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How environmental and organizational complexity affects opportunity recognition and exploitation in development projects

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ABSTRACT

New product development projects are experiencing increasing internal and external project complexity. Complexity leadership theory proposes that external complexity requires adaptive and enabling leadership, which facilitates opportunity recognition (OR) and opportunity exploitation (OX). We ask whether internal complexity also requires OR and OX for increased adaptability. We extend a model of OR and OX to conclude that internal complexity may require more careful OR and OX. This means that leaders of technically or structurally complex projects need to evaluate opportunities more than those in projects with external or technological complexity. We plan a focus group of Project Managers to test these propositions.

Key Words: Corporate entrepreneurship, Complex projects, Entrepreneurial orientation, Opportunity recognition; Complexity Leadership Theory

INTRODUCTION

Project structures are often created by entrepreneurs and large corporate organizations to develop new products. Since new product development projects (NPDP) are more often situated within a larger organization, intrapreneurship or corporate entrepreneurship plays an important role in bringing these projects to fruition. As the project itself may be large, the creation of new value in new product development projects draws to some extent on theories of corporate entrepreneurship.

While many think of entrepreneurship as applying to small start-up ventures, Pinchot (1995) popularized the idea that entrepreneurs could, and should, exist within larger organizations. Entrepreneurial behavior by larger established corporations (Knight & Cavusgil, 1996) and government entities (Pinchot & Pelham, 1999) is now called corporate entrepreneurship. By applying this thinking, entrepreneurship includes entrepreneurial behavior taking place in NPDP.

Projects are temporary organizational structures that are characterized by having a beginning and an end (Project Management Institute, 2009). The project is a distinctive entity with its own budget, stakeholders, users and a strategy to provide a new service or product. Since NPDP often involves the development of a new product using immature technology, we will describe development of an immature technology in this paper. In our case study example the Joint Strike Fighter (JSF) F-35 aircraft is being developed by the U.S. Department of Defense and eight allied nations. In 2001, the Lockheed Martin won a \$19 billion contract to develop the F-35, an affordable, stealthy and supersonic all-weather strike fighter designed to replace a wide range of aging fighter aircraft. This involved the development of a number of new technologies such as low observability, commonly called stealth, which uses an integrated airframe design, advanced materials and an axisymmetric nozzle to minimize the F-35's radar signature. In addition to identifying opportunities to more efficiently and effectively develop the new product, complex projects

like the JSF also need to identify and exploit opportunities to increase agility in response to changing stakeholder demands or to reduce project risks.

As business environments become more and more complex, the law of requisite variety (Ashby, 1956) contends that our organization structures will also become more and more complex. The law of requisite variety proposes that in a closed system “the faster the environment changes, the faster the system has to respond to stay stable.” (Stacey, 1992, p. 162). This appears to be happening to our projects as they are used to develop more and more complex technology within more and more complex business environments.

In this research we define a complex project as one that demonstrates a number of sources of uncertainty to a degree, or level of severity, that makes it extremely difficult to predict project outcomes, to control or manage project (Remington & Zolin, Forthcoming). Project complexity has been conceptualized by Remington and Pollock (2007) in terms of four major sources of complexity; temporal, directional, structural and technological complexity (See Figure 1). *Temporal* complexity exists when projects experience significant environmental change outside the direct influence or control of the project. The Global Economic Crisis of 2008 – 2009 is a good example of the type of environmental change that can make a project complex as, for example in the JSF project, where project managers attempt to respond to changes in interest rates, international currency exchange rates and commodity prices etc. *Directional* complexity exists in a project where stakeholders’ goals are unclear or undefined, where progress is hindered by unknown political agendas, or where stakeholders disagree or misunderstand project goals. In the JSF project all the services and all non countries have to agree to the specifications of the three variants of the aircraft; Conventional Take Off and Landing (CTOL), Short Take Off/Vertical Landing (STOVL) and the Carrier Variant (CV). Because the Navy requires a plane that can take off and land on an aircraft carrier, that required a special variant of the aircraft design, adding complexity to the project. *Technical* complexity occurs in a project using technology that is immature or where design characteristics are unknown or untried. Developing a plane that can take off on a very short runway and land vertically created may highly interdependent technological challenges to correctly locate, direct and balance the lift fans, modulate the airflow and provide equivalent amount of thrust from the downward vectored rear exhaust to lift the aircraft and at the same time control engine temperatures. These technological challenges make costing and scheduling equally challenging. *Structural* complexity in a project comes from the sheer numbers of elements such as the number of people, teams or organizations involved, ambiguity regarding the elements, and the massive degree of interconnectedness between them. While Lockheed Martin is the prime contractor, they are assisted in major aspects of the JSF development by Northrop Grumman, BAE Systems, Pratt & Whitney and GE/Rolls-Royce Fighter Engineer Team and innumerable subcontractors.

Hence, temporal and directional complexities stem from the project environment, while structural and temporal complexities arise within the project itself. (See Figure 1)

Insert Figure 1 about here

Complexity Leadership Theory contends that in complex environments adaptive and enabling leadership are needed (Uhl-Bien, Marion and McKelvey, 2007). This is consistent with Miller’s (1983) observation that organizations need to be entrepreneurial to survive in turbulent and dynamic environments. Adaptive leadership facilitates creativity, learning and adaptability, while enabling leadership handles the conflicts that inevitably arise between adaptive leadership and traditional administrative leadership (Uhl-Bien and Marion, 2007). Hence, adaptive leadership involves the recognition and opportunities to adapt, while and enabling leadership involves the exploitation of these opportunities.

Complexity Leadership Theory also proposes that entrepreneurial behavior can and should occur at all levels of the organization (Uhl-Bien and Marion, 2007). In other words, it is not only the project managers who must act entrepreneurially; they must also encourage others to do so. To date little research has been done to investigate the need for entrepreneurial behaviours by project leaders of large complex projects.

Our research questions revolve around the type or source of complexity and its relationship to opportunity recognition and exploitation. For example, is it only external environmental complexity that creates the need for the entrepreneurial behaviours, such as opportunity recognition and opportunity exploitation? Do the internal dimensions of project complexity, such as technological and structural complexity, also create the need for opportunity recognition and opportunity exploitation? We examine these questions and other aspects of the interrelationships between complexity, opportunity recognition and exploitation.

Technological and structure complexity are the two types of internal complexity. Technological complexity creates the need for highly skilled problem solving to achieve the goals of the project using the technological tools available. But it may not be possible to solve these problems and achieve the project goals with the chosen technology. Structural complexity creates the need for carefully chosen responses to unanticipated environmental change or work-based exceptions because the structurally complex project is difficult to redirect, once it is underway. In addition, small influences, such as a small delay of a critical part, can have large influences as they roll through the large and highly complex system. Thus, internal sources of project complexity may not always be adequately addressed by the creative, learning, and adaptive responses facilitated by adaptive and enabling leadership.

In this paper we extend a model of the relationships between entrepreneurial orientation, opportunity recognition and organizational performance to address the impacts of external and internal complexity in project organizations. We develop a series of propositions that explain some of these relationships. We then describe a methodology for exploring the impact of internal and external complexity on opportunity recognition and exploitation. In our discussion we explain the theoretical and practical implications and limitations of the study.

Kropp, Zolin and Lindsay (2009) propose a model of the effect of environmental and organizational factors on the relationships between entrepreneurial orientation, opportunity recognition and organizational performance in military organizations. In this model opportunity recognition (OR) is central to the realization of successful outcomes from creativity, learning and adaptability. When a creative idea is surfaced, it is necessary at the individual, team, management and maybe even stakeholder levels to recognize the value of the idea and then invest time and effort to develop the idea and determine the idea's potential value.

These desirable behaviors in complex adaptive systems; such as creativity, learning and adaptability, are closely associated with entrepreneurial behaviours such as opportunity recognition. Without opportunity recognition the fruits of creativity will not be realized and adaptability will not be achieved. Thus these desirable behaviours in complex organizations could be facilitated by an organization culture that facilitates entrepreneurial behaviours with an entrepreneurial orientation. Part of acting entrepreneurially involves recognizing and capitalizing on new opportunities. OR is one of the most important abilities for successful entrepreneurs (Ardichvili, Cardozo & Souray, 2003).

Environmental factors and organizational factors are shown to influence the extent to which entrepreneurial orientation affects OR, OX and project performance (e.g., Lumpkin & Dess, 1996).

The following sections describe OR, OX and how they are affected by internal and external project complexity.

OPPORTUNITIES AND LEADERSHIP IN COMPLEX PROJECT

Opportunities are proposed to “emerge from a complex pattern of changing conditions” (Baron, 2006, p.107). In the private sector, opportunities are conceptualized in terms of meeting market needs through creative combinations of resources to deliver superior economic value (Schumpeter, 1934; Kirzner, 1973; Casson, 1982; Ardichvili, Cardozo, & Ray, 2003). Schumpeter (1950) proposed that new products, processes, markets and management fuel the economy. . Opportunities are ways of generating profits or adding value through the creation of a new product, service, process or exploitation of a new technology (Ardichvili, Cardozo, & Ray, 2003).

NPDP opportunities could generate profits in the traditional sense of the word, however, even if they do not, they can still create value through solving problems or finding better ways to achieve project goals. In large complex projects problems develop due to changes in the environment and the directions of

stakeholders, difficulties in applying the chosen technology, or unanticipated changes in the schedule, such as delays or increased tempo. These problems may be resolved if opportunities to solve the problem are recognized and exploited.

Opportunities in complex projects can, therefore, increase benefits or reduce costs, creating greater added value through new products, services, processes or technology exploitation. Complex Therefore we propose that project opportunities can be couched in terms of meeting project goals through creative combinations of resources to solve problems, deliver more efficient or effective project performance and/or reduce project risks. But to create value opportunities must be recognized and exploited and in complex environments that involves leadership (Uhl-Bien et al, 2007).

Complexity Leadership Theory proposes that a complex adaptive system, in which agents interact and influence each other, the future state of the system cannot be predicted, and therefore require additional and different forms of leadership. The unpredictability of complex adaptive systems create adaptive challenges, which require new learning, innovation and change, as opposed to technological problems that can be solved with the knowledge at hand.

In complex adaptive systems, leadership is “an emergent, interactive dynamic that is productive of adaptive outcomes” (Uhl-Bien et al, 2007, p 299) where leaders are individuals who act in ways that influence the emergent interactive dynamics and outcomes. In addition to traditional Administrative leadership, Complexity Leadership Theory proposes that in complex adaptive systems, *adaptive* and *enabling* leadership are also required. *Adaptive leadership* occurs in the informal, emergent adaptive dynamics that occur throughout the organisation; while *enabling leadership* facilitates the adaptive dynamics and manages entanglements between administrative and adaptive leadership. Thus the goal of leadership in complex adaptive systems is to facilitate creativity, learning, and adaptability, and enable control structures for coordination and producing outcomes. In this sense leadership in complex projects facilitates the identification and exploitation of opportunities to achieve project goals while adapting to the changing environment and managing the constraints of the technology and intricate project structure. .

MODEL OF OPPORTUNITY RECOGNITION IN COMPLEX PROJECTS

The Kropp, Zolin and Lindsay model (2009) describes a relationship between entrepreneurial orientation (EO), opportunity recognition (OR), and opportunity exploitation (OX) in complex projects, with environmental and organizational contextual variables as moderators. We extend their model by defining the affects of the environmental factors that make up external complexity, i.e. temporal and directional complexity, and also the organizational factors that constitute internal complexity, which are technological and structural complexity. The revised model is shown in Figure 2 and a discussion of the model constructs and presentation of propositions appears below.

Insert Figure 2 about here

OPPORTUNITY RECOGNITION (OR)

Entrepreneurs recognizing opportunities and thereby create and deliver value for their stakeholders (Ardichvili, Cardozzo, & Ray, 2003). Opportunity identification or recognition is a central behavior of the entrepreneurial process (Shane & Venkataraman, 2000; Venkataraman, 1997). OR is a first step in the process. OR is distinguished from, and proceeds, opportunity evaluation and development (Ardichvili, Cardozzo, & Ray, 2003).

Entrepreneurial individuals tend to be better at identifying opportunities (Ardichvili, Cardozzo, & Ray, 2003; Shane and Venkataraman, 2000). Entrepreneurship is not solely about creating new businesses, although research to date has tended to focus on OR being associated with entrepreneurs who start-up and develop entrepreneurial businesses (Cooper & Dunkelberg, 1986; Ucbasaran, Westhead, & Wright, 2001; Ucbasaran, Lockett, Wright, & Westhead, 2003). Entrepreneurship is a creative process (Vesalainen and Pihkala, 1999) that can apply to large organizations as it does to small organizations (Knight & Cavusgil,

1996; Pinchot & Pelham, 1999). Thus, OR is just as relevant complex project leaders as it is to the founders of small, fledgling, privately-owned, start-up firms.

OR is a cognitive processes by which “individuals conclude that they have identified an opportunity” (Baron, 2006, p.107). Opportunity recognition processes involve the perception, discovery, and creation of opportunities (Christensen, Madsen, & Petersen, 1989; Conway and McGuinness, 1986; Singh, Hills, & Lumpkin, 1999: in Ardichvili, Cardozzo, & Ray, 2003). These processes have been described in terms of pattern recognition, in which the individual recognizes opportunities using prototypes or exemplar models based on knowledge of exemplars already stored in memory (Baron, 2006).

Cognitive processes of OR in complex projects are likely to be similar to those in the private sector, involving pattern recognition or exemplar models. For example, one widely used procedure for is called “lessons learned”. Following a major project activity, it is a customary for participants to identify what they could have done better and report on their lessons learned. This procedure potentially, identifies new opportunities by documenting problems, and proposing potential solutions..

For project leaders to capitalize on opportunities to solve problems or find better ways to achieve project goals, the opportunities must first be recognized. OR involves identifying a potentially better way to solve a problem or achieve a goal. This can be associated with reducing the risk of an undesirable situation, achieving product or technology effectiveness and/or increasing efficiency. Individual and collective OR motivations, however, may be different in complex projects compared to privately owned enterprises. In complex projects OR motivations are more likely to be related to promotion opportunities bonuses or ownership of shares, rather than receiving direct financial rewards through profit or profit sharing.

OPPORTUNITY EXPLOITATION (OX)

Opportunity exploitation (OX) includes activities associated with the evaluation and development of an opportunity including the investment of resources to move from a prototype to full scale operations to take advantage of an opportunity to gain returns (Choi & Shepherd, 2004; Choi, Levesque, & Shepherd, 2008). OX is the implementation of a set of decisions that achieve the “execution of competition strategy” (Plummer, Haynie, & Godesiabois, 2007, p. 367). Deciding whether to exploit an opportunity or not is based on evaluating whether the opportunity’s expected value will exceed the expected cost of its exploitation (Shane & Venkataraman, 2000; Plummer, Haynie, & Godesiabois, 2007). The “characteristics of the opportunity and the nature of the competitive environment” (Plummer, Haynie, & Godesiabois, 2007, p. 368) will determine how the opportunity will be exploited.

OX follows OR and effective and efficient implementation is essential if benefits are to be realized. Just how long OX occurs after OR depends upon the time taken to evaluate the opportunity and gather adequate information to reduce uncertainty and amass the necessary resources and capabilities (Choi & Shepherd, 2004a; Choi, Levesque, and Shepherd, 2008). Increasing the speed of the OX process can gain the first mover advantage, however, slower OX can increase information quality relevant to the OX process thereby reducing uncertainty (Choi & Shepherd, 2004a, 2004b; Choi et al., 2008). Thus, OX involves tradeoffs and compromise because the best way to exploit the opportunity is often not known, sometimes resulting in under-exploitation. In turbulent and uncertain environments under-exploitation is more likely to occur, which may be exacerbated by high technological complexity

Whereas OX in a civilian setting is associated with generating profits, OX in complex projects is associated with achieving project goals, including adaptability and risk reduction. In turbulent project environments, the under-exploitation of opportunities can hinder the implementation of an adaptive strategy, which could result in failure to satisfy critical stakeholders. Under-exploitation due to technological uncertainty could also leave gaps in the market, which could be filled by competitors, eroding any first mover advantages. Hence opportunity exploitation is extremely important in complex project management.

ENVIRONMENTAL AND ORGANIZATIONAL VARIABLES: INTERNAL AND EXTERNAL COMPLEXITY

The entrepreneurial orientation-performance relationship is moderated by environmental variable such as dynamism, munificence, complexity, competitiveness and other industry characteristics (Lumpkin & Dess, 1996). Increased environmental complexity such as temporal or directional complexity, could heighten the affect of entrepreneurial orientation on OR. All things being equal, the same level of EO is likely to result in greater OR when the environment is recognized as being more dynamic and complex

In contrast, we propose that internal complexity will negatively moderate the relationship between EO and OX. When the organization is more complex, either through greater technological or structural complexity, opportunities are more likely to be more carefully screened and vetted, resulting less OX. However, it seems that EO is even more important in these contexts. For example, if there is low EO, it is much less likely that the opportunity to address technological or structural complexity issues will be exploited.

External complexity: Temporal and Directional Complexity

Environmental variables that affect project complexity are described as external complexity. These include temporal and directional complexity and are likely to influence the impact of entrepreneurial orientation on OR. Temporal complexity exists when projects experience significant environmental change outside the direct influence or control of the project. In a temporally complex project, the fitness landscape is not stable. Projects of longer duration are likely to experience some temporal complexity. There is ambiguity with respect to the constraints. It is not so much a question about whether goals will change, but when, in what direction and whether the changes can be anticipated. A temporally complex project is chaotic. Capabilities relevant at one point in time may lose their relevance as time passes, except the ability to adapt to change. Again, this would be exacerbated in projects of longer duration.

Directional complexity exists in a project where goals are unclear or undefined, where progress is hindered by unknown political agendas, or where stakeholders disagree or misunderstand project goals. In directionally complex projects the problem space is larger than the solution space. Ambiguity exists with regard to the issues of problem definition, understanding stakeholders' needs and negotiating an agreed direction for the project.

Internal complexity: Technological and Structural Complexity

Organizational variables that could influence the impact of entrepreneurial orientation on OX include technological and structural complexity. Technical complexity occurs in a project using technology that is immature or where design characteristics are unknown or untried. In technically complex projects the solution space is larger than the problem space. We know what we want to achieve but we do not know how to achieve it. In technically complex projects there is a real possibility that a design solution may not be found.

Structural complexity in a project, analogous to the structural intricacy described above, comes from the sheer numbers of elements, ambiguity regarding the elements, and the massive degree of interconnectedness between them. Although elements may have narrowly defined problem space and solution space, a small change in an element can have a large impact on the performance of the project. These projects tend to use hierarchies and formal communication systems to transfer information quickly and efficiently. Structurally complex projects tend not to be adaptive. They are highly influenced by initial conditions and difficult to redirect once they build momentum, making the project definition and feasibility stages critical. Project management must rein in stakeholders who want to start before these stages are fully complete.

Therefore, environmental factors such as external complexity can moderate the impact of the relationship between EO and OR in a complex project, while and/or organizational factors, such as internal complexity could moderate the impact of EO on OE.

Entrepreneurial orientation

Entrepreneurial orientation (EO) is an organizational level construct (Lumpkin & Dess, 1996, 2001; Miller, 1983) that involves the processes, practices, and decision-making activities employed by entrepreneurs that lead to new entry and exploit entrepreneurial opportunities. EO is conceptualized by Lumpkin and Dess (1996) to include risk-taking, proactiveness, autonomy, innovativeness, and competitive aggressiveness. Proactiveness, risk-taking, and innovativeness (Coviello & Jones, 2004) are the three most commonly researched dimensions of EO. The relationship between EO and the performance of a firm, contingent upon organizational and environmental contexts has been established by previous research (e.g., Lumpkin and Dess, 1996; Kropp, Lindsay, & Shoham, 2006).

Proactiveness takes the perspective of opportunity-seeking, forward-looking anticipation of future demand (Lumpkin and Dess, 1996, 2001). The identification of opportunities and market trends, assessment of the strengths and weaknesses of opportunities, and forming teams capable of exploiting them are included in the proactiveness concept (Kropp, Lindsay, & Shoham, 2006). In addition to creating a future vision, proactiveness implies a willingness to participate in emerging markets, acting opportunistically. Proactiveness has been found to be more important to firms in the early stages of industry development than in more mature industries (Lumpkin and Dess, 2001).

Fundamental to contemporary definitions of entrepreneurship is innovativeness (Miller, 1983; Shane & Venkataraman, 2000), which is required for product/market development in environments of continuous change and uncertainty (Miller, 1983). Research has shown that the greater the environmental dynamism and hostility, the greater the innovation required (Miller, 1983). Creative and innovative firms outperformed other firm types in these more dynamic environments (McKee, Varadarajan, & Pride, 1989). And in larger organizations entrepreneurs are more innovative than general managers (Buttner & Gyskiewicz, 1993).

Risk involves the uncertainty regarding the potential gains or losses that are associated with a set of outcomes (Forlani & Mullins, 2000). It also involves the commitment of assets and or resources venturing to new activities (Baird & Thomas, 1985). Risk-taking is the tendency to take bold actions (Lumpkin & Dess, 1996). Arguably, while entrepreneurs are generally willing to take calculated risks in return for potential rewards, project leaders are likely to prefer lowering the risk in the risk-return equation.

Effects of complexity on the relationship between EO Proactiveness and OR

Entrepreneurs identify with the need to be proactive in identifying, evaluating, and developing opportunities (Kropp and Zolin, 2005). For example, OR can involve an active search for opportunities (e.g., Shane, 2003; Hills, Lumpkin, & Singh, 1997; Hills & Shrader, 1998; Gaglio and Katz, 2001; Kirzner, 1973). Search involves proactive behavior involving the scanning of the environment for potential opportunities. Sometimes, however, opportunities arise from situations and appear before entrepreneurs without their actively searching for them. In these situations, entrepreneurs need to be proactively alert for these opportunities (Kirzner, 1973). Entrepreneurial cognition (Baron, 2004, 2006; Shaver and Scott, 1991; Hills, 1995; Hills, Lumpkin, & Singh, 1997; Hills & Shrader, 1998) also is associated with proactiveness. It assists search and alertness behaviors through pattern recognition and the use of heuristics based on prototypes or exemplar models (Baron, 2006).

When the environment is dynamic and complex EO is more likely to result in OR because project members will be actively looking for solutions to problems created by environmental change. Similarly, in project with high technological complexity, team members will be actively searching for opportunities to resolve the outstanding technological problems. But in projects that are structurally complex project leaders and members may try to make the minimum changes possible to reduce the risk of creating new problems due to delays or schedule changes. Therefore,

Proposition 1a: External complexity will positively moderate the relationship the proactiveness dimension of EO and OR in complex projects.

Proposition 1b: Internal complexity will negatively the relationship between the proactiveness dimension of EO and OR, such that for a given level of EO, the more internal complexity the less OR will result.

Affects (Effects?) of complexity on the relationship between EO Innovativeness and OR: Schumpeter (1954) identified innovativeness as a “firm’s tendency to engage in and support new ideas, novelty, experimentation, and creative processes” (Lumpkin & Dess, 1996, p. 142). Entrepreneurial organizations use their resources to gain a competitive advantage (Alvarez & Busenitz, 2001). Numerous activities or mind-sets are associated with innovativeness including a creative spirit, R&D and experimentation, new products/services and processes, and technological leadership (Lumpkin & Dess 2001).

Creativity, innovativeness, and OR are conceptually related. Particular personality traits are associated with entrepreneurial individuals who are involved with creativity (Ardichvili, Cardozzo, & Ray, 2003). Entrepreneurial individuals are creative (Shane, 2003). They use their creativity to develop innovative solutions that break new ground (Baron, 2006, Gaglio & Katz, 2001) and in being alert to recognizing opportunities (Baron, 2006). They also appreciate that one does not need to know all the answers to solve a particular problem but that one does need to know where to look and who to talk to in identifying particular solutions. In this regard, entrepreneurial individuals are good at developing and tapping into social networks (Hills, 1995; 1999) to access solutions and to stimulate and synthesize ideas and thinking. Hence, in project with environmental or technological complexity project leaders who encourage the innovativeness dimension of EO will increase OR in complex projects. In projects with structural complexity innovativeness will not necessarily result in the recognition and exploitation of opportunities due to the over-riding importance of maintaining stability in the highly intricate and interconnected project structure.

Proposition 2a: External complexity will positively moderate the relationship the innovativeness dimension of EO and OR in complex projects.

Proposition 2b: Internal complexity will negatively moderate the relationship between the innovativeness dimension of EO and OR, such that for a given level of EO, the more internal complexity the less OR will result.

Affects of complexity on the relationship between EO Risk Taking and OR: Entrepreneurs generally accept that entrepreneurship involves risk-taking and are willing to take risks in return for potential rewards. Prior knowledge of markets, industries, and/or customers (Shane, 2003) moderates the financial reward-OR relationship (Shepherd & DeTienne, 2005). Identifying a potential opportunity will implicitly or explicitly involve risk. Entrepreneurs prefer to be associated with opportunities where risk is manageable (Timmons & Spinelli, 2007). If the risk associated with a potential opportunity is perceived to be too high, the opportunity will not be pursued. Strong risk aversion is likely to reduce OR, while a “managed”, slightly positive risk acceptance is likely to enhance OR.

Risk involves the uncertainty and potential gains or losses that are associated with a set of outcomes (Forlani & Mullins, 2000). It also involves venturing into new activities and a commitment of assets and or resources (Baird & Thomas, 1985). Risk-taking involves a tendency to take bold actions (Lumpkin & Dess, 1996). Arguably, although entrepreneurs are generally willing to take risks in return for potential rewards, they prefer to lower the risk aspect of the risk-return equation.

Risk Management is a central feature of the discipline of project management. While Project leaders understand that no project is risk free, the reduction and management of risk is a central goal of their job. This can contribute to the development of a risk adverse culture for project OR.

We propose that in projects with environmental complexity creating the need for change and innovation project leaders, who are willing to accept and manage risk, are more likely to identify opportunities to increase project effectiveness and efficiency. In contrast in projects with internal complexity a much higher willingness to accept risk will be necessary to trigger opportunity recognition. In structurally complex projects we predict it will be less likely to find a relationship between risk taking and OP. Therefore,

Proposition 3a External complexity will positively moderate the relationship the risk taking dimension of EO and OR in complex projects.

Proposition 3b: Internal complexity will negatively moderate the relationship between the risk taking dimension of EO and OR, such that for a given level of EO, the more internal complexity the less OR will result.

Autonomy implies freedom or the ability to act independently. In the organizational context, autonomy implies the ability to take independent strategic initiatives (Burgelman, 1983). It may, however, be difficult for an individual or group of individuals to be autonomous when they face rigid organizational constraints (Lumpkin & Dess, 1996; Lumpkin, Cogliser, & Schneider, 2007). Strategic alignment between the operational and corporate levels can often be challenging when autonomous actions are taken (Burgelman, 1983).

When the environment is complex, and a project has autonomy, they will be motivated to execute opportunities to improve the project's performance. In contrast, when the project has high internal complexity, they will be more cautious in execution.

Proposition 4a: External complexity will positively moderate the relationship the autonomy dimension of EO and OX in complex projects.

Proposition 4b: Internal complexity will negatively moderate the relationship between the autonomy dimension of EO and OX, such that for a given level of EO, the more internal complexity the less OX will result..

Competitive aggressiveness refers to the degree to which an organization attempts to outperform its rivals (Lumpkin & Dess, 2001). It involves challenging competitors with a view to improving the organization's position in the market place and is characterized by responsiveness, confrontation, and a "willingness to be unconventional" (Lumpkin & Dess, 1996, p. 149). It can also involve a "defense of existing resources" (Lumpkin & Dess, 2001, p. 434). When and a project experiences high competitive aggressiveness and their environment is complex, project leaders will be motivated to execute opportunities to improve the project's performance. In contrast, when the project has high internal complexity, they will be more cautious in execution.

Proposition 4a: External complexity will positively moderate the relationship the Competitive aggressiveness dimension of EO and OR in complex projects.

Proposition 4b Internal complexity will negatively moderate the relationship between the Competitive aggressiveness dimension of EO and OX, such that for a given level of EO, the more internal complexity the less OR will result.

Methodology

This paper will report upon the first stage of a three year study into the behaviours of managers, leaders and team members of complex projects. We will report a qualitative study involving a Group Discussion with experienced project leaders. . . The objective of the group discussions is to determine how leaders of large and potentially complex projects perceive that external and internal complexity will influence the affects of EO on OR. Secondary objectives include their understanding of the importance of entrepreneurial behaviors such as OR and OX in large complex projects. A group discussion is appropriate because we want to understand how the Project Managers perceive and talk about entrepreneurial behaviors.

This 3-year longitudinal research project is one of four overlapping studies designed to answer the research questions proposed above. Participants will be drawn from the Australian Defence Materiel Organization (DMO) and from industry contracting organisations (in Australia and overseas) approached through our partner organisation, DMO. Acquisition projects that will serve as an initial sampling frame

within both DMO and the industry contracting organisations will either be major (Acquisition Category (ACAT) I & II) or minor (ACAT III & IV) projects. In the case of industry contracting organisations, references to collecting data from contractors, will in reality be data collected from their sub-contractors.

We propose to use multiple methods, multiple data sources, and longitudinal data collection to overcome methodological limitations in prior leadership and project management research. We do this by employing methods such as interview, diary, observation and focus group studies, survey studies, a quasi-experimental study, and employing longitudinal research designs. These studies will involve collecting data from multiple sources (e.g., project leader, team leader, contractors & team members).

Conclusion

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Figure 1. External and Internal Dimensions of Project Complexity

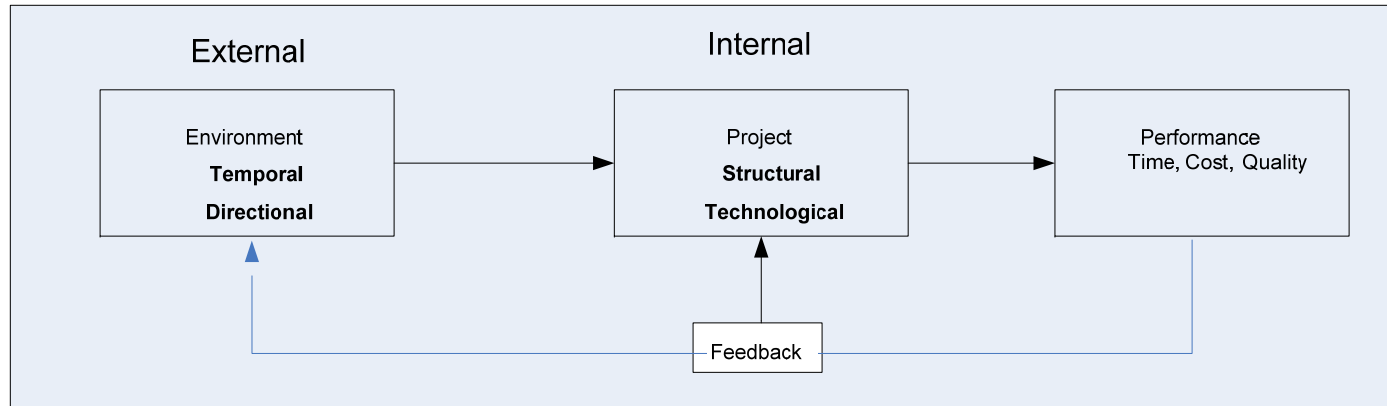


Figure 2. Theoretical model of the influence of external and internal complexity on the relationships between entrepreneurial orientation, opportunity recognition, and organizational performance in complex projects (adapted from Kropp, Zolin & Lindsay, 2009)

