbody>
</table>

**Conclusions**

Fundamental to the extant research on exploration and exploitation is the strategic and planned perspective of the decision making. Where to allocate development resources; the balance between exploration and exploitation, and the
method of pursuing both (serial or parallel ambidexterity), are all viewed as the result of explicit choices and conscious plans (March, 1991). In a recent Academy of Management literature review, this perspective was again highlighted: “Scholars have measured only the net effect of exploration–exploitation trade-offs and organizations’ proactive efforts to reconcile these activities.” (Lavie, et al., 2010; 117).

This strategic/planned perspective of exploration purports that, when properly managed and with conscious ambidexterity, the inherent tradeoffs could be mitigated. But this perspective has also been refuted in that the tension and zero-sum aspect is intrinsic: “The coexistence of exploration and exploitation does not negate the inherent trade-offs between them, so that scholars should avoid assuming away these trade-offs” (Lavie, et al., 2010; 117). While this dissertation embraces the centrality that tradeoffs to exploration/exploitation are done at the planning stages, it demonstrates that the tradeoffs do not end at the planning stage; choices are ongoing, changes to the balance are endemic, and conscious management decision making is erratic. It makes a contribution to two gaps in the literature (Table 1). First, it indicates that regular, significant, and unplanned manpower\(^1\) shifts that occur after all planning and balance are determined should not be overlooked. The commencement of the development phase, and operations through project completion, is the focus of this dissertation.

Second, exploration and exploitation research has investigated the issues of incumbent firm response to technological disruption, finding that firms regularly do not respond well to market disruptions stemming from technology change (Benner &

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\(^1\)The term *manpower* is used throughout this dissertation to describe engineering resources. “Engineering resource” or “development resource” might be confused with the “resource” of Resource Dependence Theory.
Tushman, 2003). This dissertation contributes to this academic discourse by helping to answer why exploratory innovation often occurs at insufficient rates; why incumbents fail to respond when exploration innovation is needed, and what factors contribute to the phenomena.

**Innovation**

Innovation research has studied the ability of firms to innovate, and innovation’s impact on performance. The ability of firms to innovate has been found crucial to success in volatile markets that constantly introduce new products, or have rapidly advancing technologies and shifting competitors, (Bayus, Erickson & Jacobson, 2003; D’Aveni, 1994; Tabrizi & Eisenhardt, 1995). Successful innovation has been found to be a critical determinant of company success, especially in early stage technology firms (lansiti, 1995; MacCormack, Verganti & lansiti, 2001; Sharma, & Lacey, 2004). Included in this stream is also the study of disruptive innovation and its impact. Since the introduction of the resource-based view, innovation literature has largely studied the effect of resources and capabilities on product innovation. According to Eisenhardt and Martin (2000), explicating the link between resource-based theory and product innovation continues to be central, and will both inform resource-based theory and bolster its empirical foundation. For instance, Helfat and Raubitschek (2000) positioned new product activity definitively within the resource-based theory, arguing that organizational capabilities and products co-evolve over time.

Innovation is researched either as a process or as a tangible output (Larson & Brahmakulam, 2001). For instance, it can be defined as a new technology; a management practice being used for the first time, or as a significant improvement in a
process or product (O’Neill, Poudre & Buchholtz, 1998). Researchers have logically segmented the innovation domain into subcomponents and examined each more closely (Garcia & Calantone, 2002). Camison-Zornoza and colleagues (2004; 331) identified four commonly-used dimensions that categorize innovation research streams: “the stages of the innovation process, the level of analysis, the types of innovation, and the scope of innovation”. The stages of the innovation process logically partition the different phases that innovations proceed through longitudinally over time. Most phases use constructs that overlap with those of exploration/exploitation research and include idea search; design; development; production, and market launch (Cooper & Kleinschmidt, 1986; Dooley & O’Sullivan, 2001; Knox, 2002; Rogers 1995).

<p>| Table 3: Illustrative examples of the foundational and more recent innovation literature. |</p>
<table>
<thead>
<tr>
<th><strong>Author</strong></th>
<th><strong>Description</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dimensions &amp; Stages</strong></td>
<td></td>
</tr>
<tr>
<td>Camison-Zornoza et al.</td>
<td>2004</td>
</tr>
<tr>
<td>Cooper &amp; Klein Schmidt</td>
<td>1986</td>
</tr>
<tr>
<td>Knox</td>
<td>2002</td>
</tr>
<tr>
<td>Cohen &amp; Levinthal</td>
<td>1990</td>
</tr>
<tr>
<td><strong>Innovation Type</strong></td>
<td></td>
</tr>
<tr>
<td>Heany</td>
<td>1983</td>
</tr>
<tr>
<td>Clegg, et al.</td>
<td>2002</td>
</tr>
<tr>
<td>Leifer, O’Connor &amp; Rice</td>
<td>1993</td>
</tr>
<tr>
<td>Von Stamm</td>
<td>2003</td>
</tr>
<tr>
<td>Christensen &amp; Bower</td>
<td>1996</td>
</tr>
<tr>
<td><strong>Measurement</strong></td>
<td></td>
</tr>
<tr>
<td>Kleinknecht</td>
<td>1989</td>
</tr>
<tr>
<td>Acs &amp; Audretsch</td>
<td>1993</td>
</tr>
<tr>
<td>Frenkel, et al.</td>
<td>2001</td>
</tr>
<tr>
<td>Hall &amp; Reenen</td>
<td>2000</td>
</tr>
<tr>
<td>Greve</td>
<td>2003</td>
</tr>
<tr>
<td><strong>Firm or Industry</strong></td>
<td></td>
</tr>
<tr>
<td>Kivimaki et al.</td>
<td>2000</td>
</tr>
<tr>
<td>Acs &amp; Audretsch</td>
<td>1988</td>
</tr>
<tr>
<td>Acs &amp; Audretsch</td>
<td>1991</td>
</tr>
<tr>
<td>Vaona &amp; Pianta</td>
<td>2008</td>
</tr>
<tr>
<td>Damanpour</td>
<td>1992</td>
</tr>
<tr>
<td>Becheikh et al.</td>
<td>2006</td>
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<tr>
<td>Jung et al.</td>
<td>2003</td>
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<tr>
<td>Sorensen &amp; Stuart</td>
<td>2000</td>
</tr>
<tr>
<td>Beneito</td>
<td>2003</td>
</tr>
<tr>
<td>Galende &amp; Fuente</td>
<td>2003</td>
</tr>
<tr>
<td>Zahra</td>
<td>1993</td>
</tr>
<tr>
<td>Acs &amp; Audretsch</td>
<td>1993</td>
</tr>
<tr>
<td>Rogers</td>
<td>2004</td>
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</tbody>
</table>

Dimensions of innovation study: stages the process, level of analysis, types of innovation, scope of innovation. Stages of the innovation process: search, design, development, production, launch.

Innovation ranges from incremental to radical. Radical innovations transform areas within organizations. Innovation can be defined as ranging from incremental to frontier. Disruptive innovation defined as causing fundamental market changes.

R&D spending is a problematic measure - all innovation does not originate from R&D. All R&D is not innovation. Patents measure invention. Additionally, not all innovations are patented. Rates of patenting differs widely by industry and sector, so reliability is questioned. R&D expenditures are dependable and defensible as a measure of innovation.

Innovation is correlated with the number of people employed in R&D. Positive association of innovation with firm size - so-called Schumpeter II. Record of past innovation success in a firm influences later decisions to invest.

Size of firms as positive is refuted: a meta analysis of studies 4 were negatively correlated, 11 not significant, 5 bell-shaped, and 3 U-shaped. Age of the firm is positive with innovation. But big firms tend to be older.

Differentiation strategy is positively correlated with innovation. An industry sectors rate of change and growth affect innovation. Referred to as technological dynamism. Industry place in the life cycle is pivotal to linking innovation and firm size.
<table>
<thead>
<tr>
<th><strong>Development Process</strong></th>
<th><strong>Role of Individuals</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Bloom &amp; Van Reenen Kleinschmidt, <em>et al.</em></td>
<td>Lumpkin &amp; Dess Souitaris Chandy &amp; Tellis</td>
</tr>
<tr>
<td>2002</td>
<td>1996</td>
</tr>
<tr>
<td></td>
<td>Perry-Smith</td>
</tr>
<tr>
<td></td>
<td>2006</td>
</tr>
<tr>
<td>2004</td>
<td>2003</td>
</tr>
<tr>
<td>Repenning Stuart Vissa &amp; Chacur Zhang &amp; Li Von Hippel</td>
<td></td>
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<tr>
<td>2001</td>
<td>2000</td>
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</table>

Research that focuses on finding successful (and poor) project skills and team capabilities that are related to innovation success.

Similarly, the research aims to provide industry with guidance on “Best practices” for good innovation outcomes. Skills and capabilities based.

Research into the causes of development project delay.

Finding correlations to development/innovation outcomes that are related to development team makeup, development stages and processes, and team practices

Investigates the reasons for team and development project failures. The importance of a firm’s network ties to their ability to innovate. A research focus on method and benefits of user influence on innovation

Research looks at the importance of managers and project leaders to development outcomes. Presence of a project leader with strong support is positively correlated to positive outcomes.

Network ties of individuals as well as their network centrality influences “innovatedness”.

CEO characteristics such as background, education, and longevity is correlated to innovation of the firm. Top management perceptions of cost and risks of innovation

Perception of how much the company supported innovation

Incentive-based compensation
Innovation types have been categorized as well, with the new ideas mostly placed on a continuum of originality, from incremental to radical. Heany (1983) proposed that the minimal and least risky innovations are incremental changes to product style. At the other end of the proposed continuum are innovations that radically influence the marketplace or create new markets or industries. Christensen and Bower (1996) referred to these more radical innovations as disruptive. Spanning the two extremes in the continuum are other innovation categories such as product improvements, product line extensions, new products for the current market, and new products for an existing market that is new to the vendor (e.g. Clegg, et al., 2002; Leifer, et al., 1993; Von Stamm, 2003).

Innovation is a complex activity, and its measurement has proven difficult for researchers (Archibugi & Pianta, 1996; Archibugi & Sirilli, 2001). At the industry level, quantitative studies usually measure innovation using two indirect variables that are readily available in the public domain: research and development (R&D) spending, and patents. Numerous studies have shown that a firm’s R&D expenditures; numbers of people employed in R&D, or patents, are linked to innovation (Dosi, 1988; Freeman & Soete, 1997, Greve, 2003; Parthasarthy & Hammond, 2002). However, these indicators are also well known to have shortcomings for use as dependent variables. For instance, while R&D is an input to the innovation process, all innovation does not originate from R&D departments nor does the development department carry out all innovation investments. Second, all R&D is not innovation (Kleinknecht, 1989). Patents also present a measurement problem of construct validity in that they measure invention rather than innovation. Not all patents are the basis for innovations and not all are intended or pursued for development. Furthermore, not all innovations are
patented, with the propensity to patent differs widely by industry and sector (Acs & Audretsch, 1993; Frenkel, Shefer, Koschalzky & Walter, 2001).

**Firm level research**

Innovation has been studied at differing levels of analysis, from individual to industry. Innovation research is often conducted to tease out the factors - the independent variables - that can help predict the level of investment firms will make in R&D, or can predict or explain their patent activity. Those studies most often reported on, rely heavily on a resource and capability perspective, or are knowledge-based studies, as discussed below.

**Firm size & age**

Many studies have investigated R&D expenditure as being positively correlated with firm size (Acs & Audretsch, 1988; Acs & Audretsch, 1991a; Bertschek & Entorf, 1996; Dosi, 1988; Fisher & Temin, 1973; Greve, 2003; Vaona & Pianta, 2008). Tests of the (later) Schumpeterian (Schumpeter, 1943) hypothesis that large firms have positive impact on innovation has predominated these efforts (Scherer, 1984). The theorized reasons for the positive relationship are that larger companies have more resources to invest and are more likely to support risky activities. They are more able to raise and dedicate the funds needed (Damanpour, 1992; Tsai & Wang, 2005), and have economies of scale (Stock, et al., 2002). Though research results mainly support size as a significant and positive link with innovation, this conclusion has been refuted. In one meta analysis, for instance, four studies found a negative relationship between firm size and innovation; eleven were not significant, five were bell-shaped, and three were U-
shaped (Becheikh, et al., 2006). The relationship between firm size and R&D activities is complicated by the large number of smaller firms with intensive innovative activity as in high-tech industries (Acs & Audretsch, 1993b; Kleinknecht, 1991; Scheirer, 1991).

Large firms also tend to be older than smaller firms, and the age of the firm has been shown to have a positive relationship with innovation (Jung, Chow & Wu, 2003; Sorensen & Stuart, 2000).

Past Innovation

A firm’s level of investment in R&D may be path dependent. In other words, a track record of innovation success is a key criterion for deciding to fund future R&D efforts (Acs & Audretsch, 1988, 1991; Audretsch, 1995; Feldman, 1994; Freeman & Soete, 1997; Kleinknecht, 1996; Tsai, 2001; Zahra, 1993). If the outcome of R&D investments is perceived to be less risky due to past success, then implicit return on investment is higher and more projects are chosen. This conceptual relationship relies on the resource-based view for the insight that if a firm has better capabilities in innovation, it will tend to fund and deploy those resources.

Strategy

Strategy-based innovation research has tended to use Porter’s (1980) generic strategy framework, finding innovation rate differences between firms that are predominantly differentiators versus those that are predominantly low cost. The findings tend to show that differentiation strategies are more positively correlated with innovation (Beneito, 2003; Galende & Fuente, 2003; Zahra, 1993). Intention to differentiate is hypothesized to motivate investment because ongoing innovation is
necessary for sustaining the differentiator over time and thus is key to a sustained competitive advantage (Zahra, 1993).

**Industry Level Research**

Variations in R&D investment rate have been linked to industry sector when (1) rate of technological change; (2) the growth in demand, and (3) industry structure have been modeled. Studies (e.g. Evangelista, Perani, Rapiti & Archibugi, 1997; Kalantaridis & Pheby, 1999) have found that more technology intensive industries such as software and pharmaceuticals are in fact more innovative. The reasons given to explain why some industries are more innovative and some less innovative have been broad. For instance, interrupted access to raw materials and having a larger number of production facilities have been found to be important. Also, established industry sectors tend to have lower R&D expenditures when compared to newer industries (Jacobides, Knudsen, & Augier, 2006). The results of the many studies, which model attributes of industries against innovation rates, have produced industry groupings according to their innovation rates (Acs & Audretsch, 1993; Frenkel, *et al.*, 2001).

**Organization: Structure & Individuals**

The effect of firm structure and internal decision making processes on innovation has produced inconsistent results in the literature. For instance, informal processes versus formal ones have received significant attention, as has centralized versus decentralized decision making. Formal decision making in the form of clarified roles, hierarchic oversight, and concentration of resources increases innovation in newer companies but may cause decline in later years (Koberg, *et al.*, 1996; Van de
Ven, 1986; Walsh & Dewar, 1987). Other studies show that it is the type of formalization that matters (Gatignon & Xuereb, 1997). Decision control increases innovation in late-stage versus early-stage firms, while financial control aids innovation in early rather than in late-stage ones (Liao, 2006).

The innovation literature related to the micro-level of analysis of the individual may be segmented into main streams, which are either (1) related to top management, or (2) related to individual employees. Central to this research on individuals has been the study of the effect of project leaders or champions at the senior level when they are involved in the innovation process. Souitaris (2002a), and Chandy and Tellis (1998) established that a project leader with strong support from upper managers was a factor that favored successful innovation, supporting earlier similar work by Cooper (1979) and Rothwell (1992).

CEO characteristics, and how they relate to innovation outcomes, have also been extensively researched. Many studies, including Jung, and colleagues (2003), Papadakis and Bourantas (1998); Romijn and Albaladejo, 2002; and Souitaris (2002) have found that positive innovative results can be related to certain CEO qualifications including technical background, education, and longevity with the firm.

The studies of factors relating employees and innovations are quite mixed. Employee perceptions related to how much the company supported innovation (Jung et al., 2003) is reported as being directly related to outcome. The more employees perceive company support, the more innovation occurs. Most related research on employees, however, focuses on the profile of the workforce. For instance, educated, qualified and experienced personnel were each found to be important for innovation (Freel, 2003; Romijn & Albaladejo, 2002; Souitaris, 2002). Training (Souitaris, 2002);
incentive-based compensation (Baldwin & Johnson, 1996; Koberg et al., 1996), and whether employees feel empowered (Gudmundson, Tower & Hartman, 2003), have also been positively correlated with innovation.

**Project or Team Level Research**

A large body of research, which has also been referred to as New Product Development (NPD), has focused on the development of projects. This research includes how the stages of project development are sequenced and the role of communication between key departments while the project is underway (Frishammar & Horte, 2005). The questions pursued in this stream of literature generally encompass an inquiry into what factors affect a project’s success in completing development or on factors that affect success of the innovation once it is in the market. When researchers focus on NPD, it is generally through a lens of teams and skills, and structures and processes, all using a project level unit of analysis (e.g. Brown & Eisenhardt, 1995 for a 25 year review). For instance, Armour and Teece (1980) focused on the benefits of cooperation in R&D and production, while Benner and Tushman (2002) analyzed the drivers of innovation, types of innovation, and quality programs. These studies have focused on finding successful (and poor) processes, or skills and capabilities that correlate to outcomes (Bloom & Van Reenen, 2002; Kleinschmidt, de Brentani & Salomo, 2007), and often have a goal of establishing “best practices” (Blindenbach, & van den Ende, 2006; Wheelwright & Clark, 1995). Within NPD research, identifying issues that cause project delay has received significant academic attention (Cooper, 1995; Ulrich, 1995; Kahn, et al., 2006). Much of the NPD body of research has used a closed system approach, where an isolated team or R&D department pursued the
development of new products. Often, the studies focused on larger firms where departments are larger and can support the more dedicated project assignments on which this approach relies (Gianmario, 1999; Damanpour, 1991).

An area of extensive study within the innovation stream, at the project or team level, has been on which characteristics of individuals and development teams matter to positive outcomes. It focuses on uncovering RBV-based issues, such as team makeup; project processes, and team practices (Brown & Eisenhardt, 1997; March, 1981; Romijn, & Albaladejo, 2002; Takeuchi, & Nonaka, 1986), or on market orientations (Atuahene-Gima, Slater, & Olson, 2005) that tend to lead to positive outcomes. Researchers in this area also look to uncover specific reasons for team failures (Repenning, 2001), or how processes advised in the literature diverge from actual practice (Griffin, 1997). Theories other than RBV are largely not considered.

At the project level, it is R&D development performance and not the innovation that is generally measured. Three parameters are most often used to measure performance, and these relate to schedule or time; budget or cost, and quality or completeness. These three factors are at times studied individually or in combination. For instance, how a project performs relative to the original schedule is used frequently as a single measurement (e.g. Ayse & Miles, 2011; Parry et al., 2009; Acur et al., 2010; Bstierler, 2005, Kessler & Chakrabarti, 1996 - refer also to the recent meta analysis of development speed by Chen, Damanpour, & Reilly (2010) for a comprehensive overview). While these three parameters of time, cost and quality have been theorized as in contention – as one improved, the others erode - these assumptions have not proven true (Patanakul, Chen, & Lynn, 2010; Blindenbach-Dresesen et al., 2010; Atuahene-Gima, 2003)
Conclusions

Innovation literature tends to adopt a dependant variable (DV) that measures rates of innovation or outcomes of innovation relative to other firms or other industries. This performance variation is often measured via indirect constructs such as R&D spending rate or patents applied for. How the firms perform relative to their own plan or own intent is largely studied only at the project level, where comparing project outcomes is usually based on whether the project is successful or on how performance is seen relative to the original schedule.

Innovation perspectives generally embody a few core assumptions: increased innovation is positively linked to firm performance; innovation is normally the optimal use of R&D development resources, and higher innovation rates can be linked to specific resources and capabilities. That antecedent skills and capabilities can then be used to formulate “best practices” has a long history and is a preeminent literature stream today (e.g. Carmeli, 2001; Clark & Fujimoto, 1991; Cooper, 1993; Gianmario 1999; Verona, 1999; Kanter, 1983, 1989). Innovation research under these assumptions then looks for positive antecedents to the chosen DV. In other words, it looks for antecedents to high levels of patents; high R&D spending rates; project completion, or projects that have market success. None of these constructs, however, is a direct measurement of innovation.

Most project-level development research focuses on sequential development using a predominantly closed system approach. Analysis is of issues surrounding a single artifact, or issues associated with one team with responsibility for development.
When management processes are considered, the predominant paradigm is still a closed system approach that analyzes the internal support of the one artifact or team.

Innovation research has a history spanning back to the start of the 20th century. Studies that have investigated innovation over the last few decades, however, have almost exclusively adopted the resource-based view (RBV), or perspective, with the goal of identifying patterns and factors in order to find the conditions under which innovation succeeds or emerges at a higher rate.

Many of these same factors that have been studied in RBV-based innovation research have an overlap with constructs that are regularly used in Agency and Resource Dependence theoretical work (see Table 4). These overlapping factors are useful to the distinctive theoretical perspective that this dissertation takes, in that they help to guide the construct development; frame, and variable selection.

That many of the factors used in RBV-based research should overlap with other theoretical framings gives evidence that the phenomenon of innovation performance may have room for a wholly divergent theoretical perspective.

Table 4. A multi-level framework of innovation variables in literature: Factors which have been the subject of non-innovation related Agency Theory and Resource Dependence research are indicated.
<table>
<thead>
<tr>
<th>Innovation Factors</th>
<th>Agency</th>
<th>Resource Dependence</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>External Variables</strong></td>
<td>Country/Region</td>
<td>Cultural</td>
</tr>
<tr>
<td></td>
<td>Legal structure</td>
<td>Industry</td>
</tr>
<tr>
<td></td>
<td>Resource Availability</td>
<td>Capital availability</td>
</tr>
<tr>
<td><strong>Strategic Variables</strong></td>
<td>Strategic goals</td>
<td>Generic strategy</td>
</tr>
<tr>
<td></td>
<td>Ongoing performance</td>
<td>Market position</td>
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<td></td>
<td>Market target</td>
<td>Network Centrality</td>
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<tr>
<td></td>
<td>External/Internal control</td>
<td>X</td>
</tr>
<tr>
<td><strong>Firm Variables</strong></td>
<td>Firm size</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>Firm age</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>Customer concentration</td>
<td>Capital requirements</td>
</tr>
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<td></td>
<td>Resource requirements</td>
<td>Past innovation</td>
</tr>
<tr>
<td><strong>Internal Variables</strong></td>
<td>Culture</td>
<td>Manager support</td>
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<tr>
<td></td>
<td>Decision processes</td>
<td>Resource allocation</td>
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<td></td>
<td>Resource allocation</td>
<td>Employee incentives</td>
</tr>
<tr>
<td></td>
<td>Skills, capabilities, knowledge</td>
<td>Assets/Tools</td>
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<tr>
<td></td>
<td>Absorptive capacity</td>
<td>Structure &amp; Networks</td>
</tr>
</tbody>
</table>

**Theory Review** (Agency & Resource Dependence)

**Agency Theory**

Agency theory is fundamental to this study because it can help explain the decision making process in any relationship of delegation. Jensen and Meckling (1976) described agency tenets when viewing firms as a set of contracts among individuals who all act in their own self-interest. They also defined the concept of agency cost, and showed that such costs are inherent and unavoidable in delegation. Agency cost is the summation of three problems: the cost of the principal monitoring the agents to ensure proper effort is expended; the economic costs incurred from the
efforts of the agent to bond or signal alignment with the principal, and the economic loss from any sub-optimal outcomes from agent decisions that diverge from the principal’s interest.

Agency Theory is now applied broadly to situations of control and behavior within any agency relationship of delegation – the dynamics whenever one entity (the principal) appoints another (the agent) to perform work. It has proved useful in analyzing key player actions when:

a) the goals or desires of the agent and principal might diverge,

b) there is significant difficulty or expense for the principle to verify what the agent is actually doing and the agent has more information on the matter than does the principal,

c) principal and agent have different profiles: risk profiles or aversions to risk, incentive preferences of rewards or punishments, and different personal and professional risk involved (Eisenhardt, 1989).

Conventional Agency Theory research also addresses what Ross (1973) called the principal’s problem. Principals pay agents for specific results and they delegate authority to them. But since results may not be predictive and may be given to occurrences beyond the agent’s control, agents more often receive payments for their effort, rather than for results. Agency Theory assumes that principals should persuade risk averse managers (the agents) either via monitoring or via aligning them with the owners through equity incentives (Beatty & Zajac, 1994; Jensen & Meckling, 1976; Tosi, Werner, Katz & Gomez-Mejia, 2000). Conversely, management will attempt to persuade the principals that they are indeed acting in their interest (Barney & Hesterly, 1999; Jensen & Meckling, 1976) which is the agency cost of bonding. Despite all
efforts, perfect alignment is unrealistic and agency costs are unavoidable (Fama & Jensen, 1983; Jensen & Meckling, 1976).

The result is that there are, in general, two types of principal-agent dynamics (Bromley, 1989). The first is the hidden action (moral hazard) model when the principal cannot directly observe the agent’s actions. The principal may be able to verify outcomes of an agent’s activity, but not the agent’s effort. The second type is the hidden information (adverse selection) model, where the agent has some concealed information or is better informed than the principal about important issues (e.g., difficulty of a projects; true cost/benefit of a decision). This dynamic implies that the agent will use this asymmetric information for inappropriate advantage, and the principal will make sub-optimal decisions. This degree of an agent’s opportunism is important to the level of agency costs that will ultimately result, and it is compounded by the amount of uncertainty that exists – without uncertainty, opportunism is less likely. Risk preference and opportunism, therefore, are linked to the estimation of the chance for success and magnitude of return.

Management Alignment

Most Agency Theory research has focused on the CEO level, but research has posited that agency problems increase in lower layers of management hierarchy because incentive exists for lower managers to increase their own financial return (Cooper & Dunkelberg, 1986), improve their chance of promotion (Feeser & Dugan, 1989), and increase their prestige (Carland, Hoy, Boulton & Carland, 1984). In addition, goal related issues of separating ownership and control have been predicted to grow
at lower levels, such as revenue targets replacing profit-based goals (e.g., Baumol, 1967; Jensen & Meckling, 1976).

Nevertheless, Agency has been mostly applied to CEOs and to compensation related research, with a spotlight on mechanisms for aligning agents with principals. Research posits that agency loss is reduced as principal and agent interests converge on the same outcomes (Lupia, & McCubbins, 1998; Niskanen, 1971; Romer, & Rosenthal, 1978). Examining equity ownership as a method of goal alignment presupposes that to increase such incentives increases alignment and risk taking (Bryan, Hwang, & Lilien, 2000).

For empirical testing of the theory, studies have looked for links between the degree of a company’s diversification activity and the extent of managers’ equity holdings. The assumption is that diversification demonstrates a misalignment, because diversification lowers risk and destroys value. Numerous database-driven empirical studies have been undertaken over the last 30 years; early findings supported the proposition that diversification is associated with lower management equity (Agrawal & Mandelker, 1987; Amihud & Lev, 1981; Esty, 1997; Hill & Snell, 1988; Zahra, 1996). The influential Amihud and Lev study was once widely cited to show that low equity is linked to goal misalignment and risk-reducing activity but has been refuted (see Boyd, Gove & Hitt, 2005).

A duplication of the Amihud and Lev study was undertaken by Lane, Cannella and Lubatkin (1998). Their study was comprehensive and “found no evidence that Amihud and Lev’s (1981) data from the 1960s or our data from the 1980s support their widely-cited conclusion that managers attempt to diversify their own risk through corporate diversification and unrelated mergers unless restrained by large block
shareholders.” (p.1077) Another influential study by Denis, Denis, and Sarin, (1999), while purporting to support Amihud and Lev, actually used underlying data that made the link questionable (The positive relationship of equity and risk existed only at extreme levels of management ownership (above 67%), and only in 13 of 933 firms.)

To further muddy the water, a well-known study found an inverted ‘U’ (Wright et al., 1996) relationship; risk-taking behavior first rises with equity ownership and then declines as the equity stake grows larger. While this study was also influential, more recent work (e.g., Goranova, et al., 2007) found even this relationship to be nonexistent longitudinally. In other words, increasing a manager’s equity did not result in any later increase in risk taking as the theory would predict: “we conducted analyses that find no support for a curvilinear model” (p 223). More recent research shows that diversification activity seems to precede manager changes; management might be selected for their diversification skills (Eisenmann, 2002). The results of all the research is now so varied, and disagreements over the value of using diversification as a measure of risk is so strong, that any conclusions are risky.

At least one conclusion, however, can be inferred. A central construct to agency – goal alignment - has been the most researched by eminent scholars and the most published in premier journals for over 30 years. Yet the construct; its operationalization, and the results, are all still under question.

Agency and Innovation

Innovation has had limited study using Agency Theory underpinnings. When used, the perspective of the research has focused on CEO-level agent activity, uses the firm level of analysis, and R&D investment as the DV measurement. The general
premise of this research stream is that innovation has uncertain cost and return (Ceccagnoli, 2009; Koellinger, 2008), and is thus representative of a risky management decision (Latham & Braun 2009). The Agency-based theoretical and empirical work on innovation has generally focused on new product risk taking by management (e.g. Jones & Butler, 1992; Zahra, 1996; Zahra, Neubaum & Huse, 2000; Ryan & Wiggins 2002), or on the firm’s innovation investment level (e.g. Balkin, Markman & Gomez-Mejia, 2000; Francis & Smith, 1995; Hill & Snell, 1989; Hoskisson, Hitt & Hill, 1993; Palmer & Wiseman, 1999). Both streams support the conclusion that managers may tend to make risk-averse decisions, which emphasize short-term financial performance. Thus, they avoid the risk of innovation investments, whose future payoff is uncertain, unless strong long-term incentives are provided.

At the project level, the issue of moral hazard or asymmetric information has been research within the project team as a closed system (e.g. Bergmann & Fried 2008). Results are that monitoring is difficult, and that, therefore incentives based on performance is important.

**Conclusions**

Agency theory is widely accepted for its impact on matters of delegation, but its application has been narrow in the literature. Empirics have been largely confined to board/CEO interactions or the dynamics of outside contracting. Most Agency-based research has tended toward analysis of acquisitions or firm level investment in R&D, both of which are macro-level constructs. The Agency unit of analysis, however, is by definition a micro-level construct: the contract between delegator and the responsible party.
Agency Theory can be applied to multi-level management decisions of delegation and to any principal/agent interaction related to development projects. The theory explains how problems can stem from self-interest and conflicting goals, coupled with asymmetrical access to information that agents tend to have (Table 5). Yet in analyzing the problems of innovation and development, using the Agency perspective below the firm level or the CEO is novel. No Agency-based research has been innovation project-related outside of the project team. This lack of theoretical application to ongoing or inter-level management issues related to innovation - at the project level - exposes a fertile area for new research, especially for innovation during the development phase.

Table 5. Agency Theory framing as applied in the dissertation.

<table>
<thead>
<tr>
<th>Agency Tenet</th>
<th>Timing</th>
<th>Dynamic/Process</th>
</tr>
</thead>
<tbody>
<tr>
<td>Divergent Goals</td>
<td>Outcome preference or selection on any matter</td>
<td><strong>Opportunism</strong>&lt;br&gt;Agent act in self-interest, to a varying degree</td>
</tr>
<tr>
<td></td>
<td>At a decision point</td>
<td><strong>Bonding</strong>&lt;br&gt;Agent acts to signals alignment with principal</td>
</tr>
<tr>
<td>Information asymmetry</td>
<td>During ongoing activity</td>
<td><strong>Adverse Selection</strong>&lt;br&gt;Principal guided to suboptimal choices</td>
</tr>
<tr>
<td>Incomplete information</td>
<td></td>
<td><strong>Moral Hazard</strong>&lt;br&gt;Shirking or self-interest action by agent</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Monitoring</strong>&lt;br&gt;Principal observes and measures</td>
</tr>
</tbody>
</table>

The innovation and development literature often treats management hierarchies as a homogenous group with “best practice” roles assigned to each managerial level (Kuratko, Ireland, Covin & Hornsby, 2005). Under this scenario, senior managers have been portrayed as identifying resources and means for investment; middle managers as proposing opportunities, and first level managers as carrying them
out (Hornsby, Kuratko & Montagno, 1999, 2002; Kuratko, Montagno & Hornsby, 1990). This line of research has found positive relationships between roles and an organization’s entrepreneurial outcomes, where management is generally assumed to execute on the strategic goals of the firm. Agency Theory is largely absent in investigation of such operational structures and decision making inside organizations. Furthermore, it has not been applied in any research related to exploration/exploitation. The reason may be that the predominant unit of analysis is the firm, while the goal of the research is often to establish best practice. Additionally, the dominant theoretical paradigm for both exploration/exploitation and innovation research has been has been RBV.

**Resource Dependence Theory**

Resource Dependence perspectives have had little use in the context of innovation or exploration and exploitation literature. Resource Dependence Theory (RDT) asserts that the external environment is the source of resources that are fundamental to a firm’s survival, to its performance, and that these shape its structure, boundaries, and internal activity (Pfeffer & Salancik, 1978). “Corporate survival depends upon successful adaptation to the constraints imposed by the uncertainty of access to needed resources” (Glasberg & Schwartz, 1983: 314)

Pfeffer and Salancik (1978) ascertained the factors that decide the level of dependence: the importance of the resource to the firm; resource scarcity, and the level of competition among organizations for control of the resource. To understand organization structure and behavior, discerning the resources that are critical is key: “Criticality measures the ability of the organization to continue functioning in the
absence of the resource or in the absence of the market for the output” (Pfeffer & Salancik, 2003: 46).

Academic literature using RDT has largely concentrated on mergers, acquisitions, and joint ventures (Hillman, Withers, & Collins, 2009), with Boards and executive replacement or succession encompassing much of the remainder (Hillman, Cannella & Paetzold, 2000).

Resource Dependence is an “open system” theory; every organization exchanges resources with its ecosystem. According to Scott (2003), the need to acquire resources creates dependencies between organizations and external units, but these dependencies can ultimately cause internal political problems between stakeholders. One of the main hypotheses of RDT is: “Those sub-units most able to cope with the organization’s critical problems acquire power in the organization” (Pfeffer & Salancik, 1978: 230). Thus, agents within organizations gain power if they control or influence important resources and whoever controls a critical resource has power over the actors who depend on them. “In general, organizations will tend to be influenced by those who control the resources they require” (Pfeffer & Salancik, 2003: 44). Pfeffer and Salancik use the concept of resource dependence for exchanges inside the organization. Departments and individuals have resource dependencies and more or less power over decisions as a result. Managers decide how external resources and the internal actors related to gaining those resources, will be handled. Decisions related to the firm’s resources lie with managers who allocate them to meet organization objectives (Sirmon, et al., 2007).
Boards of directors are discussed here because they represent a source of the firm’s capital. Boards can be eclectic, consisting of individuals with direct holdings and those without direct holdings such as venture investors, fund managers, or proxy-elected directors. The composition of boards of directors has received considerable attention in RDT research such as how the selection of board members is linked to reducing uncertainty in accessing resources. Findings indicate that the composition of boards reflect the resources most needed for the organization to survive. For example, Dailey and colleagues (2002) found that for entrepreneurial firms, the RDT role that boards have in securing resources may be more than for larger established ones, and Certo (2003) identified the importance of prestigious boards on IPO performance.

**RDT and Innovation**

While the literature which references RDT in the context of development and innovation may be thin, the impact of the work is great. Christensen and Bower (1996) focused on the consistent failure of dominant firms to respond to episodes of disruptive technology changes. Using the example of the computer disk storage industry and longitudinally studying patterns over decades, they concluded that the primary reason most businesses failed to remain leaders during disruptive changes in their markets is that they responded to their existing customers. It was not that they were unaware of the threat from radical changes, or that they did not have the capabilities or resources to innovate. On the contrary, the industry leaders had prototypes well before the firms that ultimately replaced them in market share. What Christensen and Bower (1996) found was that resource dependency tied the incumbent’s hands – they were dependent on the short term revenue that existing customers promised for current products. New development - exploration innovation -
was starved of investment in lieu of enhancing existing products - exploitation. “The demands of a firm’s customers shape the allocation of resources in technological innovation - a model that links theories of resource dependence and resource allocation” (Christensen and Bower, 1996: 197).

While the literature stream sparked by the concept of disruptive innovation - now referred to as Disruptive Innovation Theory - has largely focused on defining “disruptive”, recognizing disruptive events, and studying the evolution of these events in the marketplace (see Yu & Hang, 2010 for a review), Christensen’s original research informs the intent of this dissertation: manpower is not applied to exploration innovation projects at incumbent firms, due in part, to revenue dependence from large customers. One significant difference of this dissertation is the elimination of the episodic nature of the extant literature when looking at the incumbent firms. “Disruptive innovation” literature studies episodes of disruptive change that stem from technology upheaval in the external environment (Bower, & Christensen, 1995). This dissertation argues that inside the incumbent firms, the episodic supposition is not imperative or even applicable.

This study argues that the decision making processes internal to the firm are the same - no matter what is taking place in the marketplace outside the firm. In other words, the resource dependence on revenue does not change, whether a disruption is occurring, is on the horizon, or is nonexistent.

A second difference is that the Christensen and Bower perspective is a strategic one; it assumes conscious management planning to subordinate exploration in favor of customer demands. Christensen and Bower’s analysis of the disk drive industry described decisions at the level of the firm, where the project portfolio priority was to
meet demands of existing major customers. This perspective remains dominant in disruptive research (e.g., Henderson, 2006; Christensen & Raynor, 2003). The perspective does not consider the ongoing decisions that occur after the planning phase, and once projects are under development. This problem of resource allocation away from addressing disruptions has been studied, with the intent of developing ‘best practice’ solutions in a capabilities approach. For instance, the idea of creating ‘strategic buckets’ to manage sustaining versus disruptive projects independently (Chao & Kavadias 2007; Hogan 2005) is very similar in substance to the concepts proposed by Tushman and & O’Reilly (1996) for parallel exploration and exploitation tracks.

A third difference is that the resource dependencies that drive a firm’s decisions, such as the need for short term revenue described by Christenson and Bower, is influenced by the self-interest of individual employees (agents). This idea was exposed by Pfeffer and Salacik (1978: 26 -29):

- “There is no requirement for the participants to share vested interests or singular paramount goals”.
- “Individuals with varying interests and preferences come together and engage in exchanges.”
- “The coalition of interests participating at a point in time defines the activity of the organization”.
- “One of the inducements received for contributing the most critical resources is the ability to control and direct organizational action”.
- “Each time the organization satisfies the demands of one participant or interest group it simultaneously constrains its own behavior in meeting other subsequent demands”
This prospect is important because agents and principals are conjectured to make different decisions on the same matter should their goals be misaligned. Thus both Agency dynamics and resource dependencies may combine. For example, if a manager (e.g. a sales manager) will obtain a bonus for reaching a yearly revenue target, then reduced-price sales might be made at the end of the year – sales that render the firm unprofitable.

In summary, Theorists have found both the Resource Dependence Theory and Agency Theory perspectives useful in innovation studies. Agency helps with understanding organizational relationships in which control is exercised under conditions of goal divergence, asymmetric information, and opportunism. Resource Dependence helps with understanding how external needs such as capital dependence and revenue dependence affect both decision making and firm structure (Nienhüser, 2008). Both literature streams are used in this dissertation to guide data gathering and to develop a framework that depicts the dynamic relationship between innovation, agents, and firm dependencies, and explain how this interplay over time generates uneven outcomes for exploration and exploitation.

The next section reports on the qualitative phase of this study. It presents the case interview data that established the phenomenon of explorative innovation, and the constructs of the IVs and the DVs. The case data was also the basis for the subsequent hypothesis formation, including the explanatory links that were based on the theoretical underpinnings just covered in Chapter 2.
Chapter Three. Theory Building through Case Interview

This research proceeded in two phases that built logically on each other: a qualitative inquiry with data and analysis gathered via multi-site management interviews, and then a population study (Figure 2) of software SMEs that was based on the findings of the qualitative effort. The qualitative research phase employed an iterative methodology of case interviews that was designed for in-depth understanding of a specific phenomena, as well as explanatory theory generation. Patterns were observed, and theory extension, construct definition, and model building proceeded step by step. The first goal of this phase was to study the innovation development environment, understand problems of more innovative projects, and then develop constructs and recurrent relationships from data gathered in the initial interviews. A second set of interviews then commenced, which supported the second goal of testing, clarifying, and supporting or falsifying observed constructs and interactions. The last phase of the qualitative work proceeded by assessing whether the same constructs and models were observed consistently in an expanded set of firms. This testing phase guided the application of existing theoretical frameworks to construct explanatory models of the observations.

The data collected from the first interviews focused on gaining an understanding of project development processes and problems. Analysis of the early interviews exposed themes that, in turn, led to specific questions intended to refine and elaborate concepts; verify or refute data, and determine the idiosyncratic or more generalized nature of the earlier data. The findings (and the questions requiring further study) emerged from the interplay of an expanding literature base and the analysis of the growing case data conducted with a Grounded Theory methodology.
(Glaser & Strauss 1967; Strauss & Corbin 1990). As a theory building process, frameworks were constructed and modified as new data gathering was done (Eisenhardt, 1989; Eisenhardt & Grabner, 2007).

Figure 2. The dissertation’s main components and a track of its progression from start to completion.

The sampling strategy for firms and interviews was theory based. Given the overall objective of the research, which was to understand the development phase of innovation, and innovation project performance, it was important to include only firms that had frequent product development projects and demonstrated development competence. It was also important to select the sample from a well-defined
population, so that generalizability to population was possible. As a result, a series of interviews within twelve separate organizations, all of which are intimately involved in the software development industry, was undertaken. Nine of these firms are software companies, while three were at venture capital (VC) organizations with a software orientation for investment. All firms where interviews occurred were between 10 and 500 employees with significant revenue, as were firms associated with the VC’s who were interviewed. Interviews were conducted with representatives from different managerial levels (Board, CEO, Vice President, project leader), and from different functional areas (R&D, Sales, Marketing).

Preliminary conversations with key experts in the Greater Boston area prior to the interviews helped establish foundational interview outlines; identify firms that depended on internal software development for existing and new products, and gain access to the initial interviewees. Subsequent interviewees were identified through a “snowball” referral method. The research sites are shown in Table 6.
Table 6. Overview of the interview. Company profiles and subjects.

<table>
<thead>
<tr>
<th>Organization Type</th>
<th>Business Sites</th>
<th>Business Focus</th>
<th>Location</th>
<th>Interviews Conducted</th>
<th>Interviewed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Venture Capital</td>
<td>Three</td>
<td>Technology Early and Mid Stage Investment</td>
<td>Mass</td>
<td>Three plus follow up</td>
<td>Board Member Partner</td>
</tr>
<tr>
<td>Mid size Software</td>
<td>Four</td>
<td>Business to Business SW</td>
<td>Mass</td>
<td>Six plus follow up</td>
<td>CEO VP/Director Engineering Product Manager VP Sales</td>
</tr>
<tr>
<td>Small Software</td>
<td>Five</td>
<td>Business to Business SW</td>
<td>Mass</td>
<td>Seven plus follow up</td>
<td>CEO VP Engineering VP Sales</td>
</tr>
</tbody>
</table>

Interviews, which were conducted over a one-year period, were open ended, averaged one-and-a-half hours, and used a question guide that evolved with the research project. The questions varied to some degree by respondent (see Appendix 4). Specific concepts emerged from the interviewees, rather than from prompting. Most interviews were recorded and transcribed; interviews not recorded and transcribed were at the request of the interviewee or of poor sound quality. In each case detailed notes were taken. Follow-up phone calls or emails were used for clarification or when greater depth in particular areas was beneficial.

The first interviews focused on understanding development processes using an interview guide. In later interviews, more specific questions refined themes that emerged from the analysis of earlier interviews. I encouraged statements that included specific events and examples. Data collection stopped when more data resulted in minimal incremental understanding - theoretical saturation (Lee, 1999; Strauss, 1987). The case investigations were in four steps, and designed to help disaggregate
ambiguous information while avoiding premature analytical biases. In the first step, the focus was on a few semi-structured interviews (defined interview questions, but discussion moved with the interviewee’s information flow) that were selected for potential depth of information and degree of variance. The sample included a CEO, a VP of Engineering, and a VC, and was sized to discern patterns but also to avoid “data asphyxiation” (Pettigrew, 1990).

NVivo, a computer-aided text analysis (CAT) software program, was used for coding the interview data. The coding goal was to transform the interview data from many cases into a quantitative method for analysis and cross comparison. Quantitative analysis of these codes followed analytical steps: read the data and demarcate segments within it; label similar segments with a consistent “code” or short phrase; report via a mix of summarizing the prevalence of codes, noting similarities and differences, and comparing the relationship between codes. By iterating between field notes, themes from the coded data, and cross-case comparisons on the constructs, competing frameworks and typologies were constructed.

The line-by-line analysis of these first interviews focused on description in order to identify constructs and to understand their meanings. Less attention was on analysis at this stage. In this step, I identified key themes that occurred in the case interviews, so for each case, core concepts were extracted and compared with the instances of that same idea in the other cases. The goal was to develop good constructs - abstractions to simplify the chaotic and seemingly unrelated details of the project performance phenomena and surrounding processes. (Kuhn [1962] described theory building as being confusing and with many contradictions.) I avoided idiosyncratic findings by comparative analysis of multiple organizations using multi-level perspectives. This
detailed analysis of the interview transcripts enabled clustering of information that addressed the main questions. This clustering process led to the identification of emergent themes without introducing premature analytical bias. It classified the phenomena (via the coding) into categories of information by project performance attributes in order to simplify the data and organize around important relationships between emergent constructs and outcomes. Thus, the in-depth analysis of the original site visits identified key evidence and themes.

The next step shifted the focus to broader data gathering, with construction and application of emergent theory. In this phase, the number of interviews was expanded and the questions changed iteratively from case experience until a largely consistent guide emerged. I systematically compared alternative theoretical interpretations with the evidence from each case to assess how well or poorly they fit with case data (Eisenhardt, 1989). Associations between the construct processes and attributes, and their intensity, showed patterns that were consistent with outcomes.

These expanded observations surfaced concurrences between existing literature on Resource Dependence Theory and Agency Theory, and the resulting relationships were set up as models or were discarded for better alternatives. This iterative phase was continued until new patterns or phenomena diminished. The final step of the analysis was to confirm (or falsify) findings through more interviews, and a re-analysis of prior interviews and field notes taken during site visits and follow up activity. This phase continued until additional insight faded.

Analysis of the data and examination of the literature was done in conjunction, and continuous back and forth between data collection, review, and analysis
suggested additional inquiries and information to be collected (Danneels, 2002). Since theory generation does not require building completely new theory (Carlile & Christensen, 2005), as constructs and variables emerged it was pre-existing theoretical concepts that were most often considered and compared for use in the research models (Edmondson & McManus, 2007).

In sum, by reviewing interviews, transcribing, coding and then analyzing the data with software (NVivo), patterns were established from a systematically expanding set of interviews. Initially the coding focused on segmenting the data along typologies of innovation problems and decision processes. Constructs then emerged concerning innovation type, the actors involved in decision processes, and issues pertaining to decisions. From these patterns, theoretical constructs were applied to explain the interactions and outcomes, and models were developed, modified, or discarded. Data gathering continued until few new patterns emerged, and the explanatory hypotheses were settled (Figure 3).

Figure 3. Progression of the qualitative interview phase of the dissertation: processes & output in chronological order. The process was in two parts: theory building and theory testing.
The research was coded, and interpreted in a manner to build trustworthiness and reliability. Once theoretical frameworks were determined, transcripts were re-coded for consistent tenets of Agency and Resource Dependence Theories. Two coders were engaged in order to compare coding results, build validity and establish reliability (discussed later). Comparing the results from multiple coders showed the constructs to exist across interviewed firms. While not every interview included every code, the level of consistency allowed for conjectures to be made which formed the basis for the subsequent large scale survey testing.

The following section provides illustrative selections from the interviews, organized into the main constructs that emerged over time. These quotes are descriptive of the consistent themes and patterns that emerged, and were then to become instrumental to the theoretical framework and hypotheses.
Agency Theory – Goal Divergence, Asymmetric Information, & Opportunism

Because the qualitative phase of this study was intended to build theoretical foundation, interviews were done at multiple levels and ultimately included multiple relationships of Agency delegation. For instance, VC to CEO is one such Agency relationship (VC is principal, CEO is Agent), while CEO to Sales VP and (CEO is principal, VC Sales is Agent) is another separate Agency relationship. By spanning many such relationships a richer understanding emerged.

Goal divergence occurs whenever the objectives or desires of the agent and principal differ. This construct is important because, if opportunity arises, the agent may make decisions that are not aligned with the principals’ wishes. For innovation, a goal divergence between principal and agent might result in differing development priorities - exploration versus exploitation.

Asymmetric information generally refers to the hidden or better information that an agent may have, relative to the principal, on a matter requiring a decision. The principal may make an adverse or poor selection on an important issue based on weak or inaccurate information. The agent either provides the inaccurate information or understands that the decision being made would differ if the principal was fully informed.

Opportunism occurs when the agent utilizes asymmetric information in pursuit of self interest. For instance, sub-optimal changes to R&D manpower allocation may occur if the agent can manipulate decision making and move development resources onto projects which will benefit the agent (e.g. projects which will bring Sales commissions).
In the interviews conducted at most sites, such a goal divergence was the catalyst for Sales (members of the Sales organization) to use information asymmetry to personal advantage. In other words, Sales had better information about prospective customers or new sales orders. They used this better information to distort decision making on the best use of R&D.

The following quotations are broadly illustrative, as they occurred across numerous firms. They were not idiosyncratic, in that the same or similar construct emerged consistently across interview sites. Differences did exist, based on title/role and therefore, the quotes are indicated by position level title (VP Sales, CEO, VC, etc.).

Sales executives consistently emphasized their direct interplay with the marketplace – with the customers and prospects – on behalf of the firm. They were quick to mention the demands placed on them by their own firm, and also the pressure that originated external to the firm from customers and prospects;

**VP Sales:** “You’re out trying to win business. So, you’re asking for features that the customers are asking for... So, that’s where the drive on the features comes from. “So, the tendency to push things into engineering by what you call your strategic or big prospects. Right, so you can make quota.”

**VP Sales:** “They’re trying to advance the features so they could accelerate a deal. But, the customer said ‘I like your product. I’ll wait for your feature, but I won’t buy until next quarter - if you could accelerate the feature into this quarter I will buy.’ So, they [the Sales person] will commit and then put the company over a barrel. So, if they feel they can do that and they can manipulate the system, they will do that.”

As a result of their direct exposure to customers, sales people had asymmetric information, which they could use to their advantage. This Sales opportunism - the pursuit of divergent goals -, was a consistent narrative reported by management at all interviewee levels.
CEO: “The sales force puts things in a more positive light, in order to increase the chance that the company’s resources get moved onto their project. They always do that.”

CEO: “They always do that. They oversell me. ‘This is a massive deal, and we’re the lead’, and, you know, ‘we can’t mess it up’. You know to get the development on top of the list.”

VP Engineering: “So there’s been definitely false alarms, claims from the sales folks that I need it today in fact that wasn’t true. From an engineering standpoint we have no ability to vet that data. Because we don’t have the details, the customer relationship. So they see it as a barrier and they want it knocked down as quickly as possible so it doesn’t impede their selling regardless of what it does to the rest of the organization. Because they’re not motivated by what my team delivers, they’re motivated by commission. It goes on a lot.”

Opportunism took multiple forms: opportunities for revenue were exaggerated and often a more imminent date for the arrival of an order might be used in order to influence a short term change to development manpower.

CEO: How often do these projects you do for a customer which you’re anticipating an order for, the order’s not quite as big as you thought, or they come in a little later than you thought? They always come in later than you thought. Timing is always slower.

CEO: Major opportunities just don’t come in on time. It can be off by a lot. 6 months? It’s basic. They may add features that the company does not have in order to get a sale. Sales tells the customer we have it, or that the product does things it does not do in order to make their quota. So, they get this sale or this big opportunity. Then, they push really hard to “save the deal”.

The issue of revenue exaggeration or overly optimistic order arrival was raised at virtually every firm and at every level of management.

Product Manager: “It’s frequent. I’m, again, struggling to put a metric around it, a way of measuring it for you. I guess the challenge that we find, and this is for say for a dozen prospects, this might the case for 6-8 of them.”

CEO: That’s right. They’ll actually exaggerate if they think that there is opportunity, they will. I mean maybe one out of four times that’s the type of situation we are in.

Figure 4. Model for mechanism through which external influences may alter development priorities. Resource dependencies, whether for revenue or capital, influence R&D project priorities and manpower onto short term results and away from
exploration projects. Opportunistic Agents, with asymmetric information, may mislead decision makers in order to pursue goals of self interest.

**Resource Dependencies** → **Agents** → **Development**

- **Capital – additional external funding** → **VC/Board**
- **Customer – revenue from assured orders** → **CEO**
- **** → **Sr. Managers**
- **Other Projects**
  - **Exploitative Innovation**
  - **Explorative Innovation**

**Agency Theory - Bonding**

Bonding refers to the efforts of the agent to signal alignment with the principal. Bonding leads an agent to take action that would not normally be taken, with the express intent of demonstrating to the principal that their goals are aligned. Bonding behavior may lead CEOs to pursue such objectives as marquee (famous) customers in order to signal the Board that progress is being made. The process of bonding is incremental, beginning with the CEO setting expectations. For instance, informing the board about major future events.

**Interviewer:** Do you ever talk about specific customers or specific prospects (with the board)?

**CEO:** “Yeah absolutely. We share the good news, versus them kind of digging in and asking. It builds good confidence in the business. So, we do it whenever we can. We’ll brag about some of those things, or we’ll talk about the big fish that we’re working on.”

Once the board had been informed of these “big fish” accounts, however, there was an increased possibility that an impact on development priorities would be needed in the future.
Interviewer: So, what does the board seem most interested in?

CEO “The top revenue sources and top exposure ones. We tell them about the ones with most revenue. We also tell them about the name brands - partners.”

Interviewer: If schedule are change to ensure that dates are kept, what about projects the board knows about?

CEO “It’s rarely the ones the board is aware of (that change).”

Interviewer: Do these projects slip more or less often?

CEO “Of the 30% that fall out, those never fall out.”

Thus, once a CEO sets the board’s expectations that specific large orders are forthcoming, the bonding behavior of the CEO would be to ensure the expectations were met. The CEO would move R&D manpower as necessary onto development projects linked to these customer orders.

Bonding activity also occurred at the next layer of agent/principal relationship: The Board member is an agent to the owners. One specific example of this relationship was pursued in the research, because Board members of small firms are often representing the interest of a VC firm. These Board members are employees or partners at a VC firm that has an investment in the company, and they serve as representatives of the VC firm/Owner. In this role, these individuals may meet at the VC firm once a week and report to the partners on each firm (portfolio firm) that they are responsible for monitoring. As agents to all the VC partners at this weekly meeting, the dynamic is one of Agency bonding where asymmetric information exists.

VC Board Representative: “You’re in the room with your partners, and you’re discussing status, you’re going over your portfolio firms. Generally, we talk about bookings and customer acquisitions, bringing up customer names. This is weekly.”
Providing customer names - especially important customers or large orders - was a consistent method of signaling to the VC partners on the status of a portfolio firm. Progress in the marketplace, the viability of the technology, and the competence of management was all signaled by discussing significant new customer activity. It was an indicator of legitimacy and future potential value.

Resource dependence - Customer Demands

Prospects, customers, and partners are the source of revenue that the firms depend on for continued operations. Each may generate regular demands for which the firm must decide on a response. One type of demand is for product modifications to suit the specific need of the customer. The larger or more well-known the company, or the larger the potential order, the more leverage existed. Interviewees generally recognized the potential impact of revenue dependence on development operations. Furthermore, they recognized the special implication the dependency had for exploration efforts (Figure 8).

CEO: “Prospects almost always request work. Almost always. This particular issue – how often they request them – drives the new product release schedule.”

VC: “The more demand you have from the customers, the more of your R&D is going to go toward satisfying those demands. The fewer customers, the more you can look out and say, ‘OK, here’s what a product has to look like. Here’s what we’re going to do. Here’s where we’re going to innovate.’ Let’s say you’ve got a release and the release includes some stuff that you’ve got to get to a customer, and it includes some innovation that can be pushed out another quarter. Then you’re going to push out the innovation and you’re going to get the stuff to the customer on time.”

VP Engineering: “Basically, there are periods where – gotta do the big deal, gotta do the big deal – so product development slips. I mean, I can show
you exactly how much Biz-Dev work accounts for a slip in our major product release. Our new product releases.”

**Development Manager** “The effect - comparing the schedule with no interruptions, to the actual schedule. What tends to slip is large project. Internal desires lose. The things WE want to do. All the new. The ideas we all come up with lose. They only happen if we do them stealth. I need to hide resources or find other ways to keep people from being taken off, or none would ever get done.”

Decisions to re-prioritize certain development projects are made regularly. The decisions often have an unequal impact on ongoing exploration development projects. If a new project is to begin in the short term, then manpower movement from current projects is fundamental. These decisions are frequently a choice between continued progress of an explorative project, slowing it, or delaying the start of new exploration projects - in favor of addressing a customer’s demands. Customers leverage the firm’s dependence on short term revenue, or the legitimacy of their name (if they are a marquee account) in order to accelerate or initiate an exploitation project. Customers prefer work on existing products and existing technologies (cf., Christensen & Bower 1996). For instance:

**Product Manager:*** “It’s a running joke.... We are now on (product) version 9.2. But there is also an 8.3 8.4 8.5 8.6 8.7 because some customers demand it. It’s a large bog on really innovating because we had to keep rolling little things into old versions. Even bugs we fix. We had a new product supposed to be out in three years. It ended up being six.”

**VP Engineering:*** “Frequently. Again, it’s based on you have to go through the same analysis. Who’s the customer? Who’s the end user?” “A lot of our assaults are customer one-offs for flavor of the week, lack of prioritization. Exceptions reach my desk, so five in a week.”

**Resource Dependence - Capital**

Large or well-known prospects, customers, and partners are a source of prestige, validation, and revenue. The strong financial outlook that these sources can
generate assists firms in raising capital, increases their valuation, or can bring progress toward a liquidity event. However, these entities can also generate regular demands to which the firm must respond. How specific accounts can improve access to capital and boost valuation is well understood by VCs and by CEOs. For example:

**CEO:** “What things do they (our VCs and Board) think we need in order to get to exit? You have to show revenue traction. The company does not have to be profitable. You have to have the right type of clients. So the Fortune 500 type, top brand names, customers and clients.”

An urgent need for more capital was a strong influence on decision-making and shifting development priorities onto projects requested by certain important customers.

**CEO:** “Investors are enamored with brands. A marquee brand name is opportunity, panache. We were chosen (for investment) by (having) some marquee names. It signals to them that we were players.” “Our “C” round was based on Marquee deals – Lenovo and Acer. It helped the value. So the need to get marquee names will depend on where we are for funds. If we need funds, I will push for marquee brands and will take deals with more strings.”

Having significant revenue and having revenue growth, however, was mentioned more often than having marquee customers and partners when the discussions turned to what was important to raising capital.

**CEO:** “When we look to get more money, the existing VCs want you to pump up the goals. They need it to be more sexy. They want you to double year three, for instance. In the spreadsheet – the future revenue. They need to get the valuation up – so that the new VCs will be interested and so that their stake does not shrink too much in the round. Logos of major accounts drives valuation. In order to get valuation, you MUST have a handful of significant names. The company is important – how well known. So this changes it [willingness to make product changes]”

**CEO:** “Timing matters if you take a deal - If we need funds we WILL take the business even if it has strings attached.”
Board members corroborated that revenue growth, as well as having established, well-known customers, were important to them and were important to raising additional capital.

**VC:** “If you’re trying to raise money ... suppose you have to do another round, and you want to go to later stage guys, and you need 10 or 20 million dollars to scale the business, they’re going to focus a lot on customers, and to the extent that those customers are recognized names, and powerful in their own markets, they’re going to be more impressed.”

**VC:** “I think that what the name gives you is basically prestige and cachet with investors. So if you’re trying to raise money, and if you say, ‘well we have this 20 million dollar deal with GE’, everybody knows who GE is. If the 20 million dollars is with Joe’s Flux Capacitor Company, then people say, ‘well what’s that? Never heard of those guys’.”

**Manpower Shifting: The decline of Exploration in favor of Exploitation**

Manpower refers to the amount of (engineering) resources available for R&D project development. Changes to the manpower allocated to any project impacts when the project will be completed, and/or the number and depth of a feature set. The interview evidence showed that as new or urgent issues arise, which need engineering work, manpower moved quickly - taken from projects already underway. Predominantly, the manpower was shifted from projects that had no immediate revenue impact - market exploration projects factored prominently. This directionality of the manpower movement - from exploration to exploitation - was consistent across firms.

**Interviewer:** Can you remember an incident where an (exploration) innovation was pushed out because of a customer special or a large customer’s bug had to be fixed, or a partner project?

**Development Manager:** “That’s not hard to recall because it happened in the last hour. Just this morning. A customer decided not to buy unless we made
changes. This was customer to sales and product manager. When the 23
item list came in, we had to just stop and do the list. “

Interviewer: What would you say is the biggest category of interruption in
development?
Engineering Manager: “These are the breakthroughs. There’s for me two
things that stand out right away. There is the sustaining effort of the current
product line, which is probably the biggest thing. It constantly interferes and
destabilizes your predictability of the new program you’re on.”

The requests from Sales (or Business Development - Biz Dev - which focuses on
partnerships) were often described as both incessant and predictably urgent. Requests
were made for R&D to add new projects to the plan and begin them immediately:

Development Manager: “So on a weekly basis, there’s an assault. So this week,
there were two requests and it’s only Wednesday. Two requests so far. That’s
from Biz-Dev. Two customer one-offs.”
Interviewer: OK. So your assault is all customer one-offs?
Development Manager: “A lot of our assaults are customer one-offs for ‘flavor
of the week’, lack of prioritization. So the ones we’re talking about, five per
week, are the ones that they want you to start like: “Can you find a way to just
get it in now?” Yeah. They always want everything yesterday.”

The requests and the resulting R&D manpower shifting had additional
complexity beyond simply moving developers from one project (exploration) to
another (exploitation). There was extended investigation of the new project that was
required before engineering work could begin – an investigation that was needed
whether or not a development project ultimately ensued. Often, investigation was
done - R&D manpower used - for a project request that was never completed.
Extensive insight was given into the overhead required for new projects, as well as the
impact that manpower shifting caused to ongoing planning:

Product Manager: “Our interruptions are from sales and pre-sales support.
This prospect is asking for these features. Can you explain it, or tell me if we
can do it, or tell me how long it will take to do it?” This process is a white
board effort that takes time. We need to understand it, see what it means to
current plans, current performance of the product. How long will it take, who
needs to work on it, what will slip. It could be ½ day disruption just to discuss
it before we get back to the customer with an answer.”
“This type of thing happens every other week.”

Project Performance – Impact to Schedule

Project performance – a firm’s attainment of development plans - is the basis of the Dependent Variable. Attainment Performance for exploration versus exploitation is measured as a combination of adherence to schedules, completeness of the feature set plans, and reduction (or increase) in the number of projects when compared to the original exploration/exploitation plan. Interviews showed that as a result of manpower shifting due to external (customer/partner) factors, exploration development projects were behind schedule more often than were other project types. This shortfall included both higher relative delay to project commencement date as well as lengthening of project durations.

CEO: “We don’t hire more. We only have so many (people) and we have to prioritize. What gets pushed is anything that won’t bring in revenue this year. Let’s say you’ve got a release and the release includes some stuff that you’ve got to get to a customer, and it includes some innovation that can be pushed out another quarter, then you’re going to push out the innovation and you’re going to get the stuff to the customer on time.”

Board member: “You’re not going to push out the release date to keep stuff that doesn’t need to be out that quarter. And it might be a compromise into how well you test the feature. It might be that you want to get it out at a certain time and you don’t test the feature as much as you might have otherwise.”

Interviewer How often do the schedules/plans need to change?
CEO: “We change them constantly. New customers generally cause work. Most new customers cause this. It’s driven by customer need. I will have the VP’s come in to discuss. VP of Engineering reports on it if there is a need to change resources. Marketing will talk about customer need.”

Product manager: “Always. Three to six months, and that’s across the board. That’s not only here. Usual plan is about nine months, with a three-month alpha/beta program before general release. So, it’s a year cycle, on average.” between 25 to 50 percent late (to schedule).
CEO: “On our customer project delivery, we have been – in January, we were about 80% delivering on the key milestones, the month of June we’re at 91%. Our strategic project delivery is pretty poor. It’s at 60%.”

Interviewer: The strategic that are late, are they worse or better than for the customers ones?
CEO: “The customer ones - they might be a week or two. “
Interviewer: What about non-customer – the strategic ones?
CEO: “On the strategic projects? They’re worse on average. You’re probably talking more like six to eight weeks is probably pretty typical if they’re late - versus two.”

Project Performance – Completeness of Feature Set

For exploration projects, feature set completeness was also an issue; exploration project feature sets fell short of the original plan more than exploitation projects did. Shifting of manpower onto new and urgent field-drive projects resulted in features being dropped or the extent of a feature to be limited in exploration projects when compared to plan, versus exploitation projects.

Interviewer: For these new products {exploration} – are the feature sets matching the planned feature set?
CEO: “Yes, but the completeness is not there. A half are seriously below.”

Interviewer: Are you satisfied with how well engineering is able to predict the date slips?
CEO: “No. And it will get out the door but the features and usability is not there.”

Interviewer: Do the new product {exploration} releases have all the original content?
CEO: “No, the content falls out. New product feature sets matching the planned feature set? We are missing about 20%”

Interviewer: What percent of those that make it are seriously below expectation?
CEO: “20%”

Board Member: “What tends to occur, is that things have dropped from {new product} release. So, the release may come out within a month of when it was projected to, but it might not have what was initially put into it. You’re not going to push out the release date. You drop the stuff.”
Summary Discussion

The interview questions were broad in nature, since it was open ended to allow for unexpected information and because it emerged over time. Due to this approach, the line of questioning was not the same at each firm, and it also varied by respondent’s title (responsibility level and expertise). During the interview process, transcripts were made from the recordings and they were then coded. Code definitions were refined as new data were gathered and alternate theoretical frameworks applied.

A second person’s analysis of the NVIVO data and then a statistical check of inter-rater reliability was then used to ascertain research validity. Reliability for the interview coding is important because coding is subjective, and therefore has potential for interviewer or rater bias. Interview data were first coded in its entirety based on patterns and along constructs to find commonality across interviews. Then independent coding was done on the sample with the intent to measure how consistent multiple raters are in interpreting the transcripts. Cohen’s Kappa was then calculated for the independent sets of coding to ensure inter-rater reliability. Cohen’s Kappa measures the degree of internal consistency between two raters who categorize transcribed textual content into categories (i.e. qualitative categorical items) versus the chance of coincidental overlap (Cohen, 1960).

A research assistant independently coded transcripts, as well as the interviewer, with a focus on indicating the independent variable constructs. Four categories of constructs were coded:

- Asymmetric information: the degree to which Agent are reported to have hidden or better information on a matter of decision.
- Goal Alignment: the degree to which Agents are reported to have misaligned goals or act without consideration of firm goals.
- Revenue Dependence: the relative ability of customers or prospective customers to influence development priority due to their importance to future revenue.
- Capital Dependence: the importance of gaining prestigious or large customers, or of meeting income targets due to impact on company value.

The coding was done on the entire transcription record from a sample of four interviews at four different firms and four different interviewees. Inter-rater reliability was compared between the coding done by the interviewer and the research assistant, who was not involved in the site visits and had no prior familiarity with the research. The reliability varied by transcript and by code and ranged from a low of 75\% to a high of 87\% using the Cohen’s Kappa calculation. Asymmetric Information = 0.75; Goal Alignment = 0.80; Revenue Dependence = 0.77; Capital Dependence = 0.87.

Several recommendations have been made for interpreting kappa values. For example, Landis and Koch (1977) proposed that 0.81–1.00 = almost perfect; 0.61–0.80 = substantial; 0.41–0.60 = moderate. Cicchetti (1994) and Fleiss (1981) proposed, similarly, that 0.75–1.00 = excellent; 0.60–0.74 = good; 0.40–0.59 = fair. As such, the results found in this study are above the recommended levels for inter-rater Kappa values.

**Construct validity** means that the study investigates what it claims to (i.e. the stated concepts of the study are actually the ones observed during data collection). For instance, triangulation by using different methods and different data sources (Yin, 1994) assists with this validity. To establish construct validity, the constructs in this research were based on interviews from multiple firms, multiple levels of management, and from experts outside the firms themselves. To further introduce construct validity
for the variables and relationships of the data and analysis, results were reviewed with three managers from three different companies in the sample. This validation was conducted in person, and lasted approximately one-half hour. These member checks (Hirschman, 1986) of the emerging insights were done on an ongoing basis with the informants. Lastly, the research used two methods – case interviews to conjecture theory and population census for quantitative testing - for greater credibility.

**Internal Validity** establishes a causal relationship between premises and results with logical and compelling reasoning that is more than just plausible (Yin, 1994). The argument needs to be strong enough to defend conclusions and rule out alternatives. To support internal validity, this study has had consistent results modeled in a clear framework that shows that the variables lead to the outcomes. Next, patterns seen in each case compared well with patterns established in prior gathering and in different contexts (Eisenhardt, 1989). Finally, theory triangulation by using multiple methods was again employed (case interview and population census) to verify the findings (Yin, 1994).

**Generalizability** (external validity) means the degree conclusions might be applicable outside of the cases directly observed. Case studies do not allow for statistical generalization to population (Yin, 1994). Qualitative interview cases, however, can be generalized to theory (Yin, 1994), and are a foundation for theory development (Eisenhardt, 1989), especially if many sites are used. The interview segment of this dissertation was intended only for the generation of a theoretical model for further testing via population census.
Conclusion of the Interview Phase of the Dissertation

Robust support for clear constructs and processes emerged consistently during the interview stage of this research. Furthermore, a number of important operational conclusions surfaced from the construct development effort as well. First, the performance of market exploration innovation projects along attainment constructs of schedule and completeness was considerably worse than for other development projects (exploration). The data supported a theory-based model of decision making that was consistent over time and across firms that contributed to this outcome.

Second, interview data consistently showed that development manpower re-allocation occurred as a result of responding to (market-based) dynamics that were often external to the firm. The manpower change decisions were driven from repeated contemporaneous and unplanned spontaneous processes. They always had origins external to the project group and the R&D development department.

Third, the decisions that changed development manpower allocations were made not in unusual circumstances, but instead were typical. In other words, whether or not a market or technology disruption was underway was not a factor. Decisions that incrementally reduced market exploration attainment over time were based on information unrelated to any technology breakthrough, market change, or the existence of any other extraordinary issue. The process may explain a lack of response during disruption, but the same process exits permanently; normal periods and in the exceptional disruptions.

Fourth, the reprioritizing and decision-making process that resulted in manpower removal from exploration was ongoing, and not strategic. The process incrementally changed the original development plans – and the ultimate output of
exploration – with regularity and with each decision. The official plan for exploration/exploitation was never formally changed, only the development schedule was altered. This outcome highlights the spontaneous and operational nature of the phenomenon, which contrasts to the planned and strategic perspective taken by most exploration/exploitation literature.

The interview phase of the research was fundamental to formulating the hypotheses that are outlined in the next chapter. The case data were associated with specific tenets of theory as patterns emerged. These tenets were subsequently used to form models and then testable hypotheses. The intent of the following chapters is to show how the hypotheses were constructed; the method and operationalizations that were then established from these, and finally how statistically valid data were gathered to test the hypotheses.
Chapter Four. Hypotheses and Theoretical Framing

In this chapter, hypotheses are derived which use existing theoretical and domain knowledge from the literature to guide the insight gained from the theory building exercise of Chapter three. The goal is to both extend theory and create new knowledge in the domain of innovation within the exploration/exploitation paradigm. The hypotheses draw heavily on two broadly accepted theories of organizational dynamics, and apply Agency Theory and Resource Dependence Theory to a perceived gap in the literature on exploration/exploitation – the development phase – in order to produce a better understanding of firm innovation outcomes.

Chapter two reviewed the extant literature on exploration/exploitation, innovation, and the main research paradigms that have been employed in these domains of research. Because this dissertation began as an investigation of innovation during the development phase, innovation and development (NPD: New Product Development) literature guided the initiation of the theory building phase of the research.

Chapter three reported the findings from the theory building exercise. The theory building proceeded from the research questions, and Chapter three lays out the progressive learning that was accomplished by first having an expansive field of vision in the initial case interviews, and then narrowing the questions and pursuing specific lines of inquiry as constructs and relationships were exposed. It was during this theory building phase that the literature review needed to be expanded in order to find theoretical underpinnings that could assist in explaining the emergent models that were formed based on the case interviews. In other words, as the interviews and their analysis progressed, patterns emerged that followed the innovation and NPD literature.
with regard to development stages and development processes. The relationships between the dependant variable of project performance to plan, and the emerging constructs of innovation type, and inter-departmental relationships and decision-making, however, lacked theoretical underpinnings from within either innovation or NPD research. Iteratively, the ongoing theory building and extension effort widened. New models were constructed, components were discarded or modified, data were re-analyzed, new interviews were done, and an expanding literature was reviewed.

4.1 Models & Hypothesis Derivation

As new models of the iteratively exposed constructs and relationships were constructed, modified, or discarded, Agency Theory and Resource Dependence Theory emerged as particularly foundational to explaining the patterns found in the qualitative groundwork. Based on the theory building exercise, and using first the extant domain literature for innovation, NPD, and exploration/exploitation, and then the theory literature for Agency and Resource Dependence, I built conceptual frameworks. These frameworks were subsequently tested in a new set of interviews.

The iterative approach of case interviews, as well as the use of theory for guidance, was instrumental in narrowing construct definitions as well as specifying the theoretical tenet underpinning the constructs and their interrelationships. As a result, it is both from the body of qualitative data and from extant literature that the final models were constructed, and then the dissertation hypotheses were created.

4.2 Model & Hypothesis Organization
The hypotheses derived in this dissertation are organized into three models, one that explains exploration/exploitation from an Agency theory perspective, one that explains exploration/exploitation as derived from Resource Dependence Theory and a third model that combines these two theoretical perspectives for a more holistic view on the exploration/exploitation dilemma.

Models were derived to explain and predict the same dependent variable. Specifically, all models hypothesize that variation in firm-level performance for exploration/exploitation innovation after the plan enters development phase are linked to the variation in either Agency-based or Resource Dependence-based Independent Variables. The same Dependent Variable, the exploration - exploitation tradeoff, is the foundation of all the hypotheses. It is defined as the change in market exploration innovation during development, from the firms’ original plan (the original planned exploration/exploitation balance).

The chosen independent variables used in each of the models are organized by theory (figure 5). The first model and related hypothesis relies on theoretical underpinnings of Agency Theory using tenets of Opportunism. The second is based on the underpinnings of Resource Dependence. The third model combines the IV’s and adds interaction effects. Each model is intended to explain and predict any shift in the firms established plan for exploration/exploitation innovation that occurs during the development phase.

Figure 5 shows a combined framework. It simplifies the hypothesized relationships into one diagram according to the theory-based framings; Agency Theory (Opportunism) and Resource Dependence Theory. Later in this chapter, each model from this simplified framework is shown in individual detail. In Chapter six, each of
these framings and their related hypothesis is tested as individual models separately as well as in the format of a single unified model.

The model framings are consistently labeled throughout the next chapters according to the theoretical tenets that underlie the specific models’ independent variables.

Figure 5. Conceptual framework of the main elements of the dissertation, and their relationships.

**Agency Theory**

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<thead>
<tr>
<th>Goal Incongruence</th>
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<tr>
<td>Information Asymmetry</td>
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<tr>
<td>Intent to Mislead / Gulle</td>
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</tbody>
</table>

**Resource Dependence**

<table>
<thead>
<tr>
<th>Customer Concentration</th>
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<tbody>
<tr>
<td>Order leverage</td>
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<tr>
<td>Reference Customers</td>
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</table>

**Exploration/Exploitation**

H1

H2

4.3 Agency Model: The Influence of Opportunism on Exploration/Exploitation Plans during the Development Phase

While Agency Theory has been applied to innovation, this has consistently been at the level of CEO or Board (e.g. Amihud & Lev, 1981; Cooper & Dunkelberg, 1986; Feerer & Dugan, 1989; Latham & Brown, 2009; Lupie & McCubbins, 1998; Zahra, 1996). This dissertation is one of a few that performs direct tests of the Agency Theory (Crabbe & Helwege, 1994; Sloof & van Praag, 2008). By a direct test, I mean
one that uses primary and not secondary data, and does not use data based on indirect measurements such as CEO turnover, ownership structure, or bonus (Ang, Cole & Lin, 2000). Furthermore, I found no studies of Agency behavior by employees in one department, and its impact on other functional departments, on innovation, or on development projects.

Figure 6, Conceptual Framework of agency opportunism and Exploration/Exploitation

**Agency Opportunism**

- Goal Incongruence
- Information Asymmetry
- Intent to Mislead/Guile
- Variable Interactions (IV a X IV b)

**Agency Opportunism and Variables**

The first model (Figure 6) has three underlying constructs to measure opportunism; Goal Incongruence, Information Asymmetry, and Guile (the level of intent to mislead). The intent is to measure the agency behavior of employees of the Sales department that is theorized to ultimately influence development performance. This research focused on the Sales organization because of the frequency with which it appeared in the theory building case interview phase of research. The constructs
were derived during this qualitative phase, and were subsequently defined and bounded by literature.

**Goal Incongruence** One fundamental Agency tenet that is theorized to result in agency costs is goal incongruence, defined as being present when the goals or desires of the agent and principal diverge (Eisenhardt, 1989). Goal incongruity, while often applied to the separation of ownership and control, has been established at lower levels of the firm in any roles of delegation (Baumol, 1967; Jensen & Meckling, 1976). Significant research has investigated how the level of agency costs vary (as a DV) by using variables intended to measure the level of principal and agent goal convergence on the same outcomes (e.g. Lupia, & McCubbins, 1998; Niskanen, 1971; Romer, & Rosenthal, 1978). For instance, examinations of equity ownership and goal alignment use the level of incentives as an indirect measure of goal alignment or incongruence. Literature has shown that goal congruence (Eisenhardt, 1989; Jap, 1999; Rossetti & Choi, 2008) affect performance of organizational efforts, such as NPD projects (Jap & Anderson, 2003).

In this research, direct measures of goal incongruity were devised. Using precedence set by Kozlowski and Bell (2006), Likert-type items were developed to measure the extent of goal incongruity as an IV. The construct devised measures the extent to which Sales’ considers the firm’s existing goals for development when taking action. Consideration of firm goals when any new projects are interjected into development is a key metric, regardless of the agents’ knowledge of the goals (Keil et al., 2000). Goal incongruence was measured from the management/principals’ perspective. Items were designed to measure whether such issues as the company’s
development plan were considered when recommending new projects. (Appendix I Questionnaire. Section IV questions 14 - 17).

**Information Asymmetry.** Information asymmetry has a history of use as a variable in empirical research. This is an important agency variable because it affects the motivation aspects of the individuals and is potentially dysfunctional to organizational performance (Chia, 1995). Studies which utilize information asymmetry as a research variable have an established base (e.g., Chow, Cooper, & Waller, 1988; Dunk, 1991; Penno, 1984), and generally define information asymmetry as the extent to which subordinates have better information than the superior relating to subordinate's area of responsibility. Under agency theory, this divergence of information between the principal and the agent results in an agency cost. Jensen and Meckling (1976) described contracts among individuals who all act in their own self-interest and agency cost as an inherent and unavoidable outcome. These costs occur because the agent, who has more information about the environment in which he operates, may use the "private" information to make decisions in his self-interest (Chia, 1996). Multiple ratio items were used to measure the extent that agents have asymmetric in matters related to development requirements. (Appendix I Questionnaire. Section III)

**Intent to mislead, guile, level of deception.** The concept of opportunism includes a construct of self-interest seeking with guile (Jap & Anderson 2003). Variations in the extent of an agent’s deception are thus important to a model of opportunism (Wathne & Heide, 2000). Agent willingness to advocate for new development projects which may not be justified was an intent to mislead in order to gain commission or meet quota. Such agency factors exist within an organizational hierarchy when an agent
attempts to bring about a result, which serves their self-interest instead of the interest of the organization (Keil et al., 2000). Multiple Likert-type items were used to measure the extent that agents are willing to misinform in order to advance their self-interest, with guidance from prior research of Mooi & Frambach (2011). (Appendix 1 Questionnaire. Section IV questions 1 - 5)

An interaction in the relationship among the three opportunism variables was conjectured, in that the simultaneous influence of two variables on exploration/exploitation is not additive. If two independent variables interact, it is more difficult to predict the consequences of changes in the value of either variable (Cox, 1984). In the opportunism model, asymmetric information is hypothesized to potentially exhibit an interaction effect. The level of intent to mislead or the level of goal incongruence may interact with asymmetric information. In other words, goal incongruence and asymmetric information together may better explain or predict a change to the original exploration/exploitation plan.

Agency theory can help explain decision making and decision outcomes in any relationship of delegation (Eisenhardt, 1989). Jensen and Meckling (1976) explained agency tenets when they described firms as a set of contracts among individuals who all act in their own self-interest. They also defined the concept of agency cost, and it has been shown that such costs are inherent and unavoidable in delegation (Fama & Jensen, 1983). The economic loss from sub-optimal outcomes as a result of decisions that diverge from principal's interest is at the core of this study. Research shows that agency problems increase in lower layers of management hierarchy because incentive exists for employees to increase their own financial return (Cooper & Dunkelberg, 1986), improve their chance of promotion (Feesper & Dugan, 1989), and increase their
prestige (Carland, Hoy, Boulton & Carland, 1984) by acting in their self interest. Goal related issues of agency have also been predicted to grow at lower levels (e.g., Baumol, 1967).

In summary, the Opportunism model included three specific tenets of Agency Theory: goal alignment – the extent that Sales agents have divergent self-interest; asymmetric information – the level of Sales’ superior information regarding customer orders and timing; and the level of guile or intent - how misleading is the agent willing to be. The model is hypothesized to determine the extent that employee Agents acting opportunistically can explain the variance in the DV. Asymmetric information, goal incongruence, and level of intent to mislead will correlate to a shift in the planned balance of exploration/exploration attainment after the plan enters development.

**Hypothesis 1:** Agency opportunism has a positive effect on the extent to which Exploration innovation declines during Development.

Hypothesis one asserts that the degree of opportunism manifested by certain agents within the firm will be reflected in the degree to which exploration innovation plans change after they enter development. The opportunism model was formed based on the three independent variables described above. Each of these IV’s has a related sub-hypothesis as well.

The first sub-hypothesis is based on the Agency Theory tenet of goal alignment. Also referred to as goal incongruity, the construct was initially observed and defined in this study because of the regularity in which it was observed in the case interview data. For instance, sales management reported incongruity between firm goals and agent goals when related to quota and commission. In other words, Sales goals centered
on compensation and were misaligned with the firm’s goals for development. For instance, management reported that that sales tended to “push things into engineering by what you call your strategic or big prospects. Right, so you can make quota”. The degree to which the goals of agent and principal do not align in a hierarchy is fundamental to agency (Jensen & Meckling, 1976). If goals align perfectly, then no agency costs will occur. Therefore, having goals misalign, and the degree to which they diverge are central to opportunism.

**H1 a.** Goal incongruity has a positive effect on the extent to which Exploration innovation declines during Development.

Hidden information (Bromley 1989) is fundamental to the agency dynamic of adverse selection. The agent may have concealed information or better information about an important decision, and may use it for inappropriate advantage so that the principal will make sub-optimal decisions. Asymmetric information in which the agent has better information than the principal is fundamental to opportunism.

**H1 b.** Asymmetric Information has a positive effect on the extent to which Exploration innovation declines during Development.

Opportunism assumes that the agent desires to pursue self-interest. Numerous study findings have linked agency problems with how willing the agent is to pursue selfish goals. This level of guile (Jap & Anderson, 2003; Wathne & Heide, 2000) is important to an overall opportunism model.

**H1 c.** Intent to Mislead/Guile has a positive effect on the extent to which Exploration innovation declines during Development.
The last sub-hypothesis asserts that two independent variables may interact. In other words, two variables may have a simultaneous influence on the DV that is not additive. Should this be the case, variation in exploration of either interacting IV would depend on the value of the other interacting variable. For the agency model, information asymmetry is hypothesized to interact with the agents’ level of intent to mislead (guile), and with the amount that agents goals are not aligned in affecting DV variation.

**H1d. Interaction of information asymmetry with either Intent to Mislead/Guile or goal incongruity has a positive effect on the extent to which Exploration innovation declines during Development.**

4.3 Resource Dependence: The Influence of Resource Dependencies on Exploration/Exploitation Plans during the Development Phase

In this section of the dissertation, the model, which focuses on the extent to which outcomes are linked to the resource dependence of the firm, is formed. Christensen & Bower (1996) found that incremental product changes made for existing customers and prospects can drain resources from the development of radical new products. While the overall intent of their research – disruptions and firm failure to respond to them – may be tangential to this study, their insights highlighted the effects of resource dependence. Existing customers who purchased existing products directly affected poor innovation outcomes.

In this section, a framework of firm dependence on its sources of revenue dependence is discussed and the hypothesis is formed that predicts how resource dependence is linked to exploration/exploitation during development. This study
directly tests the impact of a firm's resource dependence on exploration/exploitation balance, on innovation, and on development.

Resource Dependence includes variables based on the literature – in the form of large orders, future revenue, and demand from important customers. The formulation of the hypotheses was guided by Pfeffer and Salancik's (2003) detailed constructions of such dependencies. The Resource Dependence Theory model was formed as a result of two factors. First, consistent revenue dependence constructs were exposed during the case interview phase of the research. In other words, subjects of the interviews - at all levels and at each firm site - were consistent. Additionally, these tenets have precedence in innovation research in studies of disruptive technology (e.g. Christensen & Bower, 1991) where revenue dependence swayed investment decision making and in innovation investment (Barney, Fiet, Busenitz & Moesel, 1996)

Resource dependence measures the strength of existing major customers, large new customers, and the importance of prestigious customers in influencing changes to the firm’s development plans. An interaction may exist in the relationship among the three resource dependence variables in that the simultaneous influence of two variables on exploration/exploitation is not additive. The threshold of revenue for which a firm is willing to do a new R&D projects is hypothesized to potentially exhibit an interaction effect with the level of customer concentration. This concept follows Christensen and Bower’s (1996) finding that dependency on large sources of revenue tied the hands of the hard drive manufacturers. Because the firms catered to the largest buyers of their products, new developments that were not of immediate need to these users were starved of funds. The influential customer construct of Christensen
and Bower (1996), coupled with the results of the qualitative theory building were used to derive the resource dependence model. The revenue threshold at which a firm will pursue new R&D for a customer and the degree to which a firm’s customers are concentrated are variables to explain or predict changes to exploration/exploitation during development.

The resource dependence view on innovative activity (Cooper and Schendel, 1976) is that firms allocate resources to programs for customers who provide the resources that the firm needs to survive. Resource Dependence theory holds that a firm’s freedom to choose is limited.

**Figure 7.** Model of resource dependence IV’s and the Exploration / Exploitation DV.

![Resource Dependence Diagram](image)

Hypothesis two conjectures that new projects will be added to the development plan when linked to unusually large orders, when they are requested by prestigious accounts, or when they are from the firm’s largest customers. These projects, in turn, will result in a shift in the planned balance of exploration/exploitation attainment away from exploration.
**Hypothesis 2:** Resource Dependencies have positive effect on the extent to which Exploration innovation declines during Development.

Hypothesis two asserts that the resource dependencies of the firm will be reflected in the degree to which exploration innovation plans change after they enter development. The Resource Dependence model was formed based on three independent variables, each of which has a related sub-hypothesis as well.

The external environment is the source of resources that are fundamental to a firm’s survival, to its performance, and that these shape its structure, boundaries, and internal activity (Pfeffer & Salancik, 1978). Christensen and Bower (1996) found that resource dependency tied the incumbent’s hands – they were dependent on revenue that existing powerful customers promised for existing products. In other words, having a few customers that represent a large portion of the firm’s revenue is conjectured to mean that these customers can influence development.

**H2 a.** Customer Concentration has a positive effect on the extent to which Exploration innovation declines during Development.

The qualitative theory building exercise determined that new customers regularly demanded new development work to meet their special requirements. Therefore, as potential customers demand changes the resources that might produce exploration may instead be used to satisfy these demands. Firms may vary on the threshold of quid pro quo revenue for which they will agree to begin a new project. Some firms may require the potential customer to make a huge purchase (as a percent of the quarters total revenue) while other firms may be willing to commence a new project for a small order. The lower this threshold, the more often the firm is
conjectured to add new projects into development and alter the plan. Therefore, higher leverage (small dollar amounts cause new projects) is hypothesized to influence the variation in exploration performance.

**H2 b.** Order Leverage has a positive effect on the extent to which Exploration innovation declines during Development.

RDT proposes that “Corporate survival depends upon successful adaptation to the constraints imposed by the uncertainty of access to needed resources” (Glasberg & Schwartz, 1983, p.314). Having reference or prestigious customers can reduce uncertainty, because new revenue acquisition is more certain if firm legitimacy increases (Perrow, 1961). Acquiring and being associated with specific prestigious customer accounts has been found to increase market legitimacy. Legitimacy is a resource dependency (Pfeffer and Salancik, 1978). The assertion is that as the desire to acquire these accounts increases the likelihood that development resources are allocated to satisfying their demands. As a result, new unplanned projects will be commenced, rather than accomplishing the exploration plan. Thus:

**H2 c.** Interest in Reference Accounts has a positive effect on the extent to which Exploration innovation declines during Development.

Two RDT independent variables are conjectured to interact and have a simultaneous influence on the DV that is not additive; variation in the DV due to interacting IVs would depend on the value of each interacting variable. For RDT it is hypothesized that having large customers and a willingness to alter development plans at lower revenue commitments will interact in affecting DV variation.
**H2 d.** Interaction of customer concentration and order leverage has a positive effect on the extent to which Exploration innovation declines during Development.

### 4.4 Combined Model: The Influence of both Resource Dependence and Agency IVs on Exploration/Exploitation Plans during the Development Phase

A combined model of both resource dependence and Agency opportunism tenets, as previously described, is formed in order to analyze the simultaneously. The goal is to gauge the extent that the identical tenets and operationalizations, together, bring increased or decreased power for explaining the variance in the amount of exploration accomplished in Development when compared to the original plan.

**Hypothesis 3:** A combined model of Agency Opportunism tenets and Resource Dependencies have a positive effect on the extent to which Exploration innovation declines during Development.

In the qualitative interview phase of this study, a pattern emerged in which the firm’s resource dependencies were exploited by agents in order to serve their self interest. According to Scott (2003) the need to acquire resources creates dependencies between organizations and external units, but these dependencies can ultimately cause internal problems between stakeholders. “In general, organizations will tend to be influenced by those who control the resources they require” (Pfeffer & Salancik, 2003, p 44). Therefore, as part of the model that combines Agency and resource dependence tenets, independent variables from the two theoretical foundations (Agency & RDT) are combined in an interaction term to test the observation and the literature. Therefore, this study asserts that interactions between
Agency Theory and RDT tenets may have a simultaneous influence on the DV that is not additive.

H3.a Interaction of information asymmetry with either customer concentration or order leverage will have a positive effect on the extent to which Exploration innovation declines during Development.

4.5 The Exploration and Exploitation Outcome

The exploration/exploitation and innovation literature was instrumental to both describing and constructing the dependent variable. There is a large body of recent exploration/exploitation literature with an innovation focus. These studies of exploration/exploitation have used a range of operationalizations which guided this dissertation including the scope of a patent search (Katila & Ahuja, 2002), radical versus incremental innovation (Bierly & Chakrabarti, 1996 a,b), newness of business development projects (McGrath, 2001) and technological and organizational boundary spanning (Rosenkopf & Nerkar, 2001). The intent of most studies has been to measure the effect of the exploration/exploitation pursuits on firm performance (growth, profit, etc.).

Much past research has focused on firm level performance and the amount of exploration or exploitation a firm initiates during search or project portfolio selection. Exploration versus exploitation is rarely used at a competitor or at the industry level (He & Wong, 2004). As a dependent variable, prior studies have tended to use average sales growth rate or profitability measures when firm performance is the objective. Because past research has studied processes unrelated to changes in
exploration/exploitation mix during the development phase, they only offered direction
to the effort to construct an appropriate dependent variable for this study. Danneels
(2002 and 2007) provided a definition of product innovation for the exploration and
exploitation domain that used dimensions of technology novelty and market novelty.
Pure exploration is viewed as new technology developed to serve new customers or
new markets, while pure exploitation is intended to strengthen existing technology to
serve existing customers.

The construct measured in this study adheres to Danneels’ (2002, 2007)
definition of exploration and exploitation. This research, however, focuses on the firm’s
exploitation/exploration plan. More specifically, it is concerned with what happens to
the plan for exploration/exploitation after it enters development. How much the plan
changes after it enters development is anticipated to vary at different firms.

The goal is to first quantify how much, on average, the planned balance of
exploration/exploitation changes during development for the firms in the population
of study. Then, further analysis will explain the variance (why some firms change more
or change less than average) for the population under study. Projects being
developed for a new market or a market new to the firm is exploration innovation,
while projects being developed in support of the existing business (e.g. to improve
existing product-market efficiency, existing product quality, reduce production cost) is
exploitation. These two categories capture the essence of “exploration of new
possibilities” in the market, and of “exploitation of old” (March, 1991; 71).
Why is this DV Interesting?

Organizations need to continuously renew themselves in order to survive and prosper in environments where changes in customers, technologies, and competition is common (Danneels, 2002). Product innovation has long been recognized as a primary driver of this renewal (Dougherty, 1992; Bowen et al., 1994) and firms have been urged to focus attention on more innovative rather than incremental development.

Much of the innovation literature which studies the extent or “radicalness” of innovation has taken on the framing of exploration/exploitation (e.g., Katila & Ahuja, 2002; Danneels, 2007; He & Wong, 2004). The research, as previously discussed, has focused almost exclusively on the planning stages (search, portfolio selection, design), and the plan for a balance of exploration to exploitation that these early stages create. However, a firm’s plan for innovation is not its innovation; planned outcomes are not outcomes.

The DV of this research is important not because it is unique to innovation research, but because it asserts that innovation plans are not central to renewal without considering how much of it is accomplished – i.e. delivered in a finished product form. Exploration plans that are followed through to completion will have consequences for renewal.

The DV of this study is asserted to be important because:

- The development stage is where exploration/exploitation plans become finished product, yet it has been overlooked in exploration/exploitation research.
• Innovation plans may not make it through development intact. If exploration/exploitation plans systemically change during development, the change impacts the amount and type of innovation produced.

• Knowing the variance - how much exploration/exploitation plans change in development - can inform researchers and practitioners. The extent of this variance may be minor, or it could singularly determine the long term viability of firms. There is no scholarship that can inform scholars or practitioners on this variance.

• R&D and the Development stage, in the context of product or project development, has a long history and an expansive literature. In fact, numerous scholarly publications spotlight this research (e.g., Journal of Innovation Management, Technovation). R&D has often been studied through the lens of understanding problems or identifying ‘best practice’ and the DV of the research is regularly project or project team performance (e.g. Wheelwright & Clark, 1995; Brown & Eisenhardt, 1995; Benner & Tushman, 2003). The DV in this study is of consequence to this research stream because explaining variance to the exploration/exploitation development plan is analogous to overall R&D organization performance variance. Performance of the larger development plan subsumes every project. Any explanation for the variance in the DV of this research is directly informative to project, product, and team performance within R&D research.

In other words, if innovation and organization renewal are important to firm performance, then knowledge concerning only exploration/exploitation planning is
not sufficient. The degree to which innovation delivery (how much is created or completes development) differs from the innovation plan is critical.

There are no studies of the variation between the intended exploration/exploitation ratio - the company’s strategic development plan - and the actual delivery. To fill this gap, this study first measures development differences that emerge compared to the plan for a balance of exploration and exploitation.

Exploration and exploitation are two distinct dimensions of decision making rather than two ends of a one-dimensional scale (Bierly & Daly, 2001; Katila & Ahuja, 2002). Comparing performance to plan for market exploration projects with performance to plan for exploitation projects is not a complex measurement, and has some precedence in the innovation and NPD literature. For instance, performance can be a relative scale; a firm can attain their original plan measured as a percent regardless of the magnitude of the projects (Katila & Ahuja, 2002).

This study uses three separate and direct measurements to determine the DV of exploration and exploitation development performance against plan: adherence to project schedule, completeness of project features/functions, and percent of planned development undertaken.

**Completeness of features/function.** Completeness measures attainment of project content relative to the original plan. Projects can have more features than planned, meet the plan, or have fewer. The construct was formed based on the extensive product literature on product quality and feature set. (e.g. Patanakul, Chen, & Lynn, 2010; Blindenbach-Dressesn et al., 2010; Atuahene-Gima, 2003). The variable measured is the percentage attainment of the planned feature set for exploration
projects relative to other components of the plan. (Appendix 1 Questionnaire, Section II).

**Amount Undertaken.** Undertaken measures how much development (exploration/exploitation) manpower changes relative to the original plan. Work on project attainment levels, such as Nohria & Gulati (1996) assisted with the development of the construct. Measurement is based on movement of development resources from one category to another (exploration/exploitation). (Appendix 1 Questionnaire Section IV question 18).

**Adherence to schedule.** Adherence to schedule measures project duration relative to plan. Projects can complete earlier, on time, or later relative to plan. How a project performs relative to the original schedule is used frequently in development literature (e.g. Perry et al., 2009; Acur et al., 2010; Bstirler, 2005. The recent meta analysis of development speed by Chen, Damanpour, & Reilly (2010) gives a complete overview). The variable measured is the attainment to the planned schedule set for exploration projects relative to other components of the plan. (Appendix 1 Questionnaire Section II).

These three constructs were used together to quantify development attainment and followed the literature for measuring development along three factors: schedule, completeness, and amount undertaken when compared to plan. These factors give one performance metric when summed. They can be analyzed separately and indexed together as a single DV. The change in exploration/exploitation attainment can be discerned when the original development plans are the basis of the comparison. This construct follows He and Wong’s (2004) conclusion that exploration
versus exploitation should be studied with reference to a firm’s *ex-ante* pursuit of innovation, and not *ex-post* or external success with it. The measurements used in this study are intended to inform us to the magnitude and direction of any change that alters the balance of exploration/exploitation output against the original plan.

In summary, the independent variables used in each of the models are hypothesized to change the plan for balance in exploration/exploitation after the plan enters development. New unplanned projects or increased urgency of exploitation projects already underway can decrease the amount of exploration that is accomplished. Given that total manpower available does not rise in the short term, any additions or changes can be anticipated to affect projects in progress or delay project start dates. The dependent variable – attainment to plan after the exploration exploitation plan enters development – is thus affected by any addition or reprioritization of projects.

It is hypothesized that when new work is added to the fixed manpower pool of the development organization, the plans for exploration and exploitation are affected *differently*. Exploration is hypothesized too decline while exploitation increases. In other words, the change in manpower that results from external demands, the addition of new projects, or changing priorities is posited to concentrate its impact on market exploration projects. For instance, as customers, partners and prospects request product changes, manpower is conjectured to move from existing projects. But the movement is not uniform; it is proposed that the re-allocation of manpower is accomplished by shifting manpower away from market exploration projects almost exclusively. Therefore, exploitation development increases and exploitation decreases.
The suggestion is that the planned exploration/exploitation balance, or ratio, shifts toward exploitation for two reasons. First, the projects added to development are predominantly exploitation projects (current customer demands for current products). Second, whenever manpower is shifted to meet these demands, it is the ongoing projects that have no fixed deadlines or certain revenue that are likely to suffer manpower reductions. Market exploration projects fit this description. This performance impact (the DV of a change in exploration/exploitation balance) is measured by the variance in project time (adherence to schedule), project quality (completeness to planned feature set) and the amount of work undertaken. The ratio or balance of exploration to exploitation is asserted to shift from the original plan after the plan enters the development phase - the amount of exploration innovation will decline as an increase in exploitation development crowds it out.

4.5 Summary of the Hypotheses

This chapter intended to develop hypotheses concerning the relationship between activity observed outside the development department and the amount of exploration innovation. The constructs, relationships and theoretical framing that emerged from the extended case interview phase of the study, and extant literature were used to create the conceptual frameworks and to form the hypotheses.

In the next chapters, the iterative theory building exercise of the qualitative case interviews, the extant literature, and the models are again used to operationalize the constructs of the dependent and independent variables. The models and constructs were structured into question form and then turned into a comprehensive questionnaire. The questionnaire was in a population census – meaning it was mailed
to an entire population. This effort was the data gathering stage of the quantitative analysis phase of the study.

In chapter five we discuss the research setting; the population mailing; how the hypothesized constructs of the models were operationalized, and the specific independent variables used in each. The method for testing the reliability and validity of constructs and relationships, and the results of those tests – on the data that was gathered by the questionnaire - is also detailed.
Chapter Five. Data & Methods

5.1 Research Setting

The frame for this research is US-based small and mid-sized enterprises (SMEs) in the prepackaged non-consumer software industry, with a product that is commercially available. This frame was chosen for numerous reasons. First, this size of firm was chosen because small- to mid-size firms allow the study to be applicable to a large segment of firms in the software industry. Those in the 10 - 500 employee range represent over one-third of all software enterprises (SUSB, 2006), and a large majority of software firms are below 50 employees. Second, this framing is conducive to an investigation in which interrelationships (individuals and departmental) may be important since product development teams are not isolated by distance. In SME environments, a single development department may work on many projects at many stages of development in parallel (Wolff & Pett, 2006; Hewitt-Dundas, 2006). For instance, Lavie and Rosenkopf (2006) followed the amounts of exploration and exploitation in a sample of 337 software firms over eleven years. They found that exploration and exploitation are done simultaneously and, due to the smaller size of the development team at SMEs, developers may work on multiple projects simultaneously. All development needs and projects of the organization are handled by the same resource pool of engineers.

As a result, isolated projects (where an engineering team is segmented and dedicated to one project) are out of the scope of generalizability for this research. Furthermore, while very small firms (1-9 total employees) represent a significant portion of all software enterprises, they were precluded from the study since a defined
management hierarchy and a separate and distinct R&D department were important to the project.

**Industry Choice**

The software industry was chosen because of the innovation intensity of the industry, its economic importance, and the currently high research interest in it. The top five most research-intensive industries are medicinal chemicals (SIC 2833); biological products excluding diagnostics (SIC 2836); prepackaged software (SIC 7372); diagnostics, in vitro and in vivo (SIC 2835); and telephone and telegraph apparatus (SIC 3661) (Medcof, 1999).

In addition, the population of software development firms was chosen in order to limit the impact of external supply dependencies on the research study. The reasoning is as follows: software development is knowledge work and is design intensive – it is a development that is mostly generated internally within the firm. The number of external suppliers to the development process is small. In contrast, industries such as hardware or food/chemical firms may have development project issues injected into their operations from external suppliers. For instance, program delays can be caused by purchased component defects, material shortages, or changes a supplier decides to make to important subcomponents. Such externalities – project performance issues due to processes external to a firm - make it harder to isolate organizational issues.

**Additional Selection Criteria**

A criterion for inclusion in the research frame is that the firms must have existing customers as determined by ongoing revenue. As a result, early stage
software firms that have yet to introduce products were excluded. First, if a company has a commercially available product, it is more reasonable to believe that their development organization has some competence. Choosing firms with merchantable product is a simple means of ensuring external validity that the cases are representative of “functional firms” - with credible product development skills. Distinguishing between incompetence in development, a weak product idea, or other issues of market failure, is a complicating factor that is best avoided. Second, once a company has a customer base, the existence of problems within the product, customer requests, and other market-related burdens arise. Firms with an installed base have more multifaceted and dynamic development processes due to market feedback loops and customer demands. Third, a firm’s strategic goals after commercialization and achieving revenue (e.g. setting revenue targets) are factors important to this study. Fourth, the focus of this research is the study of innovation in existing firms and existing industries, specifically avoiding research on initial product success or new ventures.

5.2 Census and Methodology

This quantitative phase of the research is a population study. Therefore, it will be referred to as a census (versus a sample survey), since every firm within the frame, as previously described, was sent a questionnaire. The research is not intended to explain the dynamics at particular firms, but instead to create a generalizable profile of the population.

Data Selection

To ensure frame quality, the databases chosen were of recognized high quality. To ensure that the census population from which the database was to be drawn was
valid, I used Standard Industrial Code (SIC) 7372 and crossed checked with the US Census information. The goal was to ensure that the database I used was validated against a trustworthy source. Data from the past two US censuses gave a profile of the target population, with breakdowns by firm size as a percent of the total. The number firms in the SIC 7372, as counted by the US Census, was taken to be reasonably accurate. If the US Census and any potential list source that purported to use SIC 7372 significantly differed in number, the source was rejected as potentially flawed for coverage error. Coverage error can occur when a list does not include all elements of the target population to be studied (Groves, 1987). US Census information was cross-checked against potential sources of mailing lists and it correlated well with the lists available from Dunn and Bradstreet (D&B). Both the United States Census and D&B are often used in business research (e.g. Adams, 2011; Barker & Cagwin, 2010).

**Frame Selection**

Since the goal of the research is to understand management decision processes in firms with management layers and departments, certain size parameters were established. The minimum size firm was set at ten employees which also meets an accepted lower bound definition of SME (EU, 2003). The second aspect of the frame was to understand processes in ongoing development rather than in new startups. As a method of establishing a firm as an ongoing concern, a revenue hurdle of firms with in excess of $500,000 a year was set. These criteria produced a population of 944 firms. Next, the database was searched to exclude consumer firms, custom software
developers, and firms that had ceased operations or had been acquired. The final count was 826 firms.

**Method Selection**

The quantitative phase of the dissertation tested the models and hypotheses based on data received from a self-administered mail questionnaire. Phone, mail, and web-based questionnaires can reach large distributed populations, but the type of questions anticipated require reflection and potential calculation, so a phone-based methodology was ruled out. Because mail questionnaire has been found to have significantly higher response rates than web questionnaire for the age and business profile of the target subjects (Shih & Fan, 2009), a postal methodology was chosen. E-mail and web surveys generally have lower response rate (about 20% lower on the average) than mail surveys (Shih & Fan, 2009). Furthermore, this lower response rate is correlated to respondent age – dropping off significantly after ages in the mid 20s (Shih & Fan, 2009). The subjects in the target frame – corporate executives – could therefore reasonably be expected to have a low response if such an electronic methodology were to be applied.

**The Pretesting Phase**

Preparatory groundwork for the questionnaire occurred in three phases and was intended to gauge the potential response rate, expose potential biases, ensure the proposed questions and survey format were both understood and unobjectionable, and would test the constructs.

The questionnaire was developed in a series of iterative sequential sessions, where subjects were observed while they completed the questionnaire. Subjects were
allowed to ask questions, and raise concerns. Completion of the questionnaires was followed by interviews, which were semi-structured and lasted under an hour. The process included tests of wording suitability and clarification of the items. Five such sessions occurred with changes made to the survey after each session, and prior to the next session, so that the survey progressed and improved sequentially.

**The Testing Phase**

A second step determined how effective the mailing would be and to reduce chances of failure. The methodology of all the mailings followed the Tailored Design Method (TDM) as outlined by Dillman (2007). It consists of specific design elements and mailing protocols for mail questionnaires in which the respondent is answering for the firm. The protocol differs from those for questioning individuals, or for questioning individuals who report on their own activity within a firm.

The mailings followed the established TDM methods designed to increase participation, and were tailored to organizational rather than personal surveys. These methods included custom letters, keeping the questionnaire short, ensuring salience, and an immediate incentive versus the less effective promise of lottery. Efforts to increase the response rate were based on theories of survey participation (Couper & Groves, 1996). The decision to participate in a survey occurs in the first moments of interaction with the survey vehicle. To that end:

1. The cover letter was constructed with the sole intent of increasing participation.
2. Questions were all closed (%, title, etc).
3. Concepts were clearly defined and questions directly phrased. Self-administered postal questionnaires require that every question be clear, answerable, and with a reasonable expectation of honesty.

4. The questionnaire was kept to three pages, since long questionnaires give respondent fatigue, inattention, and incomplete answers. Limiting the number of questions asked is important since research shows that longer surveys have dramatically lower response rates (e.g., Yammarino, Skinner, & Childers, 1991; Greer, Chuchinprakarn and Seshadri, 2000).

5. The cover letter included the offer to share the research results, and one dollar was included as an incentive.

A test mailing was done before the complete mailing to expose any weaknesses in question format, wording, or other unintended issues and avoid failure. This mailing used the same methodology planned for the remaining census so that as much information on errors or prospective problems could be gleaned as possible and so that the data could be merged. The protocol used for the pretest included four mailings:

1. A Pre-notification letter to the recipients.

2. A package that included an introduction with Internal Review Board (IRB) statement; the questionnaire; a stamped return envelope, and the monetary incentive.

3. A follow up mailing reminding the recipient to fill out the questionnaire.

4. Contacting the targets via phone and request that the survey be completed.

5. A follow up mailing package that included a reminder letter, the questionnaire, and a stamped return envelope.
This test phase comprised a mailing of 270 questionnaires and resulted in 61 returned questionnaires for a 22.6% response rate. Once the data analysis was complete, the questions and the operationalization of the constructs were re-analyzed. The only changes made to the questionnaire were minor typographical and physical layout changes. This consistency of questionnaire supported the merger of these data with data from the full survey.

Next, the full survey was executed. As each response arrived, an identification number was again assigned and it was written on each returned envelope and on each questionnaire. The data were then entered into a database.

In total, 171 questionnaires were completed and returned, for a response rate of 20.7%. Since our method is a census and the sample is the whole population, there are none of the undercoverage or confidence-level issues related to surveys, sampling, and sample size. All the firms have postal mail and there are no issues of groups or clusters which would tend to prevent one sub segment of the sample to have lower response rates than another.

**Combining the responses**

Because the survey proceeded in two steps, a test mailing and the full mailing, testing was done to compare the resultant data sets in order to ensure that they were consistent and that they could be merged. An independent sample T-test was used to determine if a significant difference existed between the two data sets. The results from the questionnaire that were used for the test were questions specifically included in the questionnaire for the purpose of establishing a baseline concept definition. Five
questions were subjected to the T test. Table 7 shows that there were no significant differences between results from the test mailer and the full mailer.

Table 7. Result of Independent Samples Test shows that the two samples are considered to be the same when each variable is measured.

<table>
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<th></th>
<th>t</th>
<th>df</th>
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</table>

5.3 Variables: Operationalizing the Constructs

Operationalizing the constructs was a two-step effort. The first step was to adopt or adapt applicable past approaches from the literature. Second, when a prior operationalization did not exist, a direct measurement was devised. All operationalizations - the questions to be used for the population census - were then tested to ensure validity. Since there was little empirical precedent to measure different aspects of Agency Theory or Resource Dependence Theory in exploration/exploitation or innovation research at the development level, multiple ratio and Likert-type scale items were developed to measure some of the constructs by relying on our fieldwork and on extant academic research that has studied NPD, and agency tenets in other settings. Following accepted procedures (Armstrong and Overton, 1977), a tentative
pool of measures for each construct was first generated based on its definition and on prior research. From this pool, the questionnaire was reviewed by scholars with experience in survey design, and then pretested in personal sessions with industry representatives. Revisions were made, and confusing items were modified or dropped. All Likert-type items, use a seven point scale (1 = “strongly disagree,” to 7 = “strongly agree”).

The Dependent Variable.

Past research using an exploration/exploitation framing has often used firm level performance as the dependent variable and measurements of exploration or exploitation during early phases such as search and portfolio selection as the independent variable (e.g. Ahuja & Katila, 2004; Bierly & Daly, 2007). Moreover, exploration versus exploitation is rarely used at a competitor or at the industry level (He & Wong, 2004). For a dependent variable, prior studies have tended toward such measurements of performance as average sales growth rate or profitability measures (Lavie & Rosenkopf, 2006; Smith & Tushman, 2005). Because past research has studied processes unrelated to changes in the exploration/exploitation mix during the development phase, they offer only limited guidance to the effort to construct an appropriate dependent variable for this study.

The construct measured in this study is performance to the exploration/exploitation development plan as measured after the plan enters the development phase. Finding an optimal balance of exploration to exploitation is encouraged by the academic literature, yet research results that show a shortfall in exploration is endemic (Adler et al., 2009; Levinthal & March, 1993; Bierly & Daly 2007).
The dependent variable in this research is used to quantify how the planned balance of exploration/exploitation changes relative to the balance actually attained. Specifically, the DV needs to reflect how projects being developed for a new market or a market new to the firm perform to plan, versus the performance of projects being developed in support of the existing business (e.g. improve existing product-market efficiency, existing product quality, reduce production cost). These two categories capture the essence of “exploration of new possibilities” in the market, and of “exploitation of old certainties.” Therefore, we are measuring the degree to which exploration shifts away from the original plan – either increasing or declining – during the development phase.

There are no studies that question how much the intended exploration/exploitation ratio – the company’s strategic development plan – differs from the actual delivery. To fill this gap, the study measures development differences that emerge compared to the plan for a balance of exploration and exploitation. As a result, measuring the development performance of market exploration projects versus the development performance of exploitation projects required a novel approach, but relied on the significant past research on innovation and NPD performance. Much research exists which specifically measures development performance, and measurement criteria are commonly accepted (e.g., Bloom & Van Reenen, 2002; Kleinschmidt, de Brentani & Salomo, 2007; Perry et al., 2009; Bstirler, 2005). This study leveraged the extant research and only needed for respondents to discern market exploration projects from exploitation projects. The construct could then be used to expose changes to the planned exploration/exploitation balance that occurs during the development phase.
Exploration and exploitation are two distinct dimensions of decision making rather than two ends of a one-dimensional scale (Bierly & Daly, 2001; Katila & Ahuja, 2002). Firm performance to plan for market exploration projects against that for exploitation projects is not a complex measurement, and has some precedence in the literature stream as the dependent variable (DV) in the innovation and NPD literature. For instance, performance can be a relative scale; a firm can attain to their original plan measured as a percent regardless of the magnitude of the projects (Bloom & Van Reenen, 2002; Kleinschmidt, de Brentani & Salomo, 2007).

This study combines three separate, direct, and often-used measurements to determine the single DV of exploration and exploitation development performance to plan: adherence to project schedule; completeness of project features/functions, and planned development undertaken.

Completeness of features/function. Completeness measures attainment of project content relative to the original plan (Perry et al., 2009; Bstirler, 2005). Projects can have more features than planned, meet the plan, or have fewer. The variable reported is percent attainment of feature set relative to the plan. [Appendix 1 Questionnaire. Section II].

Amount Undertaken. How much development (exploration/exploitation) manpower is changed relative to plan (Acur et al., 2010; Kahn, et al., 2006). Measurement is based on any movement from one category to another (exploration/exploitation). [Appendix 1 Questionnaire Section IV question 18].

Adherence to schedule. Adherence to schedule measures project duration relative to plan (Chen, Damanpour, and Reilly, 2010). Projects can be earlier, on time, or later relative to plan. [Appendix 1 Questionnaire Section II]
These three constructs, combined together, quantify development attainment of the market exploration construct and the exploitation construct relative to the original plan in a single DV. Analysis is done on the constructs as a sum index, and is also done individually. As a single index, the change in exploration/exploitation attainment can then be discerned. The original development plans are the basis of the comparison. Before development begins, exploration and exploitation plans commence as a given ratio (e.g. the plan for exploration and the plan for exploitation). This construct follows He and Wong’s (2004) conclusion that exploration versus exploitation should be used with reference to a firm’s ex-ante pursuit of innovation, and not ex-post or external success with it. The measurements used intend to inform us to the magnitude and direction of any change that alters the balance of exploration/exploitation output against the plan.

**Independent Variables.** Since this study uniquely uses exploration/exploitation development outcomes when measured against the original plan as the dependent variable, it also theorizes antecedents that influence exploration and exploitation development projects differently. Specifically, it looks to expose the effects of antecedents that occur during the development of the chosen exploration/exploitation projects, rather than the antecedents that occur during search or portfolio selection.

The two theoretical models developed here represent the antecedents uncovered during the qualitative theory building phase of this dissertation. Each model has its own set of independent variables; one model uses Agency Theory variables and one model reflects Resource Dependence Theory variables. Both are
unique in that they have not been applied to exploration/exploitation and innovation research in a manner that is similar or applicable to this research.

The broad review of literature helped to guide variable design, however, the creation of novel ones was unavoidable. Direct quantitative ratio measures were employed when possible and Likert-type scale measurements were employed as well.

The models, each representing a theoretical framing, are specified separately because the theoretical tenets are independent and the hypotheses do not rely on linkages to each other. Therefore, I discuss the operationalization of the variables separately, and then test the models individually. Combinatory tests were also done to analyze the extent that both theories, when used together, might enhance results.

**Agency Theory Model**

The literature that includes direct tests of Agency Theory is limited. Most rely on indirect measurements such as diversification activity (e.g. Ahmud & Lev, 1999). The scope of the literature is also narrow. For instance, I found no studies of Agency behavior by employees in one department, and its impact on other functional departments, impact on innovation, or impact on development projects.

**Model 1: Agency Opportunism**

**Figure 8, Model of agency opportunism IV’s and the Exploration/Exploitation DV**
Agency Opportunism

Agency Opportunism Variables

The Agency Opportunism model (Figure 8) includes three underlying independent variable constructs to measure the degree of opportunism; Goal Incongruence, asymmetric Information, and level of deception/intent or guile. (Williamson, 1975, 1985). The main issue with the Opportunism model is to measure the agency behavior of employees of the Sales department that is theorized to influence development manpower. Sales is operationalized as the agent of the CEO principal. Early survey research of opportunism (e.g. John, 1984; Anderson, 1988) assisted with question construction.

Intent to mislead / level of deception (guile). To discern agent willingness to influence new development projects which may not be justified, measurements gauged the variable of Sales’ willingness to exaggerate if it would help gain them a commission or to meet a quota. Such agency factors exist within an organizational hierarchy when an agent attempts to bring about a result, which serves their self-interest instead of the interest of the organization (Keil et al., 2000; Williamson, 1975, 1985). Multiple Likert-type scale items were derived using the work of Morgan & Hunt (1994) and used to
measure the extent that agents are willing to misinform, alter facts, or distort information. (Appendix 1 Questionnaire. Section IV questions 1 - 5)

Asymmetric Information: Asymmetric information focuses on the construct of the differences in important information between the sales employees and the CEO. Attempts to measure information asymmetry have usually been at the firm level and not direct measurements (Cai, Liu, & Qian, 2009; Gilson et al., 1998; Krishnaswami & Subramanian, 1998.) The literature commonly measures the extent of information asymmetry with ex ante constructs (e.g., relative size, growth, tangible assets) which are inconsistent with an individual's information (Bharath, Pasquariello, & Wu, 2009). Our measurement intent is to capture the information advantage held by insiders. To measure the degree of information asymmetry between Sales employees and the CEO relating to customers, questions determined whether customer orders that required a development project were as accurately forecast as those that did not. Three manifest measurements were taken. Related to Sales' information asymmetry were: size of the order, timing (when the order will come in), and importance (to gaining future business), relative to orders which need no development. (Appendix 1 Questionnaire. Section III comparative questions 1 a,b,c & 2a,b,c)

Goal Incongruence: Consideration of firm goals when new projects are interjected into development is a key metric, regardless of the agent’s knowledge of the goals (Keil et al., 2000). Goal incongruence was measured from management/principals’ perspective. Items were designed to measure whether such issues as the company’s development plan was considered when recommending new projects. Likert-type scale items were developed to measure the independent variable of extent to which
Sales’ considered firm’s goals with respect to development priorities. (Appendix 1 Questionnaire. Section IV questions 14 - 17).

**Resource Dependence Model**

This study tests the impact of a firm’s resource dependence on the exploration/exploitation DV. Based on the fieldwork of the qualitative theory building phase of this dissertation the theoretical tenets which closely matched revenue and capital dependence were exposed. Then, expanding on the conceptual work of Christensen and Bower (1996), and Cooper and Schendel (1976) the Resource Dependence Theory constructs were derived. The constructs measure the strength of existing major customers, large new customers, and the importance of prestigious customers on influencing changes to the firm’s development plans.

**Model 3: Resource Dependence.**

**Figure 9,** Model of resource dependence IV’s and the Exploration / Exploitation DV.

**Resource Dependence**

- Customer Concentration
- Revenue Threshold for New R&D
- Prestigious Accounts
- Variable Interactions (IV² x IV²)

Exploration/Exploitation

Ratio and Likert-type scale measurements were used to gain insight into the degree to which customers control development resource allocation and compel changes to the existing development plan. Three independent variables measured resource dependence (Figure 9). The first is the construct of customer concentration.
or the amount of revenue that comes from the firms largest customers. The second was leverage threshold or the order size as a percentage of the quarter’s revenue, at which the firm is willing to add development projects at customer request (Appendix 1 Questionnaire. Page 2 second and fifth bullet questions).

The third construct used a Likert-like scale and measured the importance of having prestigious customers. (Appendix 1 Questionnaire. Section IV questions 6, 9, 10)

5.4 Reliability & Validity of the Methods and Data

It is important to first test for the reliability and validity of the underlying data, prior to testing the hypotheses. Whenever a measuring device such as a questionnaire is used for data collection, the validity and reliability of the data and methods are important because we do not want to use data that do not measure what they purport to measure. Data reliability and validity testing is approached in two steps. The first is a discussion of the reliability and validity of the methods used in gathering the data. As such, issues of common methods bias (Suchman, 1962.), and response are addressed. In the second step, the reliability and validity of the data gathered is analyzed by using statistical analysis tools.

Reliability & Validity of Census Methods

Mail based information questionnaires are widely used in business research, including innovation research, and are broadly accepted as a legitimate methodology. For instance, Crook, Shook, Morris and Madden (2010) found that over 40% of studies on entrepreneurship used survey measures as part of their data collection efforts. Furthermore, much research is based on the secondary databases, whose source of information is gathered from annual broad mail questionnaire surveys, conducted for
the most part in Europe and in North America. Nevertheless, limitations of the population census and the questionnaire used by this dissertation need to be considered in order to understand their possible effect on results.

**Variance.** Since this a population study which samples every member, sample variance is avoided. Sample variance is the degree to which findings can diverge from the whole population because of a peculiarity of the specific sample that was taken (Groves, 1987). In a population census, there is no confidence interval because sampling from the population was not done; all observations were selected. Therefore, no geographical cluster nor subgroup oversample is possible either. Variance is thus limited to issues of response.

**Response rate.** An important issue for all surveys is response rate (Archibugi & Sirilli, 2000). Non-response is inevitable as some recipients will not reply, or may not be present when the survey is mailed. Studies such as this that are conducted at the organizational level have been determined to have typically lower response rates (Cycyota & Harrison, 2006) than those for individuals. Organization level, mail-in, written questionnaires currently have typical response rates of just over 20% (e.g. He & Wong 2004). Problems can grow if not enough attention is given to obtaining recipient cooperation. The response rate achieved by this study was over 20%, and exceeds the current standard to be published in top journals (Cycyota & Harrison, 2006).

As noted, increasing the response in this study was accomplished based on theories of survey participation (Couper & Groves, 1996). They found that the decision to participate in a survey occurs in the first moments of interaction with the survey vehicle. Because response was important to research validity:
• The cover letter was constructed with the intent of increasing participation.
• The respondents were offered a copy of the survey results and one dollar was included.
• Questions were all closed (%, Likert scale, etc) and were designed to be easy to understand and quick to respond to.
• Concepts were clearly defined and questions directly phrased. Self-administered postal surveys require that every question be clear, answerable, and with a reasonable expectation of honesty.
• The survey was kept to three pages, since long questionnaires give respondent fatigue, inattention, and incomplete answers. Limiting the number of questions asked is important since research shows that longer surveys have dramatically lower response rates (e.g., Yammarino, Skinner, & Childers, 1991; Greer, Chuchinprakarn, and Seshadri, 2000).

Nonresponse bias. Bias is the degree to which findings gleaned from respondents fail to reflect what is actually happening in the population. Nonresponse bias is possible in all surveys because the recipients who respond may be uniquely different from those who do not respond. It is important to note that response rate in and of itself does not indicate nonresponse bias (Groves et al., 2006). Even if the response rate is very low, nonresponse bias may not exist – the responders must be somehow different from those who do not respond. In our study, responders are representing firms, and there is no reason to anticipate that any class of firm will be both unresponsive and be different. According to Fox and Tracy (1986; 9) it is only “when these differences are related to criterion measures, the results may be misleading or even erroneous”. In
other words, the people who respond and their responses must be different in some way that is relevant to the research.

It is important to note that in our population, there are no issues of inaccessibility (unable to receive the questionnaire) or an inability to respond. Noncompliance (a conscious decision not to respond) is not a systematic factor because those individuals in noncompliance do so for individual reasons, and do not work at firms with different profiles than those individuals who do comply. In any event, late responses were compared to early returns in order to gain some insight into any nonresponse bias (Hawkins, 1975; Suchman, 1962). The theory behind this comparison is that late responders are considered to be similar to non-respondents in that they would have been non-respondents if a survey deadline had been set. However, since they are not actual non-respondents (Hawkins, 1975), the comparison might be useful for analyzing for bias, but not its extent (Ellis, Endo & Armer, 1970). For non-response bias to exist, the individuals not responding must somehow be working for firms that are different from the firms of the responders – which was not found in this study.

Another potential survey problem is question misinterpretation or question bias (Iraossi, 2006). It is important to avoid common questionnaire issues such as asking opinion based questions when seeking facts (e.g. “did your firm introduce any improved products?”). Construct validity is the foundation of any meaningful primary research and conclusions based on questions that fail to measure what they intend to measure are likely to be wrong. Getting input from faculty researchers with experience and from those who are unaffiliated with the research program helped to alleviated issues of construct validity and bias. Pre-testing, field review, and analysis also helped in
this regard. This study relied on perceptual measures for numerous constructs. Thus, like all other questionnaire-based studies, social desirability effects cannot be fully excluded even though our respondents are relatively less inclined to it because they are responding for the firm, and not for themselves. Minimum bias was attempted by keeping all the items as neutral as possible (Nunally & Bernstein, 1994). Furthermore, researchers have found self-administered questionnaires, like the one used in this study, to be much less prone to social desirability effects than telephone or personal interviews (Dillman, 2000).

Common methods variance (CMV). Methods bias or variance can be introduced in the questions posed by a questionnaire. It is systematic error related to how and what measurement is done (Campbell & Fiske, 1959; Cronbach & Meehl, 1955). Assessing two related factors with possibly divergent responses is one example of a design that may introduce bias. Such a vehicle may push respondents to give cognitively consistent responses that do not reflect the actual relationship. This study’s questionnaire limited CMV because first, operations to performance relationships have been found relatively independent of common methods bias (Berlinger, Glick, & Rodgers, 1988; Glick, Jenkins, & Gupta, 1986). Second, CMV is caused by the measurement approach, and not by the constructs themselves (Campbell & Fiske, 1959; Cronbach & Meehl, 1955). It is the technique used to gather the data that introduces CMV. Without linked questions, the observed relationship between constructs has not been entangled.

In summary, the survey methods were initiated, constructed, and executed with both bias and validity of methods at the forefront of their design. Significant effort was made to understand and then mitigate what is an impossibility to eliminate totally.
Reliability & Validity of Census Data

Prior to statistical analysis, all data that had been received from the questionnaires and entered into a database manually were re-checked for accuracy by re-examining every questionnaire against the recorded database. Once any errors were resolved, the next step was to perform statistical analysis of the data. The first step of the data analysis was to examine the results for reliability. This was done via a number of steps:

- Factor analysis of all data, crossing the four models, to expose a reduced set of underlying factors. The goal was to verify or refute if the theorized models were correlated with the reduced set of factors. If so, support for the models being explanatory was enhanced.

- Factor analysis within a model to expose a reduced set of underlying factors. The goal was to verify if the larger set of questions which are used to create combative variables would correspond to underlying constructs. If so, support for the combative variables was enhanced.

SPSS was used to mathematically answer these questions of whether the underlying concepts theorized in the models and operationalized in the questionnaire are in the data. Then, SPSS was again used to analyze reliabilities, frequencies, correlations and descriptive statistics of the independent and dependent variable constructs.

Factor analysis

Factor analysis was used to seek out underlying combative factors that are reflected in multiple observed variables (manifest variables). The goal of factor analysis
is to simplify a large number of observed variables into a potentially smaller number of constructs or factors that may lie within the data. This research utilized 20 manifest variables, each of which had the intent of helping to measure a component within one of the theoretical models. The underlying factors that are within the data (exposed via factor analysis) are discussed along with linkages between the manifest variables, the exposed factors, and the constructs theorized to exist as the foundation of this research.

The process of factor analysis has two components. The first exposes a simplified structure (the factors) underlying the data. In other words, although there may be many questions asked, are there just a few concepts that all the questions actually can be distilled into? The results – the few factors underlying the complex data – are also given a weight to show how much each exposed factor on its own explains the total variance in the whole data (percent of all variance explained). The second insight factor analysis gives is that the results show the degree to which each of the many manifest variables is associated with each the smaller number of factors (factor loadings - or the extent that each manifest variable aligns with each factor). In other words, there may be a few factors, and each of the variables may align strongly with one, or strongly with another.

Once factors and their associated loadings are discovered and shown, researcher interpretation is needed. There were two steps to an interpretation of the factor analysis results. The first is to discern which manifest variables are heavily loaded to one factor. The second step is to look at these loadings and to interpret what any cluster of such loaded manifest variables might tell us about the factor they load to. In other words, if there are a reduced number of concepts (factors) that appear in the
data, and certain manifest variables load strongly onto this factor, what might that factor mean? Do they map well against the theorized constructs? If they map against the study’s *A Priori* theories, then some credence is given to the theoretical models.

Factor analysis is based on the correlation matrix of the variables, and correlations need adequate samples before they stabilize. Tabachnick and Fidell’s (2001) advice, and the rule of thumb for a minimum of 5-10 observations per variable, places our sample of cases as well within the necessary range for avoiding difficulties.

Table 8 shows the loadings for each variable against the exposed factors. The first component represents 35.2% of data variance and has strong loadings relative to the three variables our study used for gauging the Agency construct of opportunism. These three variables load highly and only on factor 1. Factor 1, therefore can be interpreted as reflecting opportunism as the most explanatory underlying pattern for 35% of data variation in the survey. Component 2 represents 21.73% of data variability. It shows its highest loading variables as the resource dependence variables.

**Table 8. Factor analysis Loadings for each independent variable**

<table>
<thead>
<tr>
<th>Variables</th>
<th>Factor 1</th>
<th>Factor 2</th>
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<td>Customer Concentration</td>
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<tr>
<td>Revenue Threshold</td>
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</tr>
<tr>
<td>Prestigious Accounts</td>
<td>.312</td>
<td>.949</td>
</tr>
<tr>
<td>Level Intent to Mislead</td>
<td>.681</td>
<td>.090</td>
</tr>
<tr>
<td>Asymmetry Information</td>
<td>.832</td>
<td>.378</td>
</tr>
<tr>
<td>Goal Incongruence</td>
<td>.793</td>
<td>.182</td>
</tr>
</tbody>
</table>

In summary, the factor analysis provided support for construct validity. The theoretical basis of the research, and their measurements, appear to correlate with the
underlying factors of the data. Since these theories were constructed a priori using accepted theory building methods, validity of methods and data is reinforced.

**Factor Analysis of the questions that constitute the Agency Model**

As previously stated, questions associated with the opportunism model were combined to form Agency tenet-based independent variables. Variables in other models were manifest; defined and measured to be independent variables. Factor analysis was performed on the combinative variable data in order to fully analyze the independent variables of the research.

The sales opportunism model uses three variables. Two were created by combining Likert-type scale items, and one was a combination of ratio comparisons. Likert-type data and ratio data are analyzed separately. The two variables that were the result of combined Likert-type items were first factor analyzed to study the validity of the constructs. This process took two steps. It began with a factor analysis of all nine individual scale questions, which were designed to be combined to produce two of the Agency model IVs. Five questions were designed as a measure for goal incongruence, and four were designed to gauge “level of guile” or degree of intent to mislead.

This step was SPSS factor analysis and Varimax rotation to empirically test the extent to which each of the nine individual Likert scales items would load into factors. The goal was to discern, first, if they followed the pattern that five would load to one factor - goal incongruence - and four to another - intent to mislead. Table 9 is the outcome of factor analysis of the nine Likert scale items. In summary, the results show that all of the variables indeed load significantly, loaded on only one factor, and they
loaded as predicted by the theoretical model; all four intent to mislead loaded together, and all five goal incongruence loaded together.

**Table 9.** Output results for the two Likert-type variables; comparing all components of the two Likert-based Opportunism Model variables. (Level of intent to mislead factors; Goal incongruence factors)

<table>
<thead>
<tr>
<th></th>
<th>Component 1</th>
<th>Component 2</th>
</tr>
</thead>
<tbody>
<tr>
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<td>IV Goal Inc 3</td>
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</tr>
<tr>
<td>IV Goal Inc 4</td>
<td>.385</td>
<td><strong>.847</strong></td>
</tr>
</tbody>
</table>

After combining the scale items into the agency constructs (five into goal incongruence and four into level of guile), factor analysis was again employed on the set of three variables used in the Agency Opportunism model.

In summary, all the factor analysis results have provided strong support that the questionnaire measures the construct that it was designed to measure. Furthermore, the analysis also provides strong evidence that three of the theory-based models load consistently with the most important three underlying factors. In addition, the analysis also shows that three of the models account for over half of the variability in the data set. As a result of this analysis, no variables or questions were eliminated from the study due to weak results.

3. Reliabilities
Reliability refers to whether the census questionnaire has measured some “thing” consistently. If error associated with the use of different items are of interest, then internal consistency tests are used. Typically, this internal consistency test is done by using Cronbach’s Alpha, and is the method most commonly used with multiple Likert questions in a questionnaire (Cortina, 1993). It is intended to measure how closely related a set of items are as a group. It has the goal of establishing if the scale is reliable by returning the average of the reliability coefficients one would obtain for all possible combinations of items when split into two half-tests (Cronbach, 1951). Cronbach’s Alpha will generally increase as the intercorrelations among test items increase. It is most appropriately used when the items measure different areas of a single construct. The Cronbach’s Alpha reliability coefficient normally ranges between 0 and 1: the closer to 1.0 the greater the internal consistency of the items in the scale. Depending on the intent of the survey, different results are acceptable (Zinbarg, Yovel, Revelle & McDonald, 2006).

Cronbach’s Alpha was employed multiple times across the models, to individually measure the reliability of each of the Likert-type scale based constructs that the study employed. The constructs that were based on these scale items were: goal incongruence, sales opportunism, and prestigious accounts.

a. Goal Incongruence:

Goal incongruence was measured using a combined four Likert scale items. The Cronbach’s Alpha reliability results were 0.938. Each of the individual scale items was strong as well (Table 10).
Table 10. Cronbach’s Alpha Output results for Goal Incongruence. (IV Goal Inc each refer to individual Likert-type items measuring Goal Incongruence)

<table>
<thead>
<tr>
<th>Reliability Statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cronbach’s Alpha</td>
</tr>
<tr>
<td>.938</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Scale Mean if Item Deleted</th>
<th>Scale Variance if Item Deleted</th>
<th>Corrected Item-Total Correlation</th>
<th>if Item Deleted</th>
</tr>
</thead>
<tbody>
<tr>
<td>IV Goal Inc 1</td>
<td>12.05</td>
<td>32.672</td>
<td>.822</td>
<td>.928</td>
</tr>
<tr>
<td>IV Goal Inc 2</td>
<td>12.26</td>
<td>30.498</td>
<td>.900</td>
<td>.903</td>
</tr>
<tr>
<td>IV Goal Inc 3</td>
<td>12.20</td>
<td>33.471</td>
<td>.823</td>
<td>.928</td>
</tr>
<tr>
<td>IV Goal Inc 4</td>
<td>12.05</td>
<td>32.182</td>
<td>.865</td>
<td>.914</td>
</tr>
</tbody>
</table>

These results further support the variable and the questions that form the variable.

b. Sales Opportunism/Intent to Mislead

The opportunism construct, which measured intent to mislead, was measured using five Likert scale items. The Cronbach’s Alpha reliability results were 0.949. In addition, each of the individual scale items was strong (Table 11).

Table 11. Cronbach’s Alpha Output reliability statistics results for intent to mislead (IV each refer to individual Likert items measuring intent to mislead)

<table>
<thead>
<tr>
<th>Reliability Statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cronbach’s Alpha</td>
</tr>
<tr>
<td>.949</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Scale Mean if Item Deleted</th>
<th>Scale Variance if Item Deleted</th>
<th>Corrected Item-Total Correlation</th>
<th>if Item Deleted</th>
</tr>
</thead>
<tbody>
<tr>
<td>IV Intent Mislead 1</td>
<td>16.27</td>
<td>51.811</td>
<td>.896</td>
<td>.931</td>
</tr>
<tr>
<td>IV Intent Mislead 2</td>
<td>16.02</td>
<td>55.391</td>
<td>.830</td>
<td>.943</td>
</tr>
<tr>
<td>IV Intent Mislead 3</td>
<td>15.79</td>
<td>53.111</td>
<td>.891</td>
<td>.932</td>
</tr>
<tr>
<td>IV Intent Mislead 4</td>
<td>15.93</td>
<td>53.368</td>
<td>.863</td>
<td>.937</td>
</tr>
<tr>
<td>IV Intent Mislead 5</td>
<td>16.60</td>
<td>53.793</td>
<td>.825</td>
<td>.944</td>
</tr>
</tbody>
</table>

c. Prestigious/Reference Accounts

The prestigious accounts construct which measured the firms dependence on reference-name accounts was measured using three Likert-type items. The
Cronbach’s Alpha reliability results were 0.751 (Table 12). Cronbach’s Alpha reliability results that exceed .7 are within the acceptable range (Nunnally, 1967; Nunnally & Bernstein, 1994).

Table 12. Cronbach’s Alpha reliability statistics results for prestigious/reference accounts (IV Pres/Ref each refer to individual Likert items for prestigious/reference accounts)

<table>
<thead>
<tr>
<th>Cronbach’s Alpha</th>
<th>N of Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.751</td>
<td>3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Scale Mean if Item Deleted</th>
<th>Scale Variance if Item Deleted</th>
<th>Corrected Item-Total Correlation</th>
<th>Corrected if Item Deleted</th>
</tr>
</thead>
<tbody>
<tr>
<td>IV Pres/Ref 1</td>
<td>8.49</td>
<td>13.727</td>
<td>.426</td>
<td>.827</td>
</tr>
<tr>
<td>IV Pres/Ref 2</td>
<td>9.22</td>
<td>10.269</td>
<td>.694</td>
<td>.527</td>
</tr>
<tr>
<td>IV Pres/Ref 3</td>
<td>9.27</td>
<td>10.590</td>
<td>.636</td>
<td>.599</td>
</tr>
</tbody>
</table>

These three results lend further support for the variables.

4. Frequencies & Descriptives

a. Frequencies

The Frequencies procedure is useful for obtaining summaries of individual survey variables, and provides an overview of the data. Looking first at the Likert scale data, the overall quality is high. The rate of missing values is expected, and the data ranges are all correct. (Table 13).

Table 13. Frequencies and Descriptives for Likert-type variables.

<table>
<thead>
<tr>
<th></th>
<th>Prestige/Reference</th>
<th>Info Asym</th>
<th>Goal Inc</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>166</td>
<td>166</td>
<td>166</td>
</tr>
<tr>
<td>Mean</td>
<td>13.4</td>
<td>19.95</td>
<td>16.05</td>
</tr>
<tr>
<td>Median</td>
<td>15</td>
<td>21</td>
<td>17</td>
</tr>
<tr>
<td>Std. Deviation</td>
<td>4.83</td>
<td>9.13</td>
<td>7.56</td>
</tr>
<tr>
<td>Range</td>
<td>21</td>
<td>35</td>
<td>28</td>
</tr>
</tbody>
</table>
Next, we look at distributions of the survey’s interval data. Again, the data quality is high. The rate of missing values is as expected, and the data ranges are correct (Table 14).

<table>
<thead>
<tr>
<th></th>
<th>Customer Concentration</th>
<th>Revenue Threshold</th>
<th>Level Intent to Mislead</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>162</td>
<td>163</td>
<td>153</td>
</tr>
<tr>
<td>Valid</td>
<td>162</td>
<td>163</td>
<td>153</td>
</tr>
<tr>
<td>Missing</td>
<td>10</td>
<td>9</td>
<td>19</td>
</tr>
<tr>
<td>Mean</td>
<td>35.2779</td>
<td>4.64</td>
<td>34.03</td>
</tr>
<tr>
<td>Median</td>
<td>30.0000</td>
<td>5.00</td>
<td>20.00</td>
</tr>
<tr>
<td>Std. Deviation</td>
<td>28.94127</td>
<td>1.859</td>
<td>51.040</td>
</tr>
<tr>
<td>Range</td>
<td>99.99</td>
<td>6</td>
<td>310</td>
</tr>
</tbody>
</table>

**b. Bivariate correlations**

Bivariate correlations for the variables are found in Table 15 (Appendix 2). Bivariate correlation measures the relationship or covariance between two variables. A positive coefficient means that the relationship between the two variables is positive; the variables move in the same direction together. A negative coefficient means that they move in opposite directions. The coefficients range from -1 to +1. If the coefficient is -1, the relationship between the two variables is perfectly negative, as one rises the other falls by the same amount. If the coefficient is +1, the relationship between the two variables is perfectly positive as one rises the other rises by the same amount. At zero, a change in one variable is not reflected in the other at all. Results of a covariance analysis are judged against expectation. Collinearity does not reduce the predictive power or reliability of a model, but it can affect the interpretation of individual IVs. Collinearity does not bias regression results. In other words, the model
result is valid and unaffected by correlated IVs, but care must be taken if the goal is to
determine the role of each individual IV in the model (Farrar & Glauber, 1967).

The correlation table 15 (Appendix 2) shows that variable correlations are
mostly in the low range. Levels of correlation between the Agency Theory tenets
reveal for example, that firms with higher levels of asynchronous information may be
likely to also report opportunism. This result is expected. The matrix shows that the
independent variables do not have covariance in a problematic range. Since
interaction terms are created or included in models separately from their component
terms, they are a reflection of their components.

To assess any issues that might arise in the regression results due to collinearity,
variance inflation factors (VIFs) were employed for each main independent variable. A
VIF quantifies the severity of multicollinearity, and projects how it might influence
standard error by comparing it to results if the variable was uncorrelated. If the VIF is
low, then even if a collinearity is found, it is not pertinent to results. The maximum
value VIF is 3.7 for our construct of asymmetric information and the second highest
value dropping to 2.78 for goal incongruence (Table 16). Thus, the VIFs are all well
below the recommended cut-off point of 10.0 (Kleinbaum, Kupper, & Muller, 1988).

Table 16: Output results for Variance Inflation Factors shows statistics well within
acceptable range.

<table>
<thead>
<tr>
<th>Variables</th>
<th>VIF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Customer</td>
<td>1.227</td>
</tr>
<tr>
<td>Concentration</td>
<td></td>
</tr>
<tr>
<td>Revenue Threshold</td>
<td>1.601</td>
</tr>
<tr>
<td>Level Intent to mislead</td>
<td>1.895</td>
</tr>
<tr>
<td>Info Asymmetry</td>
<td>3.700</td>
</tr>
<tr>
<td>Goal Incongruence</td>
<td>2.780</td>
</tr>
<tr>
<td>Prestige/reference</td>
<td>1.891</td>
</tr>
</tbody>
</table>
In summary, the results show correlations in a range that are expected. Furthermore, while collinearity does not reduce the predictive power or reliability of a model, and does not bias regression results (Farrar & Glauber, 1967), the analysis was done in conjunction with the results from Cronbach’s alpha and VIF and shows that a finding of reliability is well grounded.

**Testing for Regression Assumptions**

Since regression analysis will be important to testing the study’s hypotheses, it is important to pay attention to regression assumptions. Regression analyses are more reliable if certain constraints are adhered to. For instance, it is assumed in that some level of normality in the data distribution exists, and that variation is somewhat similar at all points of the regression line.

**Data Normality or Errors**

For regression, a test of normality is that the errors should be normally distributed (Peduzzi et al., 1996). Normality is only used for analyzing t-test validity, and not for the coefficients. Coefficients only require that errors be independent. Normality of Error is tested by plotting the standardized residuals (each residual divided by its standard error) on a histogram or a normal probability plot. The histogram in Figure 10 shows such a plot, and is within research expectations.
**Homoscedasticity**

Homoscedasticity is whether the variability of data around the regression line is relatively pattern free or constant (Peduzzi *et al.*, 1996). In other words, error must be independent of X. The Homoscedasticity issue was tested by plotting the X...
values against the residuals for Y, and resulted in the scatterplot of Figure 9. There is no discernable pattern of the data points.

Figure 11. Scatterplot Homoscedasticity Output for the Dependent Variable error.

Analysis of the Dependent Variable.

The DV in this study measures change in the planned balance of exploration/exploitation after the plan enters Development. This conjecture was developed during the qualitative stage of the research, prior to the initiation of the quantitative study. To test this conjecture, the DV needed to be measured, which in
turn necessitated the development of multiple measurable constructs. While the DV is a single construct of performance, it follows research convention for R&D in that three components are used for its construction. Therefore, the single DV employs the three most used measures of performance in academic research to compare performance (e.g. Ayse & Miles, 2010; Patanakul, Chen & Lynn, 2010; Chen Damanpour & Reilly, 2010): performance to schedule; project feature set, and change in projects done and results in an estimate of change in the exploration/exploitation balance after the plan enters Development.

Data analysis was then undertaken to measure the change. During the qualitative phase of the research, the conjecture emerged that total exploration innovation declines during development relative to exploitation development. In other words, the planned balance of exploration and exploitation changes in favor of exploitation during development in that the amount of exploration accomplished declines while exploitation increases.

The results of the census are noteworthy. Tables 19 and Figure 12 show that, while a full one-third of respondents report that the exploration/exploitation change is less than 20%, the average decline in market exploration development in favor of exploitation was reported to be in the 45% range. As might be expected, the largest number of respondents report a low exploration decline of between zero and 25 percent (the mode is 13). Yet a full 40% of respondents claim that the decline exceeds 45%.
Table 19. Output results for Dependent Variable analyses

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DV EXPLORE</strong></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>44.78</td>
</tr>
<tr>
<td>Median</td>
<td>34.00</td>
</tr>
<tr>
<td>Mode</td>
<td>1.3</td>
</tr>
<tr>
<td>Percentiles 25</td>
<td>13.00</td>
</tr>
<tr>
<td>Percentiles 50</td>
<td>34.00</td>
</tr>
<tr>
<td>Percentiles 75</td>
<td>69.00</td>
</tr>
</tbody>
</table>

Figure 12. Histogram Frequency Output for the Dependent Variable

Based on this analysis, the study supports a finding that exploration/exploitation innovation plans shift, as exploration declines relative to exploitation during development. Specifically, exploration innovation is approximately 45% lower, on average, than the firms had planned to produce.
(Further analysis, such as a t-test, is not appropriate because, in a census, there is no sample.)

Summary

In summary, the extensive reliability and validity statistical analysis performed on the data has provided strong support that the data gathered from the population census using the mailed questionnaire method are a strong foundation for the next phase of testing the theoretical models. The analysis lends a preliminary credence to the idea that the hypotheses made in the dissertation a priori of data gathering, have a strong underlying framework of data, well formulated variables, and credible guiding constructs for further analysis.

The next step is to perform statistical analysis on the questionnaire data with the aim of testing the hypothesized theoretical relationships developed in this study. The goal of the analysis is to use the data to model and analyze the relationship between the exploration/exploitation dependent variable and the independent variables that make up the models. Each model is individually and collectively intended to help describe, explain, and predict the phenomenon.

The goal of the following chapter is to report on the regression analyses that were conducted on the gathered data in order to test the hypotheses of chapter 4. The results are intended to test hypothesis, as well as expose any explanatory power of the models. In other words, the regressions show how much the dependent variable (exploration/exploitation) changes when the selected independent variables from each of the hypothesized models (Agency and RDT) change, while the other independent variables are held fixed.
Chapter Six. Analytic Methods and Results

I begin this chapter by briefly describing the overall population census. This description includes a specific breakdown of each independent variable and its theorized meaning. Then, a regression analysis is used to explain the dependent variable variances and the degree to which the independent variables support the hypothesized relationships of the models being tested. Multiple regression is used for two reasons. The first is because it takes into account several predictive variables simultaneously, and thus models the data within a hypothesized relationship with more accuracy. Multiple regression delivers a powerful analysis by comparing the relationship of the variables against the null hypothesis that no relationship exists between the independent variables and the dependent variable. In other words, it tests the extent to which the relationship between the variables is no better than random chance. The second reason is that multiple regression is one of the most widely accepted analytical methods for both predicting and explaining relationships between variables that is used across virtually every scientific field.

The series of regressions that this research employs focus on predicting and explaining any movement of resources compared to the original exploration/exploitation plan. The regressions parallel the theoretical constructs that were predicted to influence exploration/exploitation innovation efforts, specifically, opportunism and resource dependence. Prior to the opportunism analysis, I test the validity of the combinative independent variables on which the model relies. Last, I perform a regression analysis that includes all the independent variables (from both models) in one analysis and provides a combinative test of my two frameworks.
In discussing the results associated with each regression, I provide summary tables that list the significant coefficients and an overview of significant effects. Issues of variable co-linearity, as well as important regression assumptions are included at the end of this section.

6.1. Census Data Overview

Because the mailing was sent to the entire population of non-consumer software firms in the United States (as described in the methods section), it is a census. 171 questionnaires were returned. Because the responses were obtained from a census, there is no sample. Therefore, confidence intervals for the sample is not an applicable statistic. The population was 826 firms, which gives a response rate of 20.7%. As questionnaires were returned, data were entered into Excel and then subsequently analyzed with multiple statistical methods using SPSS version 19.0 - a statistical software program commonly used for analyzing research data.

Independent variables

The independent variables that were used from the census are outlined in Table 17. Each question in the census was fashioned to express a component of a theoretical tenet (Agency Theory or Resource Dependence Theory) that the research had hypothesized.

Table 17: The two models and their respective Independent Variables

<table>
<thead>
<tr>
<th>Variable Name</th>
<th>Measures</th>
<th>Variable Definition</th>
<th>Scale</th>
<th>Composition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model 1</td>
<td>Agency Theory</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Goal Inc</td>
<td>Goal incongruence</td>
<td>Degree Sales does not reflect ongoing firm goals</td>
<td>Likert-type</td>
<td>Composite of 4 items</td>
</tr>
<tr>
<td>Asymmetric information</td>
<td>Degree information is distorted by Sales</td>
<td>Ratio-comparative</td>
<td>Composite of 3 items</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Willingness of Sales to overstate opportunity</td>
<td>Likert-type</td>
<td>Composite of 5 items</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---------------------------------------------</td>
<td>------------</td>
<td>---------------------</td>
</tr>
<tr>
<td>Intent</td>
<td>Sales Intent</td>
<td>How concentrated the firm’s revenue is on a few customers</td>
<td>Ratio-dependence on large customers</td>
<td>Single item objective measure</td>
</tr>
<tr>
<td>RD1</td>
<td>Customer concentration</td>
<td>Degree that order size can influence plan changes</td>
<td>Ratio-size of order that will change plans</td>
<td>Single item objective measure</td>
</tr>
<tr>
<td>RD2</td>
<td>Order leverage</td>
<td>Importance of having Prestigious accounts</td>
<td>Likert-type</td>
<td>Composite of 3 items</td>
</tr>
</tbody>
</table>

**Dependent Variable**

The dependent variable is the extent to which the planned balance of exploration innovation projects and exploitation innovation changes after the plan enters development. It is a composite measure of three ratio-based sub-dimensions of exploration and exploitation: project feature performance to plan; and project schedule performance to plan, projects undertaken relative to plan. The dependent variable is a composite measure, and it is interpreted as a single construct: that measures the degree that the planned balance of exploration innovation to exploitation shifts during the development phase of R&D. As such it assesses how much exploration/exploitation is accomplished relative to the original plan.

**6.2. Regression Analysis**

Once the reliability, factor analysis, and descriptive statistics were completed, a series of multivariate regressions were done. Regression analysis is widely used for showing construct relationships. This section of the study has the intention of
explaining the observed construct variance in the exploration/exploitation DV via separate regressions: one for Opportunism and one for Resource Dependence). The objective of this regression was to show the extent to which the shift of resources and change in exploration/exploitation plan is related to the agency-based and the resource dependence -based models.

The dependent variable is the extent to which the exploration/exploitation plan shifts after it enters development. It is expressed as a single concept: the total amount, in percent, that the exploration/exploitation plan changes during the development phase of R&D. The measured variance in the DV shows that there is a mean shift away from market exploration and into exploitation development that occurs after the plan enters the development phase. That the magnitude of the shift away from market exploration innovation increases as the variables in the two models grow stronger are hypothesized by H1 and H2, and their related sub-hypotheses, and by the combined model of H3. Data from the questionnaire were transformed as needed in order for the variables to have consistent directionality, including the combinative variable questions and for consistent positive/negative data values.

The regression analysis for each model was done in a set of phases. Each set included an analysis using control variables only; then main effect IVs with control variables, and finally main effect IVs with interaction variables and controls. The control variables were introduced to detect any systematic differences attributable to firm-level attributes of size and age, which are unrelated to the hypotheses. In other words, the controls may explain some variance linked to a firm-level difference that is not related to the theorized predictor variables. Regression with control variables eliminates their effect from being hidden within the results of the predictor variables, which occurs if
regression is done without them. However, the results when control variables are included should be interpreted in that the results will show whether the control variables in fact have any effect on the DV. If a control variable is significant (beta) then inclusion in the model interpretation is warranted (Ryan, 2009).

I tested all hypotheses regarding exploration/exploitation and all of the results are combined in Appendix 3, Table 18, a, b, c, d. Hypothesis One specifies a positive relationship between the shift away from market exploration innovation (DV: a change in the balance of exploration/exploitation toward exploitation) and stronger opportunism. The individual hypothesis for each Agency tenet’s affect on the DV then follows. In Hypothesis Two, I propose a positive relationship between the same exploration/exploitation DV and increased resource dependence. The individual hypothesis for each resource dependence tenet’s affect on the DV then follows. Therefore, each model is predicted to show that as the IVs increased, the DV will show a shift in the balance of exploration/exploitation away from market exploration innovation during the development phase. In Hypothesis Three I propose that a combined model, with all IVs and interaction, has a positive relationship with the same exploration/exploitation DV of declining exploration in the development phase. I find broad support for all the hypotheses.

A second set of tests was also done to expose the relationships between each of these same three models (Agency, RDT, and Combined) on each the three components that were combined to form the single DV. These were adherence to development plan, amount of development work undertaken, and completeness of features. The goal of these tests was to gain a deeper understanding of the relationship between the individual tenets of Agency Theory and RDT, and any
variation in the three components that form the basis of development performance as well as substantiation of the three underlying components.

The first step of the regression testing was to analyze the control variables. Three controls were tested: firm age, revenue and employees. The intent was to discern how much firm-level constructs were behind any results that might be misinterpreted as being related to the study’s IVs. The results (Appendix 3; all tables) show that none of the controls was significant on its own, and models that only use the controls are by and large not significant. Only one test against a DV shows significance with firm size, but the R-squared is exceedingly small. Therefore, the observed DV variation is rejected as only being related to the controls of firm age, revenue, or number of employees.

a. Regression Set One: Opportunism

The analytic strategy for the sales opportunism model (H1) involved three main effect variables. The regression for model one was first conducted using control variables only. Then a regression was run with controls and main effects; the three Opportunism IVs against the DV: Sales Intent to mislead, Goal incongruence, Asymmetric Information.

As shown in Appendix 3, Table 18 a, the adjusted R-square was strong at 0.503, and the overall model significance was 0.000. The adjusted coefficient of determination (R-squared) is the proportion of variability that is accounted for by the statistical model, and it measures how well future outcomes are likely to be predicted by using the model with new data.

The regression also produced strong results for each individual variable’s coefficient, and each was significant. Each beta showed a positive relationship. These
results show strong support for Hypothesis 1, that Agency opportunism has a positive effect on the extent to which Exploration innovation declines during Development.

The overall model is strong, and each IV is significant and is therefore interpretable. Because the IVs were measured using different units, employing the standardized beta coefficients helps the analysis when comparing them. All of the standardized beta coefficients for the three IVs indicate that the IVs had strong effects on the results. In other words, the three IVs were roughly similar in their importance to the R-squared result. While the beta coefficient for goal incongruence is lowest at just over 0.21, asymmetric information is 0.245, and the influence of sales intent to mislead is highest at over 0.36. Therefore, H1 a, H1 b, and H1 c are supported.

**H1 a.** Goal incongruity has a positive effect on the extent to which Exploration innovation declines during Development.

**H1 b.** Asymmetric Information has a positive effect on the extent to which Exploration innovation declines during Development.

**H1 c.** Intent to Mislead/Guile has a positive effect on the extent to which Exploration innovation declines during Development.

In the third step, the interaction effects were added to the model. Analysis was done to gauge the effect of asymmetric information in concert with intent to mislead/guile, and asymmetric information in concert with goal incongruence. The results, (Appendix 3, Table 18 a) show that the interaction effects increase the adjusted R-squared only slightly to 0.528, and they eliminate the value of all the beta coefficients that were previously tested and had significance alone. Coefficients for the independent variables have eroded to non-significance and none of the interaction variables is significant. This result leads to the conclusion that the model is not as
useful, or as worthwhile, when compared to the main effects model. H1d, therefore, is not supported.

**H1d.** Interaction of information asymmetry with either Intent to Mislead/Guile or goal incongruity has a positive effect on the extent to which Exploration innovation declines during Development.

The final set of tests was to expose any relationships between the Agency model and the underlying three constructs that were used to create the unified DV. The results are supportive of the overall conclusion that the model has explanatory power. This conclusion is reached because when the IVs are regressed against each of the three constructs, each regression is significant. While no model delivers consistently significant IVs, each individual IV has significance depending on the DV construct we analyze it against. For instance, goal incongruity and guile were significant against the DV construct of schedule, while asymmetric information and goal incongruence were significant against the DV component of feature set completeness.

**b. Regression Set Two: Resource dependence**

The analytic strategy for the resource dependence model (H2) involved three independent variables. The regression was first conducted on the control variables only, then a regression was performed for the controls plus the independent variables against the same DV as was used in model one. Last, a regression was performed which included interaction effects.

All versions of the set were significant to 0.000 (Appendix 3, Table 18 b). The adjusted R-square for the main effect model, which included the control variables, was 0.174. None of the controls were significant, but the main effect IVs produced
significant beta results. H2 is concluded to have strong support, and the related hypotheses for the individual IV's are supported as well, and to be important to any accounting for why less exploration innovation is developed than was originally planned. Accounting for this proportion of variability with such a high significance for the model makes further discussion worthwhile.

**Hypothesis 2**: Resource Dependencies have positive effect on the extent to which Exploration innovation declines during Development.

**H2 a**: Customer Concentration has a positive effect on the extent to which Exploration innovation declines during Development.

**H2 b**: Order Leverage has a positive effect on the extent to which Exploration innovation declines during Development.

**H2 c**: Interest in Reference Accounts has a positive effect on the extent to which Exploration innovation declines during Development.

Next, IV interaction was added as a third iteration of the resource dependence model. The results, also in Appendix 3, Table 18 b, show that the interaction effect gave a similar adjusted R-squared as the former two models: 0.179. The interaction variable, however, was not significant, but it raised the customer concentration beta coefficient into the significant range. This result leads to the conclusion that the model including interaction has significance.

**H2 d**: Interaction of customer concentration and order leverage has a positive effect on the extent to which Exploration innovation declines during Development.

These results show strong support for Hypothesis 2: that Resource Dependence has a positive relationship with a decline in exploration accomplished during development.

c. Regression Set 3: Regressions using variables that cross theoretical models.
The intent of regression set three is to analyze the explanatory and predictive value of a model that includes all the independent variables. The goal is to discern if a combined model may add value in predicting the DV variance. Three versions of the combined model were analyzed. One model included controls, one model included main effects and controls, and a third included main effects, controls and interactions.

A regression was first performed for the controls, plus the main effect IVs from both the H1 and H2 models, against the consistent dependent variable. In this complete cross-theory regression, adjusted R-squared is 0.511, and the model is significant to 0.000 (Appendix 3, Table 18 c). While the model is strong overall, individual IVs with significance are limited to only those associated with the Agency model. In addition, the overall R-squared of the combined model is lower than the Agency model when used alone. This result curtails the model usefulness versus interpreting each model (Agency and RDT) individually.

Next, the interaction model was tested. Information asymmetry was theorized to interact with customer concentration and with order leverage. The results show that the model is significant and the adjusted R-squared of the model is similar to the model without interaction at 0.513. Nevertheless, only two of the IVs are significant. Therefore, the model is interpreted to have lower value than the first test.

The last set of tests was done to expose any relationships between the combined model, and the three individual constructs that were used to create the single DV. The results are supportive of the overall conclusion that the model has explanatory power. This conclusion is reached because when the IVs are regressed against each of the three constructs, each regression model is significant. Individual IVs
have significance only depending on the DV construct. For instance, every Agency model IV is significant against the DV construct of completeness.

Summary

The major findings of this statistical analysis are twofold. First, there is support for the foundation supposition: the balance of exploration to exploitation that is formulated during the planning, or strategy phase, shifts during the development phase of product advancement. Furthermore, the balance shifts away from exploration innovation, and toward exploitation projects so that exploration declines once the exploration/exploitation plan enters development. Second, both of the theory-based models that were developed have some level of strong support in explaining the variance in the DV.

The Agency Theory based model of Sales Opportunism has the strongest support of the two models with an adjusted R-squared of 0.503. In addition, the IVs can be interpreted since the betas of all three main effect variables were positive, were of high value, and were significant. The beta values indicate how strongly each IV in the model influences the DV. The beta value is shown as a standardized value - which is the relationship in standard deviations. For example, a beta value of 0.4 indicates that a change of one (one standard deviation) in the IV is expected to result in a change of 0.4 standard deviations in the DV. One standard deviation away from the mean is the point that includes around 68 percent of the population. Two standard deviations is roughly 95 percent.

In Chapter 7 a fuller discussion of these results, including a discussion concerning the meaning/implications of these results, linkage to theory and domain, and the strength of support for each hypothesis and each of the variables, is offered.
Chapter Seven. Discussion of Results

In this chapter, a summary of the main findings of the study is first presented, then, each hypothesis and the related findings are discussed individually with linkage to literature and theory.

The results of this study show that exploration innovation declines significantly and disproportionately after the plan for development enters the Development department. Researchers have studied development and the problems of innovation for decades, and a strong stream of research now exists whose intent is to explain low rates of exploration innovation in firms (Li, Lin & Chu, 2008). This study has taken a novel theoretical perspective by applying Agency Theory and RDT to innovation and exploration/exploitation research, and in the methodological approach by fashioning a population survey to measure Agency and RDT tenets related to development, in its effort to help discern why innovation rates are low. It contributes to scholarship by examining innovation, to some extent at least, differently. It focuses on results versus intent by measuring changes to original innovation plans that occur after the plan enters development; its theoretical base is found in agency and resource dependence tenets; it incorporates issues that originate external to R&D and any extended development team, and it focuses exclusively on a particularly explorative innovation construct (projects for new markets). The study has four major findings that emerged from a sequential research design, beginning with a qualitative investigation to form hypotheses, followed by a quantitative test of these hypotheses.

The underpinnings of this study have a genesis within research streams that establish how exploration and exploitation plans are first created. Firms must overcome strong mechanisms by which exploitation is favored over exploration
(O’Reilly & Tushman, 2008). Firms must first search for explorative ideas (Ahuja & Katila, 2004), but structure; rewards; culture; competences, and experience all bias decision making toward plans heavily weighted with exploitation (Sroufe & Curkovic, 2008, Simiter & Zhang, 2010). After all planning ends, however, firms need to deliver both exploration and exploitation for superior results (He & Wong, 2004).

The findings of this study are important first, because while firms can have a well-balanced and clear plan for exploration/exploitation, what is then developed successfully is material to firm performance. Thus, this study contributes to theory and practice because 1) it informs the literature about activity past the planning stage by focusing on development results; 2) the findings differ from conventional resource-based scholarship on development, NPD, and innovation, and 3) they help to explain a phenomenon of low innovation rates that has persisted in practice for many decades.

Study results can be separated into four main findings. The first is support for the suggestion that the balance of exploration/exploitation innovation changes significantly during development. The innovation for which firms make specific plans to produce, does not happen as intended. Specifically, the balance shifts markedly away from market exploration innovation, toward exploitation development, after the plan enters development. This finding is distinctive in exploration/exploitation discourse on innovation in that there has been no attempt to judge the merits of the original exploration/exploitation plan. The singular concern has been with the magnitude and direction of any change that occurred after the plan entered development. Therefore, the impact of this change (that exploration is compromised) on firm performance is left to future research.
The second general finding is that the decline in exploration and the shift to exploitation that was found to occur after the plan enters development is, to a large degree, explained within tenets from Agency Theory and Resource Dependence Theory. Research into innovation, development, or exploration/exploitation most often uses a resource-based framing (Danneels, 2002). This study was designed to add to innovation scholarship by testing the effect of specific Agency and Resource Dependence tenets.

The third finding is that important dynamics that affect the plan for exploration/exploitation after it enters development originate from outside the Development organization and external to any larger development team. This finding is important in part because of its potential impact on current orthodoxy in the literature. Most research into the performance of development organizations takes, in the main, a more closed system approach where the development team – including the managers, customers and suppliers (who are linked into the project or to R&D), are included in the level of analysis, along with the development employees (e.g., Brown & Eisenhardt, 2001; Romijn & Albaladejo, 2010). The results of this study imply that scholars should take a broader theoretical perspective on innovation by including both Agency Theory and Resource Dependence dynamics, and by using an open system level of analysis that extends past a project team of Development, Management, partners, and even the customer.

Finally, while each theory (Agency and Resource Dependence) explains some of the change in rates of exploration, together they provide a more robust explanation. In line with this, the findings from this study indicate that future research might benefit
from using a multi-lens approach when studying complex phenomena such as innovation and product development.

Both models (agency opportunism and resource dependence), when tested on their own and together, provided support for their respective hypotheses. The models were each significant (overall ANOVA regression significance p of .001 or less), meaning that the null hypothesis - the effect is the same as the experimental error and no difference was present - is rejected with a probability <0.001. Furthermore, the degree to which the planned balance of exploration/exploitation development shifts after it enters Development correlated significantly to the main effect independent variables that were devised to test each model’s hypothesis. There is a danger of making much from coefficients that are statistically significant, but inconsequential from a practical standpoint. This is not the case in this study, since the adjusted R-squared coefficients from each model is high; above 0.50 for Agency and above 0.17 for RDT. Findings from the regressions that test each hypothesis individually provide evidence as to the underlying mechanisms by which manpower changes after the exploration/exploitation plan enters development. The higher the reported sales opportunism and resource dependence, the larger the shift away from market exploration innovation. Each hypothesis exhibited support and the variables are significant in the hypothesized direction.

It should be noted that the findings of this study, have a context within the wider development effort of the firm. Exploration, as defined in this study, is a portion of any firms total development effort (Nerkar & Roberts, 2004; Lee & Ryu, 2002). As an illustration, an observed decline in a firms exploration innovation of 30% during development, may translate to a shift of about 10% of the total development effort or
manpower. As such, applying the adjusted R-squared of 0.503 (from the Agency model), would correspond to a shift it of around 5% of total development manpower. In other words, while a shift of just 5% of total development manpower – as explained by the Agency model - may seem inconsequential to management while it is occurring, it could nevertheless result in a severe blow to exploration innovation.

7.1 Hypothesis I. Agency Opportunism

In this section, findings at the model level are discussed first, followed by the individual predictor variables.

The Agency opportunism model was formulated to test the hypothesis that specific Agency Theory tenets associated with agents acting opportunistically, were explanatory for the variation in the exploration innovation DV that exists in the data. The model makes a contribution in that it is a direct measure of an Agency cost (Jensen & Meckling, 1976) in the form of reduced innovation, which makes this one of the few studies (John, 1984; Anderson 1988) to do so.

A number of significant relationships were found. The regression results from the sales opportunism model proved to be strong and consistent with the hypothesis. Significance for each of the model variations (with control IVs and with interaction IVs) gave p values of 0.000. As a model, the association between all three sales opportunism IVs and the DV was high and the analysis produced an adjusted coefficient of determination (R-squared) of 0.503. The adjusted R-squared measures how well future outcomes are likely to be predicted by the model. Thus, the level of sales opportunism that exists in this population of software firms is strongly associated with decline in exploration innovation. Hypothesis 1 is supported. As Agency

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opportunism increases the amount of exploration accomplished during development declines.

Moreover, the results of the Agency model tell us that the majority of the variation in the dependent variable can be explained by sales opportunism. In other words, the amount that exploration changes (exploration declines) after the plan enters development is mostly associated with the degree to which the sales force is reported to be opportunistic. This is an important result because over many decades research has investigated why firms have difficulty innovating, have trouble developing on time, and trouble releasing new products with all features intact (Bloom & Van Reenen, 2002; Cooper, 1995; Kleinschmidt, et al., 2007; Repenning, 2001). The results of the research has long pointed to implementing rigorous rational planning methodologies (e.g., Rothwell, 1992), the importance of internal and external group communications (Brown & Eisenhardt, 1997), and having the systems in place that foster problem solving (e.g., Clark & Fujimoto, 1991) – each is seen as being important to success. The precedence of Resource Based explanations have proven partially explanatory, leaving room for the results of this study to further move the scholarship toward a more comprehensive accounting.

This study thus adds to past research, by finding that – for the exploration innovation component of development in software SMEs – a performance decline in the development phase is accounted for by agency forces (opportunism) that originate outside any broader conception of a development structure. Opportunism is self-interest with guile (Williamson, 1975, 1985), which is also construed as cheating, misrepresentation and deceit. Sales force opportunism has been studied, in the context of transaction costs and honesty. For instance, Anderson (1988), found that
opportunism (measured as less honesty in pricing) between a firm and its sales force declined if the sales channel was more aligned with firm goals.

The results of this study extend research on opportunism to the exploration/exploitation and the innovation domain. This study shows that forces that are external to the Development department, the development hierarchy, and any larger development team, have a great influence on development priorities. In this study, sales opportunism compromised the exploration plan through a process that “crowded out” exploration. Agency cost (as defined by Jensen & Meckling, 1976) that results from opportunism can be “calculated” in this study by measuring the decline in exploration innovation. Firms do not gain the returns that their original development plan would have provided. Instead, as opportunism increases, exploration activity declines because of adverse selection (Bromley 1989). Adverse selection in innovation has been studied in the context of selection and in financing (e.g., Takalo & Tanayama, 2010) and is typically modeled as misleading the principal on the extent of a project’s risk or return. In this study, the adverse selection is more orthogonal – the manager chooses a new unplanned project which has unintended effects on planned innovation. Management’s resulting changes to the original development plan would be based on bad or misleading information. Agents with self-serving goals, asymmetric information and guile (intent to mislead) can influence development priorities from well outside the extended development team. While the quantitative data can statistically support or reject hypothesis, underlying motivations from the qualitative data help provide a deeper understanding. As illustrated by Engineering: “So there’s been definitely false alarms, claims from the sales folks that I need it today in
fact that wasn’t true…… they’re not motivated by what my team delivers, they’re motivated by commission. It goes on a lot”.

With the combination of both a qualitative and quantitative methodology the research results have a richer interpretation, as well as an enhanced reliability; triangulation from two-way verification that is possible from a mixed-method approach (Mingers, 2001).

In general, the Agency tenet of opportunism has a research stream that largely focuses on governance at the highest level: owners versus managers, and CEO/Board interaction (Dalton, Hitt, Certo, & Dalton, 2008; Zahra, 1996; Hill & Snell, 1989). However, agency problems have been reported to be present in lower delegation hierarchies. Incentive exists for more junior managers to increase their own financial return (Cooper & Dunkelberg, 1986), improve their prospect of promotion (Feeser & Dugan, 1989), and gain prestige (Carland, Hoy, Boulton & Carland, 1984). This study confirms this prior research, and builds upon the literature concerning lower level Agency costs. It finds that Agents at low levels in the hierarchy do indeed exploit opportunities for financial gain, and that it brings a high Agency cost to the firm. Moreover, the tenet of opportunism was seen to extend beyond direct hierarchic relationships. In this study, Agents promote adverse selection on matters well beyond their own management structure, in a direct attempt to affect or reset Development priorities. To illustrate what this concept means in practice: “They (salespeople) may sell features that the company does not have in order to get a sale. Sales tells the customer we have it, or that the product does things it does not do in order to make their quota. So, they get this sale or this big opportunity. Then, they push really hard to “save the deal” (CEO).
These results suggest that a strong explanation for any shift in balance away from exploration innovation during development is that sales’ opportunism influences decisions to reallocate development resources. Regular, ongoing demands from sales for enhancement to existing product “crowds out” development of new product innovation intended to move the firm into new markets. New, unplanned projects undermine these exploration intentions. These results align with the case research of the qualitative phase of the study. As one VP of Sales put it, “the tendency is to push things into engineering ... so you can make quota”.

It should be noted that interpreting beta coefficients in regression, when some of the coefficients are not significant, has a higher uncertainty: models with all significance coefficients are preferred (Ryan, 2009). Because the regression result showed each of the beta coefficients for the three IVs to be significant and positive in the Agency opportunism model, an interpretation of how each of the three IVs affects the DV makes sense.

Research on new products and on innovation has employed Agency Theory. Scholars have demonstrated management’s aversion to new innovative development endeavors because of their high risk (e.g., Jones & Butler, 1992; Zahra, 1993; Zahra, 1996; Latham & Braun, 2009). The results of this study suggest that asymmetric information may be used to exploit this management risk aversion. New projects intended for an existing customer can be portrayed as less risky than they are, thereby increasing the chance that riskier exploration projects would be subordinated.

Asymmetric information. This conclusion comes from analyzing the asymmetric information predictor variable used in the Agency model; the degree to which sales
misleads management on the size, timing, or importance of a new order. It returned
the strongest indicator (beta coefficient) for explaining the change in exploration
innovation during development. The interpretation of the asymmetric information
beta is that sales agents will use their better information in order to influence the
decision to add new unplanned project into development. In other words, sales
people will induce management to redirect development manpower by embellishing
the impact that a customer order will have, or by minimizing its true level of risk. This
result is supported by Agency Theory (Eisenhardt, 1989) and reflects the theory
building case results. CEOs were aware of this asymmetry: “the sales force always puts
things in a more positive light in order to increase the chance that the company
resource get moved onto their project”

This corroborating case data is not surprising. Information asymmetry was
found to have a strong beta coefficient and was highly significant, meaning that the
better or more hidden information that the Sales force had, the more that exploration
development would decline from the original plan. The interpretation falls in line with
the interview data: if a change to the firm’s existing product will help secure a
prospective customer’s purchase, there is incentive for the sales person to distort
information concerning the risk or return. “They always do that. They oversell me”,
was a common complaint of CEOs. In a situation of asymmetric information - where
only the sales person truly knows how large the order is, when it will be placed, or
how important the customer is likely to be in influencing future business - the allure of
providing misleading information is strong. Acting on the information provided in the
asymmetric relationship, managers make adverse cost/benefit decisions with
erroneous data. These decisions move development manpower away from
exploration and toward exploitation projects. With experience, agents might discern reasonably precisely what distortion is needed in order to produce decisions that are in their own interest, rather than the firms. These results have similarity to the literature on sales behavior. For instance, a strong stream exists in marketing research concerning sales and Agency Theory concerning incentives and distortion of items directly related to revenue such as pricing and forecasting (e.g., Frenzen et al., 2010; Lo, Ghosh, & LaFontaine, 2011). This research confirms the Agency behavior, and extends the cost and the impact beyond issues of direct compensation.

*Intent to mislead* IV was constructed to measure level of deception. This concept may be familiar as the “level of guile” (Williamson, 1975) in which individuals cannot be assumed to respect the interests of the principal. An agent may not enter into a dialogue in good faith, and is willing to provide misleading information. Building on the work of scholars such as Bergmann and Fried (2008), who studied optimal incentive contracts for controlling moral hazard inside Development, the intent to mislead IV of this study discerned the extent to which agents outside Development are willing to mislead management. As one VP of Sales illustrated when discussing his own sales representatives, “If they feel they can over commit and put the company over a barrel, and manipulate the system, they will do that”.

These results indicate that in order to dampen opportunism, monitoring for patterns of misleading information by individual sales people might be needed. This remedy, however, assumes that the expense of monitoring is lower than the cost of tolerating opportunism (Williamson, 1985). It is not that management is unaware of the misleading activity, since CEOs reported it (e.g., “… definitely false alarms, claims
from the sales folks that I need it today; in fact that wasn’t true’). Instead, it may be that 
the full extent of the negative impact on innovation – the agency cost to the firm – is 
not understood.

This study builds on and extends extant scholarship by demonstrating the 
existence of a significant guile problem that originates from outside both the 
development organization and the extended development team. Guile – the intent to 
mislead – has been studied in development, but with an internal perspective. For 
instance, Smiter and Zhang (2010) focused on the issues of moral hazard and 
adverse selection when development managers mislead their superiors. The wrong 
development projects are chosen, or continue to be developed, because of incentives 
that increase the development manager’s willingness to mislead their superiors.
Devising incentives to reduce this intent to mislead within a hierarchy (e.g., Bergmann 
& Fried, 2008) have likewise addressed intra-organizational agency costs. This study, 
finds that, by ignoring external sources of guile and moral hazard, significant sources of 
adverse selection are not addressed. Thus, as the level of guile/intent to mislead 
increase in sales, the amount of exploration innovation development is found to 
decline.

**Goal Incongruence** The third predictor variable of the model, the goal incongruence 
construct, measured whether sales took the firm’s goals for development and 
innovation into consideration when advocating a new task for the development 
organization. Goal incongruence has been linked to sub-optimal decisions and 
agency costs (Rossetti & Choi, 2008) in many areas of the firm, including Development. 
Xie, Song, and Stringfellow (2003), for instance, specifically looked at goal
incongruence – across departments – in extended teams working on new products. This research stream tends toward understanding goal incongruence due to cultural issues or its impact on communications within cross-functional teamwork. Thus, this study helps extend the existing literature because, again, the unit of analysis goes beyond the extended project team. Second, it demonstrates a direct impact of goal incongruence on the artifact of innovation - the project. The results confirmed the hypothesis that when a sales force is perceived to be more congruent with the firm’s innovation plans, the exploration innovation plan remains more intact during development. The results fit with the case data, in which sales executives admitted that goal incongruence led the sales force “to push things into engineering by what you call your strategic or big prospects. Right, so you can make quota.” Elsewhere in the firm, such as engineering management, the goal incongruence was described as, “They’re not motivated by what my team delivers, they’re motivated by commission. It goes on a lot.” Again, the qualitative data provide internal validation to the regression results for both the extent of the problem, its magnitude, and the continual nature it.

It was surprising that interaction of the variables did not prove beneficial to the model. Neither interaction was significant nor did either increase the model’s R-squared. This result was unexpected in that it was postulated that information asymmetry might magnify the effect when working in concert with one of the other IVs. This idea was based on the supposition that, if the sales person had asymmetric information and high intent to mislead or goal incongruity, then adverse selection would intensify. Instead, asymmetric information produced positive results only when applied as an independent variable – meaning that it is additive. This seems to indicate
that sales opportunism is linearly combinative when the sales person also has better information. Simply having intent to mislead or different goals will suffice on their own.

More research to better understand this outcome, however, would be prudent, since Agency theory views asymmetrical information as closely related to adverse selection (Eisenhardt, 1989).

Analyzing the Disaggregated DV

Three components were combined to create the single DV used in this study (performance to original schedule, completeness of features, and quantity of projects developed relative to plan). Because these three parameters are often used individually as a measure of development performance (Ayse & Miles, 2011; Parry et al., 2009; Acur et al., 2010; Bstierler, 2005, Kessler & Chakrabarti, 1996; Patanakul, Chen, & Lynn, 2010), analysis was done on each measure as a DV against the opportunism model. The goal was to gain further insight into the effect of Agency Opportunism on more granular facets of development performance.

Three regressions were done – the agency opportunism model IVs against each sub-component – and each had significant results at the model level. The null hypotheses (the baseline for all regression p statistics is that no difference was present and there is no explanatory power of the model being tested) can therefore be rejected in each case; the opportunism model opportunism is linked to exploration schedule erosion, to feature erosion, and to fewer exploration projects individually.

This result has three implications. First, it adds to the validity of the DV construct in that the three measures, which are commonly used in development and product research, are all affected by agency opportunism. This relationship emerges when
they are analyzed individually and when indexed in combination. Second, each of the three regressions has a substantial adjusted R-squared. Over 30% of the variance in development schedule is explained by opportunism; over 38% of the variance in feature set completeness is explained, and over 13% of the decline in the amount of projects is explained. This result can extend the research streams that study development using a single measure such as schedule performance of new product development (e.g., Chen, Damanpour, & Reilly, 2010). Agency opportunism should be included as a potential factor in any performance measure used to measure development. Third, the results also support recent literature conclusions that these three factors [schedule, completeness, amount] are not in contention; in other words it supports the literature that questions the argument that as one factor improves the others would necessarily erode (Patanakul, Chen, & Lynn, 2010; Blindenbach-Dressesn et al, 2010).

While support for each of the three models, which considered the DV subcomponents is strong at the model level, few of the individual IVs were significant. This makes a deeper interpretation of the individual IVs difficult. It is important to the overall findings of this study, however, that each of the three components that were combined to create the single DV index had support.

In summary, the Agency opportunism model describes a relationship of delegation where agents in the sales force have better information concerning customers and prospective customers; have a willingness to mislead management, and have goal incongruity with the firm’s plan for innovation. As these three predictors increase, they will each hinder a firm’s ability to develop exploration innovation. The mechanism by which exploration is crowded out is interpreted to be that new
unplanned projects, advocated by Sales, take precedence over certain projects that were in the original development plan. In other words, Sales will request new development projects in order to improve the chance of making quota or commission. If Sales has better or hidden information, if the goals of Sales diverge from the firms goals, or if Sales has a willingness to mislead management, then decisions will be made that specifically reduce exploration development more than other types. Manpower is moved onto new development projects that help Sales secure customer opportunities and these developments are exploitive ones. Thus, sales employees will extract adverse development decisions from their relatively uninformed managers – and the result is that innovation of new products and for new markets is crowded out. When this information advantage, goal incongruence, or intent to mislead is lower, the firm’s exploration plans are more able to proceed intact.

The agency opportunism model explains approximately half of the decline in exploration that is observed to occur after the plan for development enters the Development department.

7.2 Hypothesis 2. Resource Dependence

The Resource Dependence model was formulated to test the hypothesis that specific Resource Dependence Theory-based tenets that are associated with buyer power are explanatory for the observed variation in the single index DV. Resource Dependence theorizes that firm dependence on external sources of resources shapes firm structure and firm actions (Glasberg & Schwartz, 1983). For instance, the case interviews exposed the pervasive nature of customer influence on development. As
One CEO put it, “prospects almost always request work … this particular issue drives the new product release schedule”.

The significance of the resource dependence models as having explanatory power on the single DV showed a consistent p value of 0.000. Therefore, the null hypothesis – that there is no effect – is rejected. Furthermore, the finding produces an adjusted coefficient of determination R-squared of up to 0.179. Thus, the resource dependence model is supported, and may explain about 18% of the variation in the DV.

As a model, the association between each of the three main effect resource dependence IVs and the DV was mixed; In the model with control variables, two of the three are significant, and when interaction is added, all three main effects are again significant. The standardized beta coefficients indicate that each of the three IVs has a similar effect on the single DV variance.

*Customer concentration* IV shows that the degree to which a firm’s customers are concentrated is predictive of the variation from development plans during development. Specifically, if a firm has only many smaller customers (i.e., a few customers do not dominate the bulk of their revenue), then management is less likely to remove manpower from exploration innovation projects than if a few customers provide a large portion of revenue. When a few customers are key to revenue, exploration is more likely to decline in development. This activity - large customer control of R&D efforts - was reported often in the qualitative phase of the study. As one VP of Engineering stated during the case interviews, when we “gotta do the big deal … product development slips”.
Research that incorporates the concept of customer concentration generally studies profitability, for example, major customers have bargaining power in purchases (Porter, 1998), but the research also proposes that having such important customers can foster information sharing, can help supplier firms with production, and may encourage feedback for product enhancements (e.g., Kalwani & Narayandas, 1995; Kumar, 1996; Kinney & Wempe, 2002). This study extends the conversation on how customer concentration can mold the internal activity of suppliers. It shows that the effect of customer concentration can go well beyond pricing, efficiency of delivery, and feature input.

Investments in new explorative technology have been found to not serve the needs of existing major customers (Bower & Gilbert, 2006). The finding of this study confirms that when a firm is dependent on a few customers, the demands of these buyers will sidetrack projects not directly important to their immediate on-going need (e.g., Henderson, 2006; Christensen & Raynor, 2003). Firms with only small customers experience no such crowding out. This result also supports the RDT outcome of Christensen and Bower (1996): that the need to address the product demands of large customers side-tracks innovation. It may be the first primary-data population or sample study to do so.

*Order leverage* IV has a beta of 0.18 and was also consistently significant in the models tested. This result demonstrates that the order size – the threshold at which a firm is willing to begin a new project in order to secure a purchase – will directly affect the variation in exploration development. Firms that are willing to do new, unplanned work for smaller orders tend to disproportionately reduce the amount of exploration innovation that their existing development plan calls for.
The result is intuitive. How large a new order needs to be for the firm to move R&D manpower to support it, directly measures the development shift. The more interesting outcome, however, is the inequitable impact of the shift: it predominantly compromises exploration innovation. The more firms are willing to begin projects to support small orders, exploration innovation declines. This result is important to literature because it implies two issues: first, the new projects requested by customers will be exploitive in nature and second, that when a shift of manpower is done in development, it is predominantly taken from exploration.

Case interview data supported the results of the regression. As one Board member put it, “The more demands you have from the customers, the more of your R&D is going to go toward satisfying those demands. The fewer, the more you can look out and say, ‘OK,.. Here's where we're going to innovate.’ Let's say you've got a release and the release includes some stuff that you've got to get to a customer, and it includes some innovation that can be pushed out another quarter. Then you're going to push out the innovation and you're going to get the stuff to the customer on time.” The new work is exploitive, and manpower is predominantly removed and reassigned from exploration.

Firms willing to move development resources for smaller orders correlated with reduced exploration innovation. In a development environment of fixed manpower (Wolff & Pett, 2006; Hewitt-Dundas, 2006), the more willing a firm is to undertake new projects that a customer requests, the more often manpower must shift. The assumption made by this interpretation falls in line with Christensen and Bower’s (1997) study, which was a unique application of RDT in innovation: that customers
will demand enhancements to existing products (exploitation). They do not value explorative innovations.

*Prestigious/reference accounts* is the third RDT IV. Certain customers can bring legitimacy or prestige to a firm; justification such that the firm is publicly validated or endorsed (Perrow, 1961). Legitimacy can thus be a resource dependency to be exchanged between parties (Pfeffer and Salancik, 1978), where each organization’s need for legitimacy can vary. Studies have addressed the importance of reference or prestigious customers in reducing the potential buyer’s risk and increasing the supplier’s credibility (Elfring & Hulsink, 2003). Much research studies reference customers from the perspective of their being an asset due to their prestige – therefore, they are resources from the RBV perspective.

This study both confirms and adds to the scholarship on resource dependence because it finds that this select category of customer (or partner) also has the ability to influence a company’s development plans. With a significant standardized beta of 0.271, firms that valued prestigious accounts more highly were linked to a decline in the amount of exploration they produced. The result shows that the more a firm is willing to move development resources to secure these prestigious reference accounts, the more exploration development is crowded out. When customers are more highly valued by firms because they are prestigious, exploration projects will be sidetracked.

The processes used by firms to obtain and leverage reference customers are not well understood (Sirmon *et al.*, 2007; Zander & Zander, 2005). The interpretation in this study links development to customer power in that, if firms need to acquire reference customers, they will add projects to the development priority list if it helps
secure them. The effect is once again twofold; exploration declines since the additional projects are exploitive, and the manpower that is reassigned comes from exploration.

When interaction was included in the analysis, the adjusted R-squared remained at a similar level, and the model also remained significant. Furthermore, the significance of the main effect IVs improved while their beta coefficients increased as well. The interaction IVs, however, were not significant. This means that while interpreting the model is unwarranted, it is interesting that, by adding an interaction between customer concentration and order leverage, the overall model has slightly improved.

The Disaggregated DV. Next, the analysis turns to interpreting the effect of resource dependence on each of the components that were used to create the overall DV. The null hypotheses (that no difference was present and there is no explanatory power) can be rejected in each case; resource dependence is linked to exploration schedule erosion, to feature erosion, and to fewer exploration projects. Nevertheless, only one of the DVs had an adjusted R-squared of a noteworthy size. Resource dependence explains over 12% of the decline of exploration innovation project work that is ultimately developed when compared to the original plan.

While each of these models was significant, however, the fact that not all IVs were significant in any model, makes deeper interpretation of individual IVs problematic. Again, this finding shows that dependency on certain customers impacts development on all three measures of performance, but mostly on the number of projects completed. The findings support the literature that indicates that these factors
are not in contention and as one factor improved, the others would erode (Patanakul, Chen, & Lynn, 2010; Blidenbach-Dresesn et al., 2010).

In summary, the overall results of each RDT model strongly suggest that an explanation for the decline in exploration innovation during the development phase should include the impact of resource dependencies. These dependencies influence the decision making of the firm relative to deployment of development manpower. The strong results for the resource dependence model is important because it implies that RDT can be a powerful theoretical framework with which to analyze innovation. The literature stream that applies RDT beyond the board and CEO level, however, should be considered as an area where scholarship is on relatively new ground. For example, a recent Journal of Management literature review (Hillman, Withers, & Collin, 2009) omitted products and development entirely and was organized with only five streams: mergers/vertical integration; joint ventures; boards of directors; political action, and executive succession.

7.3 Analysis of the Combined Model

The next phase of the testing was to analyze the combined model (Agency IVs and RDT IVs in the same regression) to discern if, when analyzed together, any patterns or relationships emerge that might enhance our understanding of the observed DV variance.

As with the single-tenant models, the combined model was significant and the null hypothesis is therefore rejected. In addition, the R-squared for each variation of the combined model was somewhat above that for the best single model (the Agency model) alone. In other words, by adding every IV to a single unified model, the
adjusted R-squared value was not greatly enhanced over the model for Agency alone. Therefore, while H3 can be considered as supported, theories are often considered best when they explain much with little, so any goal of parsimony is not enhanced by combining the models. This result tells us that it is better to apply each model individually rather than combined.

An important result to note, however, is that a hierarchy of explanatory power has consistently emerged from all the regression testing. Agency tenets have more explanatory power for the observed variance in exploration decline than do the RDT ones. Furthermore, each Agency IV is significant, where the RDT variables are not in every permutation that was analyzed. This result was not anticipated, yet it is consistently observed both in the single DV model and in the disaggregations that when combining Agency and RDT effects, the effect of RDT tends to disappear. The combined model supports the idea that the two effects are different and combining the factors tilts the effect to Agency. This speaks to the value of having two separate models to make estimates, based on the intent of the exercise. Nevertheless, the stronger influence of one set of variables and the stronger predictor of the one theory – Agency - is interesting. It is not that RDT has no value, but in an investigation of innovation problems, Agency is more likely to lead to stronger antecedents to development problems – meaning that Agency explains more about exploration problems than does RDT.

Nevertheless, each IV did better in the Agency model and in the RDT model when done alone than in the combined model, and the R-squared was not changed to any large extent. These facts, again, point the value of using each separately.
As a result of the promising R-squared of the combined model, new IVs (which represented interactions) were subsequently added to the model and tested. Testing of this model, however, (Agency Opportunism, Resource Dependence, and interaction effects between IVs) reduced the significance of all IVs even further, but held a similar adjusted R-squared and model significance. The results from the combined models and the interaction IVs were also not expected. During the theory building exercise, it had been considered that resource dependence and Agent opportunism, together, would tend to be used by agents in order to influence development. The conjecture was that Agents might exploit the opportunity whenever the firm required a certain resource. In other words, if sales knew, for example, that management desired prestigious accounts, they could use that information to personal advantage. However, the models appear not to support this hypothesis. Resource dependence proved explanatory, as did opportunism, but any combination of tenets resulted in weaker outcomes. The models that were based on individual theoretical tenets (main effects IVs), were deemed to be most significant at the model level and with adjusted R-squared values at a level to warrant the highest consideration. These models also had consistently significant beta coefficients for all the IVs theorized and tested.

7.4 The Dependent Variable.

The findings concerning the dependent variable are important for three main reasons: veracity, magnitude, and variance. First, The DV of this research is the difference between the firms’ original exploration/exploitation plan and the results of development. The definition of exploration innovation that was used in this research relied on a recent and strong stream of literature that classified exploration according
to the market and technology axes of Figure 1 (e.g., Danneels, 2002, 2007; He & Wong, 2004; Jansen, Van Den Bosch & Volberda, 2006). While the definition is now well established, the construct has not had widespread use in empirical studies.

This study used two methods, case interview and population census, in order to build theory and enhance reliability and interpretation (Mingers, 2001 and found that exploration innovation has an appreciably one-sided decline once the development plan enters R&D. This finding is important because while the construct of exploration for new markets was established in the literature, its development performance had not been studied nor its performance measured. The existence of a discrepancy in development had not been established.

The decline was first discerned during the qualitative phase of the research. Comments from managers at different levels and functions were indicative:

CEOs described how exploration is delayed: “We only have so many [people] and we have to prioritize. What gets pushed is anything that won’t bring in revenue this year.”

Engineering Managers described customer demands made on the current product: “the sustaining effort of the current product line, which is probably the biggest thing. It constantly interferes and destabilizes your predictability of the new program you’re on.”

The possibility of a consistent phenomenon within innovation was conjectured as a result of the qualitative phase, and was then subsequently assessed for existence and for magnitude. The resulting variance in the quantitative data collected from the questionnaire shows a significant and normally distributed variance, in that some firms experience a large imbalanced drop-off in exploration, while others were more
successful in achieving to their original plan. This research, through a population study of US-based SME software firms, found that exploration innovation for new markets/new products declined from plan, on average, by over 40% after the plan entered development. In fact, the finding was that, on average almost half of the exploration innovation that the firms planned to accomplish, was not developed. A 40% drop off in the development of new products or new technology for new markets is significant, in that it confirms and explains firm inability to react to changes in the marketplace as discussed in the literature (Henderson, 2006; Christensen & Raynor, 2003) in addition, it also helps explain why firms have trouble with delivering innovation in general (Kahn, et al, 2006).

Analysis of the variance in the DV showed a fairly uniform normal distribution with a wide standard deviation. This result is indicative of a more pervasive phenomenon. In other words, the measured decline is not restricted to high rates of decline in a few firms and low in the majority. Instead, the phenomenon is common to most firms in the population studied. This finding, that decline in exploration is widespread, would seem to increase the likelihood that the phenomenon is not restricted to the population that was chosen for the study.

A study result that shows any decline in this specific and important innovation construct has consequence beyond exploration/exploitation and into innovation research and development research. This study exposed a surprisingly large decline in exploration during development. Successful innovation has long been considered critical to company success, especially in early stage technology firms (lansiti, 1995; MacCormack, Verganti & lansiti, 2001; Sharma, & Lacey, 2004; Adler et al, 2009) and this finding not only exposes a significant drop-off, but also helps to pinpoint their
antecedents. These results have implications for both development scholarship and innovation scholarship. A mechanism of systemic crowding out of exploration by new, unplanned exploitation projects may be driven largely by Agency opportunism and resource dependencies. While this finding confirms established theory and addresses gaps in research, it also differs from literature that concludes that low innovation results mainly because firms do not plan for enough exploration (Levinthal & March, 1993; O’Reilly & Tushman, 2008; Rosenkopf & Almeida, 2003), and also from research that emphasizes deficits in capabilities, resources, or knowledge in development or in R&D teams as largely explaining innovation shortcomings (Eisenhardt & Martin, 2000).

Summary

In summary, the research described in this dissertation began by investigating innovation impediments in general, but turned to the planned balance of exploration/exploitation and variance to the plan that occurs during its development. Hypotheses to explain observed phenomena were transformed into two models, each of which was subsequently tested using statistical software to analyze the data gathered from a population census.

The results of the analysis support a conclusion that exploration innovation falls victim to “crowding out”. The decline during development ensues when new, unplanned projects take precedence over exploration. Moreover, the crowding results in an average decline of over 40% in exploration innovation during development relative to the original exploration/exploitation plan. This is important because most research concludes that firms that do less exploration innovation - for new markets and new opportunities - are tied to their existing industry/product life cycle, cannot
respond to market changes or disruptions, and have inferior financial performance (Benner & Tushman, 2003; Rosenkopf & Almeida, 2003). Firms must “devote sufficient attention to exploration in order to ensure the organization’s future viability” (Levinthal & March, 1993: 105). This study shows that, regardless of whether firms have the resources and capabilities to innovate or if they have plans for large exploration investment, they may fail to deliver the innovation they desire and plan for - and the innovation scholars recommend - because exploration is squeezed during development. The projects and products intended for new markets are crowded out as a stream of unplanned projects, which originate outside of Development, regularly crop up.

So far, answering the ‘so-what’ question has been initiated as well as what the results mean in relation to the extant literature. The next chapter, is a general discussion about contributions and their implications for theory and for practice, the limitations of the research, how this research ties into a broader research agenda.
Chapter 8. Conclusion: Contributions, Limitations and a Future Research Agenda

This dissertation is meant to inform both scholars and practitioners on important issues related to innovation, and the results reported thus far provide indications of statistical significance and their relation to the literature. This chapter aims to provide further insights for theory and practice.

Recent years have shown an increasing interest among academic researchers into the problems and the benefits of innovation. Most top journals – whether they have a focus on innovation or entrepreneurship, or whether they cover general business subjects – regularly featuring articles on innovation or exploration and exploitation. This research aims to extend that understanding. It began with the goal of investigating why managers report that the innovation rates at their firms are lower than they expected. It first focused on examining the issue of this reported innovation deficit, and became a study of how the intended plan for balance in exploration and exploitation changed once the plan entered Development.

The review of the extant literature showed a large stream of research into exploration/exploitation that focused on how the plan for a balance between the two constructs came into being. As such, it generally focused on the early stages of the process at the points of search, corporate planning, and project selection. At the opposite end of the spectrum, another strong stream of literature resulted from researchers studying how the planned ratio of exploration to exploitation would affect firm performance in the marketplace. This strategy-oriented perspective on innovation – strategic planning and firm performance – left significant research gaps. For instance, what is planned for development may have little impact on firm performance if the plan is not achieved.
The major findings of this research are fourfold. First, I find that while firms may plan for sufficient exploration, their ability to execute against their plan fails during development. There is a major shift in the planned balance of exploration and exploitation after the plan enters the development phase of business operations. This shift is reported by a large majority of firms. Second, this shift is predominantly one of moving manpower away from exploration projects and into exploitive ones. The reallocation is an ongoing one due in part to a steady stream of new, unplanned projects. Third, the shift was found to result from Agency Theory-based forces, and resource dependencies that together crowd out exploration innovation. Fourth, the crowding-out of exploration innovation is a result of activity that originates from outside of the development organization and external to any definition of an extended project team. Each of these findings is a departure from conventional scholarship propositions that deficiencies in resources and capabilities are at the core of development performance issues, and that low exploration innovation is mostly the result of a lack of balance taking shape in the planning stages.

**Contributions to literature**

This dissertation contributes by addressing gaps in the domain literature on exploration/exploitation, development, and innovation (including disruptive innovation).

First, it addresses the gap concerning the under-explored development phase that is currently missing from the exploration/exploitation perspective. While development is well researched (NPD, R&D, Innovation, etc), the exploration/exploitation literature does not address it. This study applies prior work on
the tension between exploration and exploitation, to innovation processes during the development stage. Exploration and exploitation have been described as fundamentally different directions that compete for resources (March 1991). Addressing existing demands has a tendency to bring about structural inertia, which reduces a firm’s capacity to adapt to changes or address new opportunities (Hannan & Freeman, 1984). On the other hand, addressing new alternatives may slow the rate of improving existing competencies, which may hinder a firm’s ability to compete in their existing market (March, 1991). Firms, therefore, must decide on the benefits and trade-offs of each, and then develop a strategy of balance between the two (He & Wong, 2004). This research makes an important contribution to the literature that explores this exploration/exploitation tension, by finding that any such initial plan which determines a balance is likely to undergo considerable change during development. In other words, even if management recognizes the need for both exploration and exploitation, and fashions a well-conceived plan, the plan is unlikely to survive the development stage. Exploration development will not meet the plan, as the exploration innovation component of the plan can be expected to erode significantly, as it is crowded out. Continual decisions to add new, unplanned projects to the development schedule or to prioritize the more exploitative projects is likely to occur as a result of resource dependencies and agency opportunism.

The possible ramifications to firm performance are multi-fold. First, firms have a more limited capacity than their plans might suggest, to innovate in ways that allow them to expand beyond their existing product and customer base. Second, firms are destined to stay closer to the industry life cycle of their existing product line. This ramification is particularly harmful in the mature and decline stages, and in instances of
market disruptions. Third, firms may expend far more investment capital on development that tailored to specific customers and prospects than is warranted.

The extant exploration/exploitation literature lacks conceptual and empirically validated understanding about any impact of the project development phase on outcomes. While the reasons for the existence of the gap are not clear, it may be that development is largely considered a “black box”. Once the design phase is over, the skills and resources inside this box are assumed to determine results (e.g., Garcia, Calantone & Levine, 2003). Such research concludes that successful development for exploration or exploitation projects requires similar development skills, and that development is analogous for both breakthrough and incremental projects (Griffin, 1997; Parry, Song, Weerd-Nederhof & Visscher, 2009; Goktan & Miles, 2011; Cooper, Edgett & Kleinschmidt, 2004; Kahn, Barczak & Moss, 2006). Therefore, extant exploration/exploitation research concentrates on activity prior to engineering, or on outcomes in the market after development is completed (Sidhu, Commandeur & Volberda, 2007; Li et al., 2008). This view posits that development progresses similarly for all R&D projects, and therefore a firm’s plan for exploration and exploitation outcomes would not be materially affected.

While it may be the case that R&D projects do, in fact, have similar performance if left alone to be developed, this research finds that different development project types may be treated much differently. The results of this study suggest first, that once an innovation project enters development, organization-wide decision dynamics do not stop. An open system approach was used in which actions that originate external to R&D were considered. The perspective posits that many diverse projects (exploration, exploitation, bug fixing, etc.) are often under simultaneous development
and compete for manpower. Furthermore, the results also suggest that development project priority and development schedules cannot be assumed as static after any plan enters the development phase.

Second, the results suggest that the changes made to the exploration/exploitation plan after it enters development are uneven. The exploration portion of the development plan (new product, new market) erodes by half. The development performance of this specific construct had not been studied in prior research, and therefore it had never been measured. A focus on these gaps (exploration innovation performance in general, and its development performance in particular) is important to research because the construct of innovation for new market/new product has been highlighted for many years as being particularly important (e.g., Benner & Tushman, 2003; Rosenkopf & Almeida, 2003). A finding that it shrinks by over 45% while in development, in an industry such as software, is compelling. The ramifications are that almost half of a firms planned new products for new markets may never occur. Through delay, deficit, or cancellation, projects would fail to be developed and delivered.

An additional contribution to the exploration/exploitation literature is in helping to refine the definitions of exploration. Exploration has had many definitions, and there are multiple meanings applied solely within the context of innovation. These innovation-related definitions have included technology-based definitions (Lavie & Rosenkopf, 2006); market-related definitions (Danneels, 2007); and levels of novelty (e.g., Bierly & Daly, 2007). This dissertation has furthered our understanding of innovation as an exploration concept, and has expanded our understanding of innovation by first adopting the four quadrant model (two dimensions of exploration
novelty – market and technology – and two dimensions of development novelty - exploration and exploitation - Figure 1, page 15), and then researching the construct of exploration for novel markets as the DV. It is surprising that this is the first study to do so, since exploration of new technology for existing customers would seem, *prima facie*, very different from exploration done for markets as yet unknown to the firm. For instance, the first has risk limited to development failure, since revenue is assured. The second adds revenue risk; development failure plus market failure.

A DV that measures the amount of market exploration that firms produce brings important insight for investigations of innovation. This research has shown that not all development projects perform equally during development, and not all projects on the development plan maintain their priority. The results of testing the hypothesized models indicate that new and unplanned projects, when added to development, will impact different types of development projects differently. Exploration development projects intended to initiate new markets tend to be crowded out in favor of shorter-term exploitation projects intended to satisfy buyers of existing products. One possible explanation for the discrimination against exploration projects could be that new products for new markets may have no hard deadline, and a less certain return on investment. As a result, when new urgent projects arise, managers must choose between delaying projects with guaranteed revenue and inflexible schedules, or delaying exploration innovation - uncertain novel markets and schedules whose delay is hard to monetize. The differing risk profile would be material to the management decisions.

**Contribution to Theory**
**Agency Theory.** Agency Theory is largely missing from both exploration/exploitation and innovation research, especially below the firm level of analysis. This omission is particularly notable given that over 20 years ago, in her widely cited 1989 review of the literature, Eisenhardt specifically recommended using Agency Theory as a lens for understanding innovation: “Topics such as innovation and settings such as technology based firms are particularly attractive because they combine goal conflict between professionals and managers, risk, and jobs in which performance evaluation is difficult.” (Eisenhardt, 1989: 71).

When Agency Theory has been applied to innovation, it has almost exclusively been at the CEO level, and has been used to analyze innovation investment decisions and CEO/owner alignment (e.g., Hillman & Dalziel, 2003). Thus, a gap exists in Agency Theory research for understanding issues of organizational delegation below the owner/CEO level. This dissertation makes a theoretical contribution to Agency Theory in three areas. The first is by extending the theory to the exploration/exploitation literature. The second is by extending the possibility of its application into R&D/development performance research. The third is by demonstrating that Agency Theory has a place well below the level of the CEO, and beyond the analysis of two-party contracting. Agency has a place in the analysis of dynamics and outcomes at all levels of firm hierarchy. Moreover, it should be considered when intra-organizational phenomena, such as the dynamics between peer organizations within the same firm, are the subject of study.

Another of Eisenhardt’s (1989) recommendations was to employ Agency Theory in conjunction with other theories, and thereby avoid a single-theory paradigm. Nevertheless, the prevailing single paradigm for studying both exploration/exploitation
and innovation is the Resource Based View (RBV) of the firm. This research has attempted to apply Agency Theory along with Resource Dependence Theory. What we have learned is that Agents with asymmetric information on a firm’s dependent resources (e.g., the magnitude of a potential customer order), may potentially act on these asymmetries to accomplish self-serving goals. While this relationship was strongly and consistently exposed in the qualitative interview phase of the research, it did not materialize as strongly in the subsequent testing. More investigation of the possible interrelationships of the two theories is warranted, however, and is an avenue for potential future investigation.

**Resource Dependence Theory.** This research adds to the extensive body of Resource Dependence Theory literature. Resource Dependence Theory (RDT) asserts that resources outside the firm are fundamental to its survival and performance, and they shape firm structure, boundaries, and internal activity (Pfeffer & Salancik, 1978). As such, resource control and access is a primary mission of organizations, and its main ongoing activities as well as the structure of the firm will reflect this mission. Yet the literature that references RDT in the context of development and innovation is limited.

Christensen and Bower’s (1996) work on the consistent failure of dominant firms to respond to episodes of disruptive technology is a major exception. A recurring pattern is described in which incumbent firms lose their dominant market position and new firms rise to prominence, whenever disruptions occur in the marketplace. Businesses fail to remain leaders because they respond to their existing customers’ demands instead of innovating (exploration). Resource dependency on their existing important customers starved innovation investment. Customers demand the
enhancement of existing products (exploitation). “The demands of a firm’s customers shape the allocation of resources in technological innovation - a model that links theories of resource dependence to resource allocation” Christensen & Bower (1996: 197). This study extends the Resource Dependence literature concerning innovation because it takes the theory beyond its historical focus on episodes of disruption.

RDT, when it has been used in the study of innovation, has focused almost exclusively on such disruptions (e.g., Tripsas, 1997; 2009; Danneels, 2002). But assuming that resource dependencies will preclude innovation only during those occasional episodes when a notable disruptive innovation occurs, is questioned by this study. The model of resource dependence that was tested by this research would lead scholars and practitioners to a very different conclusion. The model clarifies a systemic and ongoing crowding out of exploration innovation, with an 18.5% (adjusted R-squared of 0.185) decline in exploration that is accounted for by resource dependence variables. Importantly, none of the main effects IVs is episodic in nature. In other words, the resource dependence model’s results were based on persistent factors: customer concentration, importance of prestigious accounts, and the point at which an order’s size would influence development change. This result implies that it is purely coincidental that major disruptions occurred during times when decisions were made to starve exploration investment (as in Christensen & Bower’s disk drive industry study or Tripsas’ (1997) typesetting study). This research indicates that the processes and decision-making that shift innovation to the demands of existing customers – and away from exploration – are always strong. They are constant, not episodic, and explain on-going exploration innovation shortfalls. The occurrence of market
disruptions, therefore, may simply intensify the consequence of these perennial decisions to crowd out exploration.

**Methodological Contributions**

Some contribution to method was made by combining a qualitative and then a quantitative phase, together in the same study. The progression of the mixed method approach, one to build theory and then one to test the hypothesis, showed the importance of field research to expose phenomenon and gain a rich understanding of it. But one method was not assumed to provide confirmation. Immediately testing the hypothesis with a quantitative phase was important to test the validity of the qualitative findings. Conversely, having extensive field notes provided the ability to more fully explain results as viewed through the eyes of managers. If the research had relied on one method alone, confirmation, enhanced validity, and rich explanation would not have been possible.

**Implications for Managers**

In addition to theoretical contributions, this research can inform management practice. The study is important to practice because of its explanatory power for the low rate of exploration innovation. The research finds that effects of Agency and resource dependence may be foundational to the low exploration innovation rates regularly reported by managers and scholars (Li, Lin, & Chu, 2008, BCG, 2006). The results of this study directly address management’s disappointment with their own expected innovation outcomes.
This study predicts the following: that when a firm’s development plan enters R&D, it includes a list of projects - a small percent of which would fit the description of exploration innovation. Those exploration projects would continually, on average, perform worse that the other projects on the list; later completion to schedule, feature set more diminished, or more projects indefinitely delayed. While managers may not recognize that factors outside the R&D group have a major or even primary impact on this innovation performance, this study suggests otherwise. Managers should be aware that their future products and innovations can be crowded out. The resource shifting from exploration to exploitation during project development could be substantial.

This reduction of exploration innovation has broad implications (Bayus, Erickson & Jacobson, 2003; Tabrizi & Eisenhardt, 1995). Guarding against adverse selection due to Agency or RDT dynamics may need heightened management vigilance. Likewise, due care when making changes to development – by adding unplanned projects and delaying projects already underway – should be a concern, and treated as an on-going process versus a “one time” or exceptional event. In other words, the on-going stream of requests for new or urgent exploitation projects should not be viewed as extraordinary, but instead as a persistent reason for exploration innovation development delay or failure. Managers should have a formal rather than an ad hoc approach to requests for new and unplanned priorities. Thus, the greater a firm’s reliance on explorative innovation for future performance, the more the problem of “crowding out” needs to be recognized and managed.

The strongest model developed in this study linked exploration performance decline with sales force opportunism. Practicing managers should consider using this
model as an aid when reviewing reasons for changing priorities and removing resources from exploration projects that are already underway. If the goal of a firm is to increase the rate of exploration innovation outcomes, the models tested in this study may provide guidance and metrics that can help discern if a crowding out problem exists in their organization.

Limitations of the research

The conclusions from this research are subject to a number of limitations relating to both method and theory. A number of these issues were first raised in the methodology chapter.

Methods

The method used in this research was a combination, initially of a qualitative phase, followed by a mail questionnaire to an entire population, the results of which were analyzed quantitatively.

Qualitative Phase: While a number of cautions were discussed in Chapter 3, the qualitative phase of this research was also limited by the number and geography of the data points. In-depth access to multiple top managers of the kind that this study was able to attain is often difficult, and the contacts utilized were not selected via random sample. Interviews were initiated via a snowball approach and through personal contacts.

The qualitative nature of the interviews provided depth of information and insight, and provided information that was critical (and unexpected) at the initiation of the research. However, although the data gathered were checked and triangulated at
multiple firms and with multiple informants, such validation is not foolproof. Independent verification - additional interviews conducted by researchers unrelated to this study - would help with validation.

Quantitative Phase

The quantitative phase of this study was a census, performed via mail questionnaire followed by analysis. While the mail questionnaire methodology is widely used and accepted in innovation research, a discussion of the limitations and the steps used to mitigate them is nonetheless warranted.

Population. This was a population study that used a specific population of US-based SME software product organizations. Therefore, generalizability of any conclusion is limited to this population. For instance, large firm practices, such as isolated projects (e.g., sequestered engineering teams, or dedicated projects), are out of the scope of this research. Furthermore, while very small firms (1-9 total employees) represent a significant portion of all software enterprises, they were also precluded since having a defined organization structure and hierarchy were deemed important to this study. Therefore, while the results appear intuitive and expansive, generalizations beyond the population described should be done with caution.

Mail-based Questionnaire. Mail questionnaires are often used in business research and broadly accepted as a legitimate methodology. Crook, Shook, Morris and Madden (2010) found that over 40% of studies on entrepreneurship used the survey method.
Much other research is based on shared databases using secondary data that is gathered from annual mail surveys. Nevertheless, limitations need to be considered.

**Response.** This research used a population census (of firms), so the degree to which findings vary with different samplings is not relevant. There is no sample confidence interval because all observations were selected. Variance due to response rate, however, is a critical factor (Archibugi & Sirilli, 2000) as some recipients will not reply, or may not be present when the survey is mailed. Studies at the organizational level typically have lower response rates (Cycyota & Harrison, 2006) than those for individuals. Organization-level mail questionnaires have typical response rates approximating 20% (e.g., He & Wong, 2004). While the response rate achieved by this study was over 20%, and meets the current publishable standard (Baruch & Holtom, 2008), it should be remembered that over 70% of questionnaire recipients did not respond.

**Bias** is the degree that findings fail to reflect what is actually happening in the population for any reason. Non-response bias occurs only because specific types of potential respondents fail to reply. Nevertheless, non-response does not indicate nonresponse bias (Groves et al., 2006). Even if response rate is low, non-response bias may not exist. According to Fox and Tracy (1986: 9), only “when these differences are related to criterion measures, may the results be misleading or even erroneous”. In other words, those firms for which a response was received must be different in some way that is relevant to the research. In our population of firms, there is no a priori reason to believe that any class of firm would be less responsive and therefore be
different. Nevertheless, it is not possible for us to fully know if certain segments responded at lower rates than others did because it is not possible to know all the possible variations by which we could classify firms.

**Question bias.** Question misinterpretation or question bias (Iraossi, 2006) is partly avoided by not asking opinion-based questions when seeking facts (e.g., “did your firm introduce any improved products?”). Construct validity - conclusions based on questions that measure what they intend - is also critical to any meaningful results. Getting input from experienced researchers - review of the questionnaire - who are unaffiliated with the research program has alleviated some issues of construct validity and bias (Converse & Presser, 1986). Pre-testing, review, and analysis also helped, but the full elimination of question bias and full construct validity is uncertain.

**Common Methods Variance (CMV).** Introducing methods bias in the questions is related to how and what measurement is done (Campbell & Fiske, 1959; Cronbach & Meehl, 1955), such as using a single questionnaire to assess two related factors with possibly divergent responses. Respondents may give socially desirable answers or cognitively consistent responses versus telling the truth. CMV is less applicable to this study, but not ruled out, for a few reasons. First, CMV is caused by measurement approach, (the technique used to gather the data) and not the constructs of interest (Campbell & Fiske, 1959; Cronbach & Meehl, 1955). Without linked questions, the relationship between two constructs is not entangled. Second, the relationship between operations and performance has been found relatively independent of common methods bias (Berlinger, Glick, & Rodgers, 1988; Glick, Jenkins, & Gupta, 1986).
While respondents are relatively less inclined to social desirability effects when they are responding for the firm, and not for themselves (Nunally & Bernstein, 1994), single-source bias is still an issue. Each respondent to the questionnaire was acting as an informant for team behavior. Single-source bias in this study is moderated because 1) respondents were generally representing a small SME team and so were not attempting to aggregate the behavior of large groups, 2) respondents were reporting on directly observed activities and 3) respondents were limited to top management and so were in a position to have good knowledge of the pertinent activities.

Nevertheless, it is possible that they were not accurate. Future work could collect data from a broader range of employees to more comprehensively capture organizational activities.

A constraint of this study is the use of a single survey to capture cross sectional - single point in time - information. Alternatively, a study could be structured so that the practices studied at one point (i.e., goal incongruity) are sequentially linked to the outcome measures of development. In other words, future research could measure these practices longitudinally.

Theoretical Limitations

While the basis for the theoretical frameworks employed in this research (Agency Theory and Resource Dependence) is well established, much caution is needed in interpreting the results. Both Agency and Resource Dependence have decades of use and study, and their merits have been broadly tested. However, there is risk in applying theories in novel settings or in a novel application. Agency has very limited use below the level of CEO or outside of contractual research. Its application on innovation has a small literature stream. That resource dependencies shape
organization form and action is also established in literature, however its extension into exploration/exploitation balance is without a precedent. These limitations are important to consider since many of the variables and constructs had no prior examples in literature for guidance to this study.

Possibly the largest obstacle faced by this research was the lack of a prior research stream that directly coincided with the research questions or the domain of the study. This lack of precedence, however, also represented an opportunity, as novel approaches were required in at least two areas: construct building and data gathering. Nonetheless, construct building is a possible problem, because a construct is supposed to clearly and obviously measure a specific concept. In each of the models developed (Agency and Resource Dependence), the concepts had little guidance from prior literature. Concepts had to be linked to theoretical tenets, and then these tenets had to be specifically formulated to encompass the variations and the relationships that were observed. For instance, Agency Theory has a basic assumption that agents possess better information concerning matters related to their task than do principals (Eisenhardt, 1989). But in every circumstance, this information asymmetry is formulated differently. Contracts between firms and suppliers include information asymmetry, as do relations between boards and CEOs. These concepts of asymmetric information have a long and well-accepted literature (Akerlof, 1970; Bromley, 1989). Asymmetries in information between a sales force and company management, however, do not have a literature that provides guidance. This is one example of a concept and a construct that required pioneering effort to construct. Such efforts, without precedence or guidance, are a limitation for this study.
Related to this problem of construct precedence is operationalization and research method. While much prior work was incorporated in forming questions (e.g., Morgan & Hunt, 1994) for the census, there was little precedence for gathering data on agency tenets or resource dependent tenets in the context of product development, nor on the influence of agents who are external to the development team. The study relied on a grounded theory building (Glaser & Strauss, 1968; Strauss & Corbin, 1990) approach in order to understand and develop core concepts. Much research exists which helped with development performance criteria (e.g., Bloom & Van Reenen, 2002; Kleinschmidt, de Brentani & Salomo, 2007; Perry et al., 2009; Bstirler, 2005). Yet the questions contained in a questionnaire determine the ultimate validity of the variables. It is hoped that scholars will spend time reviewing how the tenets of this dissertation were applied, as well as how they were transformed into questions in order to improve overall validity for future research in this domain.

Conclusion

The ability of firms to innovate has been considered central to the long-term success of firms (Iansiti, 1995; MacCormack, Verganti & Iansiti, 2001; Sharma, & Lacey, 2004). Yet although research on innovation, and on finding the antecedents to strong innovation and new product development performance has spanned many decades, failure is reported with regularity. Most executives describe being unhappy with their own firm’s innovation performance (BCG 2006).
The amount of exploration innovation that firms produce, however, remains below what scholars recommend for superior long-term performance (Belderbos, et al., 2010). The past few decades of research on exploration and exploitation held out the promise that outcomes would improve when ‘best practice’ was applied in the planning stages (e.g., search and portfolio selection), and ambidextrous development policies were adopted (Medcof, 2010). The far-reaching literature on product development practices - especially resources and capabilities based research - gave hope that advances highlighted in the literature might be used to improve the innovativeness of firms. Antecedent skills required in the development department, or characteristics of project leaders, teams and even senior executives seemed to hold the keys to better, ever-improving outcomes (Greve, 2007; Lavie, et al., 2010).

Yet the existence of the low innovation and low exploration phenomenon has persisted in research up to today. Little improvement seems to have been made, and the intractability of low exploration has a doggedness that has been virtually inexplicable (Belderbos, et al., 2010). Strangely, well regarded organizational theories - Agency and RDP - had not been applied to this problem. Therefore, the most important insights that this dissertation has added to the conversation on both exploration/exploitation and innovation, is the idea that theories of organizations - alternatives to RBV - may be of assistance in helping scholars to explain, and possibly predict issues of innovation deficiencies. This dissertation has only used two such theories, and has only addressed a narrow component of innovation. Decisions that emanate from the firm’s external environment and from outside the R&D department, can influence innovation performance outcomes by shifting development manpower.
This study has results that contribute to existing research in several important ways. First, it provides evidence that the shifting of resources from exploration and into exploitation during the development stage is a significant, regular, and on-going phenomenon. Second, exploration projects exhibit markedly worse performance than do exploitive ones. Third, those firms with higher sales opportunism and resource dependencies may have significantly more exploration innovation decline during development than firms that do not. Fourth, the dynamics that result in the shifting of resources originate external to development, the development hierarchy, and the extended development team. These ideas have been absent in from prior literature.

This research also adds to the organizational literature by highlighting the influence of Agency dynamics at lower levels in the firm (and from adjacent levels in the organization structure), and its impact on product outcomes. As such, these findings substantively diverge from two prominent literature streams on innovation. The first stream is that exploration/exploitation balance is largely determined in the planning stages of strategy, and then shepherded through the many stages of creation (e.g., Ahuja & Katila, 2004; Lavie, et al., 2010). The second is that the root causes of innovation development problems (NPD) can be found in the resources and capabilities within the firm’s R&D group, or in the infrastructure that directly supports development (Brown & Eisenhardt, 1997). While this study does not reject these issues as problem sources, what is does argue is that their predominance should not be presumed when compared to Agency and Resource Dependence effects.

Future Research
This dissertation has investigated innovation performance during the development phase with a focus on the balance of exploration versus exploitation. Explorative innovation was defined as those projects intended for markets that are new to the firm, as opposed to changing technology for use within the existing business. The study first investigated the performance of these projects and determined that variation in project performance was closely linked to processes originating outside of the development organization. Processes were hypothesized using established theory, and then models were constructed to subsequently test each hypothesis. The research resulted in a new set of variables – both IV and DV – that may help scholars and managers to better understand how exploration and exploitation is managed.

Because of the novelty of the theories employed, the constructs devised, and the study’s focus on the development phase of exploration/exploitation, this research provides several potential new avenues for future research, examples of which follow in the next sections.

Theory

Agency Theory was particularly important in this research. However, other than a paper by Eisenhardt (1995), a synthesis of Agency Theory was lacking in literature. Scholarship on where the theory has been applied over the last 25 years, extension and clarification of tenets, and the empirical results would have been of great assistance to this study. Therefore, I believe that conducting such a review would make a contribution to the work of future scholars.

A second Agency Theory related research agenda would be to study the impact of Agency tenets on levels other than CEO/Board interactions. First, there is
scant research below the level of CEO. Empirical study of Agency in a myriad of delegation settings at lower levels of the firm would broaden the understanding of Agency Theory. Additionally, actions between principals and agents in one department can subsequently affect decisions made within organizations that are “third party”. For instance, this study has shown how agency dynamics between the salesforce and the CEO could ultimately have project priority implications within the Development department, and could ultimately impact innovation outcomes. Although most Agency scholars focus on the agency costs that result directly from principal and agent dynamics in matters of delegation, this study shows that activity in instances of delegation produces agency costs in seemingly unrelated work efforts.

Research that combines Agency and other organization theories was recommended by Eisenhardt almost 25 years ago, along with suggestions for more use of the theory in innovation research. While few studies have followed her advice, this dissertation made small steps toward combining the two theories of Agency and Resource Dependence by testing interaction effects, as well as testing a combined model. However, even though results from the qualitative interviews had promising indications that the two theories interacted, the quantitative results were not supportive. One conclusion is that further effort could be directed at more precisely defining interactions. This study was limited in its attempt to find interactions between the theoretical models. In other words, each model’s design and its related variable operationalizations were intended to test one theory. No variables or models were purpose-driven to measure or test cross-theory interactions, which should be a consideration for future research.
Finally, both of these well-established theories can be applied more broadly to innovation research. For instance, expanding the study beyond SMEs and beyond software firms is an obvious avenue for future research. Furthermore, the results of this study should be tested for cultural consistency. There is no evidence to support or refute that the results found in the targeted US-based population would hold in any other international setting. The results arising from this study, while important, cannot be assumed to be generalizable to other industries, firms, or countries, without testing.

Obviously, alternative theoretical approaches could be added to the research. For instance, to what extent is the inherent riskiness of exploration projects explanatory for why those projects are compromised during Development. Specifically, one avenue of study is to gauge the perceived riskiness of each project, and then determine any correlation between perceived risk of failure (either market failure or technology development failure) for explorative innovation and the variation in project performance decline while in development.

**Constructs and Processes**

The constructs and processes that were defined and used in this study were novel. Therefore, they are far from general acceptance and far from full validation. One obvious area of further research is to gain a better understanding for the processes that have been theorized and operationalized. All variables could gain from better definition in constructs and operationalization. Having results from the theory-testing phase of the research, therefore, suggests that a return to the genesis of the research is in order; the processes that were first observed need to be re-examined for completeness and accuracy in light of the testing phase results. The theory-based
tenets that were applied to form the constructs that made up the two models (Agency and Resource Dependence) need to be re-evaluated, validated, or modified. Just as importantly, how these constructs (e.g., asymmetry of information; customer concentration; exploration plan) were operationalized was novel and likely in need of modification. It would be especially helpful if researchers with grounding in Agency and RDP could extend the study, or expand on the definitions of the variables.

**Innovation**

The dependent variable of this study centered on the degree to which the plan for exploration innovation changed after entering the development stage. While strong evidence was found for a decline of exploration innovation, no data were gathered as to the ultimate effect on firm performance. In other words, firms shift their planned balance of exploration/exploitation during development – and crowd out innovation – to differing degrees, but we have no evidence to determine which firms have better performance: large shifters or non-shifters. We have determined a specific DV to measure development performance for this research, however we cannot assume that shifting of resources away from exploration is the wrong choice for overall firm performance.

A promising avenue of study, therefore, is to investigate whether firms that change their development plans, or shift their manpower away from exploration innovation perform worse or perform better (measured in terms of e.g., profit, market share, etc.). This line of inquiry follows two surprising issues that were uncovered in the qualitative interview stage of the dissertation. The interviews consistently showed that CEOs generally do not know how much development resources have been
deployed by category. In other words, they do know how much manpower is dedicated to individual products, but they do not know – and no one tracks – how much development resources are applied to items such as bug fixing, versus exploration, versus customer specials and the like. This lack of understanding would be a fertile area for research. Questioning those closer to development (e.g., VP of R&D) as well as the CEO, to contrast any differences in knowledge accuracy concerning exploration plans and changes to those plans could help in better understanding this phenomenon.

Another step, which would help determine the degree to which exploration changes during development, and the reasons for it, would be to analyze actual changes in historical development schedule records at selected (software) firms. Past R&D schedules, as they change over time, could be analyzed to compare the first schedules that are created to address the firm’s original plan, with the final schedules that are ultimately recorded. Comparing the planned resource allocations against actual resource use would help triangulate the movement of resources, the cause of the movement, and would help accurately gauge the magnitude of any exploration decline.

Understanding more about the roles of managers and employees who are involved in the decisions to shift resources is a further research topic. For instance, the management levels at which the decisions are made is unclear. The CEO, project leaders, and VP Development, for instance, are all aware that changes occur but where and how the decision-making occurs is unclear. In addition, firms report widely different degrees of Agency dynamics, such as more opportunism in their sales force (e.g., more intent to mislead in order to shift development priorities). Researching why
some firms report high levels of opportunism, while others report none is an interesting research question.

These lines of inquiry could all greatly benefit from additional perspectives on the DV and on the accuracy of the results arising from this study. A question remains of whether this shift, observed so strongly in software firms, is indicative and systemic across industries. For instance, future research could begin with qualitative interviews to discern why the Agency model proved to be stronger than the resource dependence model. It may be an anomaly that is restricted to the population of SME software firms used in this study, or it may be a consistent issue for firms in many industries. Extending the study to an industry with a very different profile would allow a comparison of results.

Summary

The results of this research are restricted to patterns of exploration/exploitation during the development phase of software products. The research supports the overall hypothesis that the balance of exploration to exploitation generally shifts away from exploration during development, and it exposed Agency-based and Resource Dependence-based mechanisms that are the antecedents to the shift.

Management literature contains many studies that focus on innovation at the project, team, and firm level - looking at the foundations of failure as well as success. But the prevalence of Agency Theory and Resource Dependencies on either phenomenon, and the outcomes generally associated with such projects, have not been previously established.
The initial objective of this study was to gain an understanding of why innovation is reported to be low in firms. It examined the influence of Agency tenets and Resource Dependencies on the shifting balance of exploration and exploitation, while such projects were in the development (R&D) phase of creation. The results of the study show that it is more likely to find a firm with a relatively high level of such resource shifting (from exploration and into exploitation) when sales opportunism is high and resource dependencies on powerful customers is large. This result implies that the effect may dissipate with firm size beyond the sample used in this study. In other words, SME’s may be more likely to suffer from a crowding-out problem than are firms in industries where scale economies result in larger firms and smaller customers. The results, however, are in line with what the tenets Agency Theory and Resource Dependence Theory would predict: agents will seek a mechanism to realize their self-interested goals, and firms’ actions are determined by the resources perceived to support survival.

Overall, the research has probed what happens to projects during development, and has shown that significant differences exist between innovation plans for development and the amount of that plan that is accomplished. The study has its limitations – as does all research – but it makes a contribution to theory by using Agency and RDT in novel ways and to exploration/exploitation research by examining the overlooked phase of development. The next stage in the overall research program is to look more deeply into how firms perform exploratory innovation, and extend the focus of a more “open system” approach.
Appendix 1: Study Questionnaire

Section I: How Do Your Technical People Spend Their Time?

Please estimate the percent of time R&D devotes to each of the six categories below, with a total of 100%. Include all R&D time, but not the time spent by your QA department.

1. Improvements to existing products (other than new features):
   - Bug fixes:
   - Improving scalability, flexibility, speed:
   - Cost reduction (i.e. reduce support or testing cost):
   - Ease of use, installation, change documentation or licensing:
   - Port to a new platform or OS, integration with or linking to third party products:
   - ____________

2. Feature changes/aditions for specific customers, prospects, or partners:
   - Customer or partner specials – even if added to regular product later on:
   - (Please include existing and potential customers or prospects):
   - ____________

3. Matching a current competitor’s feature or product:
   - That you did not include in your answers in 1 or 2 above:
   - ____________

4. New Features & products; not for any specific customers, prospects, partners:
   - New innovative products – not just a “me-too”:
   - New innovative features on existing products to enter new markets:
   - ____________

5. Changes for your development environment:
   - Adaptation to changes in items used in your products or used to develop it (new versions/updates in Windows, hardware drivers, etc.) Items required to “co-exist” (solve network issues, co-resident software conflicts, etc.):
   - Finding new suppliers or integrating them:
   - ____________

6. Other:
   - Helping Support with customer diagnosis:
   - Giving training or attending training:
   - Supporting the firm (helping IT, sales calls, web site work):
   - Other (please list) __________________________________________
   - ____________

Please adjust estimates so that your total is 100%.

TOTAL ____________

- Approximately, how many times per month do you receive ANY requests for changes/additions to existing products (from customers, prospects, partners)? ____________
- Approximately what percent of annual revenue is from your largest 10 customers? ____________
- Approximately how many times per month does the R&D Department investigate or begin projects (of any size – even small changes) or shuffle priorities due to a customer, prospect, or partner? ____________
- Out of 10 new orders, about how many on average would you expect to create engineering work – actual development or R&D just investigating the request? ____________
- At what percent of quarterly revenue is an order large enough that you will do R&D work (change schedules or add a project) if it is needed to win the deal?

Section II: Projects & Performance

Please think about significant R&D projects (roughly 3 man-months or more) of the last 6 months. Separate them into those done for a prospective customer, a customer, or partner versus new products or features with no partner, prospect, or user waiting.

1) Projects done R&D a prospect, customer, or partner (also include those added to core product later):
   a) What percent finish 2 months or more after the first projected completion date? ____________
   b) How late do they average ± percent longer than first planned release date (i.e. 2 months on a 6 month project is 33%)? ____________
   c) What percent of features are missing? ____________
   d) What percent of features are weaker than planned? ____________

2) New products or features with no partner, prospect, or user waiting,
a) What percent finish 2 months or more after the first project-plan completion date? ______%

b) How late do they average - percent longer than first planned release date (example: 2 months late on a 6 month project is 33%)? ______%
c) What percent of features are missing? ______%
d) What percent of features are far weaker than planned? ______%

Section III. New Customers & Partners

Compare new accounts for which development was done with new accounts that buy standard.

1) For new accounts for which development was done (include accelerating projects planned for later).
   a) What percent of these are well below what Sales promised (for revenue)? ______%
   b) What percent of these orders arrive later than Sales promised? ______%
   c) What percent do not turn out to be as important for the business as sales described (e.g., “it will open a new market” or “everyone customer this firms lead”)? ______%

2) For new accounts that bought standard product
   a) What percent of these are well below what Sales promised (for revenue)? ______%
   b) What percent of these orders arrive later than Sales promised? ______%
   c) What percent do not turn out to be as important for the business as sales described? ______%

• Total employees in firm
• Annual revenue ($MILL)
• Number of engineers in R&D (not including QA)
• Approximate number of customers your firm has:
• Approximate average sale (%) of your products (average customer purchase):

Section IV. Scale Questions

Strongly Disagree

1) Sales may overstate order size when they want R&D to do a project or accelerate work that a customer or prospect wants.

2) Sales may give optimistic dates for when an order will arrive should they want R&D to do a project or accelerate work that a customer or prospect wants.

3) Sales may overstate the importance of the account when they want R&D to do a project or accelerate work that a customer or prospect wants.

4) Sales may overstate the odds of winning an account when they want R&D to do a project or accelerate work that a customer or prospect wants.

5) Sales may withhold or overstate information to get R&D on a project that will help them win an order.

6) We may add a project or change development priorities in order to land prestigious accounts or partners (i.e., famous/well-known firms) because it sends a favorable signal to the board.

7) Development priorities may change or we may add a project to land orders that help meet or exceed the firm’s revenue target (e.g., expected by the board).

8) We may change development priorities or we may add a project in order to land very large accounts because it sends a favorable signal to the board.

9) Winning prestigious accounts or partners is important to our investors.

10) Having prestigious customers helps us win new customers.

11) Winning new prestigious customers or partners increases our valuation.

12) Having large-size orders increases our valuation (versus same total revenue without large orders).

13) The need for equity investment influences the decision to make product changes or add a project in order to land a large order or prestigious partner or customer.

14) Sales will suggest taking a booking without considering the impact on development plans or schedules.

15) Making commission is a Sales’ priority without considering impact on ongoing development projects.

16) Making quota is a Sales’ priority without considering the impact on ongoing development projects.

17) When Sales needs R&D work to land an order they do not consider the impact on development projects.

18) How much R&D is redirected from (category 4) new product development project in any given month, (e.g., due to existing customer demands, work to land a prospect, customer emergencies)?
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**Note:** The table above represents a correlation matrix of study variables.
Appendix 4. Interview questions that guided the qualitative case discussions.

**General Questions**
How large is your largest customer – order wise?
How many people buy directly from you?
What is an average order?
How large is the firm, use any measurement you are comfortable giving:
- Number of customers?
- Number of employees?
How long have you been in business?

**Questions for CEO**
**RD in general**
Do customers regularly ask for features or changes? How often?
Are these customers or prospects?
How do you decide which ones to do?
Who gives you information on it? (Support, Sales, Dev, Mktg)
Can you tell me about a larger one?

What drives you to take deals with strings attached?
How big does the deal have to be to influence you?
Does this change during the year?
Is it because of the customer, tell me about sales involvement?
How much does it matter if you are behind revenue plan at the end of the quarter?
Do customer orders and request arrive evenly during the quarter?
If not - what is the pattern? Why is that?

How often do bugs flow in?
How often do they have a potential to impact revenue?
Are these customers or prospects?
How do you decide which ones to do?
Who gives you information on them? (Support, Sales, Dev, Mktg)

How often do you have potential partners arise?
How often do partners who want you to do something to the product?

**Firm Goals**
How are the quarterly revenue numbers set?
What are the outside investors looking for? Why are they looking for this?
What is their time horizon?
What valuation increase do they want?
What things – like company performance or technology - do they think they need to get there?
What about big names? Customers or partners? How important to the investors/owners?

**CEO Goals**
What is your vision for the company in 2 years? 5 years?
What is key to get there?
How about when the current investors are gone? What changes for you?

Can you tell me, generically, about compensation?
How is sales reps’ compensated - % commission & bonus? What are the repercussions of missing quota?
Sales VP? CEO?

Customers - new orders
How do promised orders compare with what you end up with? Are sometimes smaller or bigger or later or earlier than promised?
How about the ones with special requests attached. Why is this?
What is Sales role in getting the company to respond to these offers?
Tell me about sales accuracy on this.

Customers - bugs
Are bugs accurately portrayed by sales when they affect one of their customers?
Why would that be?

Owners & board
I read you have X external board members. Who are the rest of your board members?
How do outside board members view larger, bigger Impact, more radical, Innovation projects?
How about relative to smaller, more regular innovation that is more guaranteed to bring some revenue?
Do Managers view them differently?

Growth and valuation and exit. Where are the differences between you, management, and board/owners??

Innovation Plan
How is the Innovation strategy set? Like major goals and R&D budget?
What is the Boards role? Who has biggest input in management? What type of things are vetted out before the outside investors see it?
Assuming they don’t just rubber stamp it, what are the most significant changes the board looks for in the Innovation plan? What do they want to talk about?

What is the largest amount of man months are you willing to devote to one project?
How do you decide which are too big or too long to try?
Tell me about guaranteed market versus a maybe big market? Do you filter out the risky stuff?
Who has biggest input in management?

Alignment
What projects or customers do you bring up at board meetings?
How important is the “fame” to the outside investors, meaning how do they like marquis partners and marquis customers if there is no revenue benefit over an unknown name? Or marquis partners even though the revenue seems nebulous?

How important does status with peers seem to be for the outside investors?
How important is their ability to raise the next fund?
How do you know this?

R&D Processes (for all managers)
How often are things added to the development work load? Even minor things?
- Added and needs to be started immediately?
- Added and impacts existing projects and existing schedules?

What do these things tend to be?
- Bugs
- New features
- Customer specials
- Partner work
- Infrastructure

Why are they added?
- What’s behind it?
- Who’s behind it? E.g. You, CEO, VP Marketing, VP Sales, Direct from Customer to R&D
- What’s the magnitude?
- Who benefits?

What is most disruptive to the schedule?
How much does just the fact that a change is made impact resources?
- Changing development environments
- Updating schedules
- RePlanning, Etc.

Who makes the request?
How do you respond?
What is the effect on ongoing work? i.e. compare the schedule with no interruptions, to the current schedule
- What tends to slip?

How does it show up in your status information you give to your boss?
How accurate are you in articulating the magnitude of the impact?
- Do they really want to know?

Do you notice more disruptive additions at beginning of month, quarter, year?
Can you remember an incident where an innovation was pushed out because of a customer special or a large customer’s bug had to be fixed, or a partner project?
Questions for R&D or Product Managers

Projects:
How often (percent) do projects arrive after the initial plan schedule?
What would you say the average delay is (months)?
As a percent of original time?
What is the biggest category of interruption?
Tell me about a significant project.

Information:
Tell me about senior management. Do they have any idea how much time is devoted to bugs, specials and infrastructure?
Do they know how much stop and starting goes on?
What percent of R&D is on innovation – new features or products not for a customer?

How often are releases late?
By how much?
Features Missing?

Questions for Sales:
How often do you need engineering to make changes to the product to get an order?
Week, month, year.
Are these customers or prospects?

How do you decide which ones to push for?
Does this change during the year? i.e. Do you request more at the end of the quarter or year?
When do you get more support for changes from CEO?

What is the impact on R&D from a change. Example?

What drives you to take deals with strings attached?
How big does the deal have to be to influence you?
How much does it matter if the firm is behind revenue plan at the end of the quarter?

What about bugs? How often do these flow in from the field and have a potential to impact revenue?
Are these customers or prospects?

How often do you have potential partners or partners who want you to do something to the product?
How does R&D respond to a feature request? How do they get the information?

How important to the CEO is:
big names? Customers or partners?

Can you tell me, generically, about compensation?
How is sales reps compensated - % commission & bonus? What are the repercussions of missing quota? Sales VP?

Customers - new orders
Are promised orders more often smaller or later than promised. Or larger and earlier? Especially the ones with special requests attached. Why is this? Does sales give the best case scenario in order to marshal the company to respond?

Innovation Plan
How is the innovation strategy set? Like major goals and R&D budget?

Moral Hazard
How often do sales people do things - ongoing - that would be different than the CEO or you would want. Such as?

Questions for VC or Board Members
This research focuses on firms that are shipping product for significant revenue. For software firms, what % of R&D would you say is developing innovation?

Goals
What are your goals for a typical investment? What do you want any given company to do when you decide to invest?
What are you looking for (return) for a fund?
How important is a big name win in a prior fund for raising the next fund? (e.g. google)
What are the outside investors looking for? Why are they looking for this?
What is their time horizon?
What valuation increase do they want?
What things - like company performance or technology - do they think they need to get there?
What about big names? Customers or partners?
How often are partner meetings? How often are well known companies a part of your partner meeting to discuss your portfolio companies?
Is this something you ask the CEO to give you? The list of larger names?
How important is the “name” to the outside investors, meaning how do they like marquis partners and marquis customers if there is no revenue benefit over an unknown name? Or marquis partners even though the revenue seems nebulous?
Do you mention these wins in your updates to the investors?
How important is status with peers seem to be for your fellow VC’s?

How are the quarterly revenue numbers set in your portfolio firms?

Board & CEO
How do outside board members feel about larger, “game changer” -big impact innovations?
Versus smaller, more regular innovation that is more guaranteed to bring some revenue. Are they different than management opinion on this?
Do CEO’s have different desires than investors for valuation and exit? Where are the differences and what tension does it bring?

**Moral Hazard**
CEOs do things – ongoing – that would be different than owner would want?

**Innovation strategy**
Tell me how innovation strategy for the company is decided and approved? (like R&D budget)
How often is it officially updated?
What filtering occurs before you hear the plan for the year?
How does the board get involved with deciding R&D spending? How about the plan for major projects? When does this occur?
How much does the board know about development processes from their own experience?
• Is there a difference between the ones that do and don’t have experience on what they think is possible or schedules? On what they push for?
What kind of projects do boards tend to want to initiate. What kind do they like?
• short term revenue
• future new market
• game change innovation
• feature enhancements
• HI PR value
• Partnerships
• Other?
Why do you think that is?
How different is the discussion when the company needs more money versus when they need no new round? Do marquee names become more important? How about when nearing IPO?
How firm are the dates for project delivery that are given to the board? How far off are they?
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