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Consortia as Technology Innovation Management Vehicles: Toward a Framework for Success in Venture Based Public-Private Partnerships

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**CONSORTIA AS TECHNOLOGY INNOVATION MANAGEMENT VEHICLES:
TOWARD A FRAMEWORK FOR SUCCESS IN VENTURE BASED PUBLIC-
PRIVATE PARTNERSHIPS**

By

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ABSTRACT:

Consortia as Technology Innovation Management Vehicles: Toward a Framework for Success in Venture Based Public-Private Partnerships

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The purpose of this research was to explore the approach by federal/state agencies, university, and private sector consortia to develop and manage commercialization of innovation technologies. The evaluation, support, and management of technologically based consortia has traditionally been held in the private sector. There is a somewhat mature literature guiding innovation management (Utterback 1996; Rosenberg et al. 1994; Quinn 1997,1992) in the private sector. However, there is an increasing emergence of consortia consisting of universities, industrial/private sector entities, and government agencies joining in collaborative efforts to launch technology based initiatives. These consortia are non-traditional and the applicability of traditional venture models is questionable. The guidance and maturity of the literature for assessment and management of these new consortia is sparsely developed. The specific research questions explored in this research are: (1) What are the major sources of consortia support for innovative technology based new ventures that seem to work? And, (2) What approaches to managing the commercial viability of advanced innovative technology-based new ventures through partnerships of industry, governmental agencies, and universities are effective?

The research used an embedded case study method (Yin 1994) to explore the research questions. Consortia development of technology innovation projects, by a state government agency located in the southeastern United States, was selected as the focus of

the case study. Four independent projects launched by the consortia were select as embedded units of analysis for the case development.

The research was conducted in three phases. In Phase I the literature was reviewed and a framework for assessment of new ventures was developed. In Phase II, the framework was used to guide data collection and the formation of the case data base. Qualitative analysis methods (Patton 1990) were used to analyze transcripts from sixteen semi-structured interviews of consortia partners and project documents. The data analysis from this phase produced an embedded unit of analysis summary for each consortia project. These summaries were validated for each of the four units analyzed and added to the case database. In the third phase, the case was constructed and validated by consortia members from the government agency responsible for consortia assessment.

The research produced an in-depth case study for the unique development and considerations for university, government agency, and private industry consortia in relation to traditional assessment models and considerations for private sector ventures. In addition, directions for future research involving the assessment, development, and management of university, industry, and government consortia were developed.

Director of Advisory Committee: Dr. Charles B. Keating

This dissertation is dedicated to all of the various forms of the Almighty Spirit without whom none of this would have been conceived and thus rendered possible. It is submitted as a testament to the selfless support, fortitude and insuppressible nature of the intellectual talents, stamina, grit, intergenerational aspirations and merit of my loved ones, kindred spirits, forebearers, and seed. Without your gifts and promise none of this would have manifested, none of the promise it holds would be advanced.

**Committed to scholarship, it is my sincere wish that the day will come when the bounty of unbridled intellectual and enlightened spiritual contribution -- however it may be housed -- will be empowered in a way that will irrevocably alter mankind's state of being into one of true transcendental boundless bliss. It is my humble hope that this work will -
- in some ever so small way -- contribute to that outcome.**

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In a very real sense in addition to God's hand, none of this would have happened without the inspired support of the faculty and staff of the department of Engineering Management at Old Dominion University, especially Dr. Charles Keating, Dr. Lawrence Richards, and Geraldine Dutton. Thanks Folks and God bless.

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CHAPTER I

INTRODUCTION

The management of technological innovation is an area that has received increasing attention by both the academic and practice communities (Quinn 1997)¹. The need to leverage technology to useful societal purposes continues to be a vexing problem. Quinn (1997, p. 3) defines technology as, "...knowledge systematically applied to useful purposes." He further states that, "Innovation consists of the social and managerial processes through which solutions are first translated into social use in a given culture." (Quinn 1997, p. 3). Thus, there is a natural convergence of technological innovation as a process of applying knowledge that must be managed to provide useful solutions for societal problems, issues, and concerns. The traditional literature concerning technological innovation has been primarily targeted to address the issues of technology innovation from the private industrial perspective (Utterback 1996; Hamal 1995; Roberts 1989; Horwitch 1986). The role of "public" entities has been much less of a focus for concerns with technology innovation.

Shifts in the critical success factors (Hax et al. 1983) that characterize the market economy of today's competitive environment have been shown to be dramatic (Quinn 1997, 1992; Hamal 1994; Senge 1990). When one considers the subject of technological innovation in this light, it is clear that determining the proper arrangement of factors that actually *effect* innovative product or process market acceptance from a traditional standpoint is a prospect that is, at best, ill understood (Spekman et al. 1996; Utterback

^{1 1} The Journal Model used throughout this document is the "Instructions for Authors", *Engineering Management Journal*, Vol. 3 No. 1 (March 1991) p. 49.

1996; Davidow 1992; Senge 1990). We do know that reaching the goal of devising more appropriate schemes to manage the dynamics involved in technology innovation is an objective that remains elusive. However, a convergence of forces exist that are producing opportunities for non-traditional sources of technology innovation and the necessary strategies, structures, and processes required to manage these novel innovation initiatives. Recent developments have seen an emergence of non-traditional partnerships directed to development and management of non-traditional technological innovation. Of particular, and problematic interest are partnerships involving universities (a recognized source of knowledge), elected government (responsible for improving societal prospects), appointed government (responsible to carry out the directives of elected government), and private industry (interested in commercialization and profit incentives). Although these partnerships are beginning to emerge, the understanding of their development and management, in contrast to traditional forms of technological innovation, are not well understood (Saunders 1997).

Rethinking Technology Innovation in the Public Sector

In addition to what the literature suggests as a wholesale *redefinition* of what constitutes “*competitively advantaged*” commercial structures and operations procedures, the public sector is likewise undergoing comparable “reconfiguration”. In both instances, changes are necessary due to shifts in fundamental aspects of the underlying social, economic and technological environments within which they must operate (DeBresson, et al. 1991; Priore et al. 1984). In response, public agencies are also “rethinking” their structures and processes for management of technological innovation in a way that their scarce resources might better harness the wellspring of current and anticipated

productivity improvements. The “improvements” reference here are those which are in large part due to the on going processes which successfully identify and develop innovative technologies.

More and more the processes, strategies, and structures that move technology based products through the stages of basic discovery, to product idea, to new product, and ultimately to 'dominant product-market' are characterized as having occurred by following a sequence of events. This sequence of launching successful “new ventures “ has been sponsored in ways that involved aspects of widely diverse forms of inter-agency collaboration (Aldrich et al 1995). For example, there is an expanding use of the practice of outsourcing critical aspects of the research and development (R & D) functional areas in private agencies (Hamilton 1986). In effect, the notion of collaborative partnership for innovative technology development and management is not entirely novel to the private sector.

Referred to alternately as “firms”, “enterprises”, or “corporations”, inter-agencies either compete, cooperate, or otherwise exercise modes of business development alliances. Inspection of the trends in public sector operational improvements, with respect to technology innovation management, supports the perspective that the public sector increasingly displays modes of competitive behaviors. These competitive behaviors, at least superficially, give the appearance of being contradictory. This contradiction, simply stated, finds public sector entities increasingly interested, and to some degree responsible, for commercial success of private sector initiatives with respect to technology innovation. The result is affected public sector agencies -- for example the regulatory and federal policy and research support agencies with relevant market *defining*

jurisdictions – tending to employ complementary modes of behavior adopted in efforts to support desired commercial outcomes. In effect, the public and private sectors are inextricably linked with respect to each achieving desired results through the effective development and management of innovative new technologies. Although each has a different ulterior motive, economic vitality for the public sector and profit motive for the private sector, there is a realization that the achievement of their principle aims is not mutually exclusive. Therefore, a partnership becomes an attractive, and in some instances, an inevitable consequence to leverage technological innovation.

All of the variants employed by state agencies for providing support to public-private consortia are intended to return competitive advantages for the eventual innovating firm's venture success. Thus, for example, non-private agencies receive funding provided to realize the promise of economic viability for the communities in which they are to reside (Aldrich et al 1994; Brandenberger et al. 1996; Mansfield 1995). The university community (quasi-governmental agencies in their own right) are also becoming aggressive in this regard. Such "technology innovation" and "business development advocacy" roles are intended to enhance the sponsoring university's *own* prospects for future political and economic viability through the careful cultivation of successful associations with the private sector (Chesborough et al 1996; Rosenberg et al 1994).

Regardless of the specifics of the case considered, a key component of the equation for continued economic expansion is the timely and appropriate participation of the subject agencies in the success of technologically innovative ventures. To realize the "win-win" outcome of a successful innovative venture's launch, the practitioners are

benefited by being able to assess the “likelihood of success” of emerging innovative enterprises. These enterprises are those that capture and apply technologically innovative concepts. Enhancements in understanding of agency involvement and development of more robust and sophisticated “models” aimed at constructing a “shared view” of the degree of “commercial promise” in each of these opportunities is an area of high impact and in need of further development.

To many, new venture assessment of innovative technological initiatives continues to be an “art form” (Preston 1990; Silver 1982). The explosion in the sheer number of entrepreneurial ideas that come to the attention of the various government and private sector entities is certainly daunting. Furthermore, commercial innovations often span and cross traditional public as well as private sector organizational boundaries. Thus, it is increasingly the case that a premium is being placed on devising *effective* new venture evaluation schemes for innovative technologically based initiatives. These are schemes which are *uniquely* suited to involvement of a variety of organizations, public and private, in the new venture’s launch.

Each of these organizations has significant organizational and industrial culture-based differences associated with their operations. As a result, effective new venture evaluation schemes are those that serve as “tools” that will help better manage each organization’s one increasingly scarce fixed asset -- time -- in making decisions with respect to support for technologically innovative new ventures considered. Any methods, “ways of thinking”, or other mechanisms which will help separate “promise versus dead-end” venture opportunities is certain to enhance a currently limited literature. The sparse guidance for public-private sector assessment, contribution, and management of

guidance for public-private sector assessment, contribution, and management of innovative technologies is certainly in need of extension. Extension of understanding of these non-traditional forms of public-private partnerships will generate benefits in terms of organizational effectiveness and efficiency of agencies tasked with assessment of potential viability of proposed technology innovation initiatives. This is particularly relevant given the increased number of opportunities the agencies must evaluate.

Research Background

The research stems primarily from two streams in the technology innovation management literature:

- The management of technology innovation -- with a focus on organizational structure and procedural practices which support “virtual” work group effectiveness; and
- The venture evaluation schema.

The Management of Technology Innovation

The relevant technology innovation management literature can be grouped into the following broad categories: (1) the underlying phenomenon of technology innovation represented by seminal work of Utterback (1996) and Priore and Sabel (1984) and (2) accepted traditional approaches to managing the phenomena associated with technology innovation. Within the latter category, a two pronged research focus is evident: (a) research on so-called structural issues represented by authors such as DeBesson (1992), Quinn (1997, 1992), and Chandler (1990, 1977) and (b) research on the systemic dynamics (or processes) which must be marshaled to effectively realize “technology innovation management” in the multitude of varying application configurations. For example, in the context of international organizations, government agencies, start-ups, or

any other of the various domestic enterprises, representative authors include Brandenburger (1996), Senge (1991), and Galbraith (1982).

The thrust of these research streams, although complex, is to develop the foundation for recognized effective approaches to the management of technological innovation. However, the management of technology innovation cannot be viewed in isolation from the evaluation of new ventures which ultimately lead to the decision to proceed.

Venture Evaluation in Relation to Public-Private Consortia

Approaches to evaluating the viability and attractiveness of a technology driven venture defines the second supporting research thrust. The research perspective developed from the venture evaluation literature served to establish a framework for development of the particular “lenses” through which the public-private partnerships could be viewed for case study research. Traditional forms of new venture assessment, stemming from the public sector, were used to generate the perspective of the so-called “art” of venture assessment. This venture assessment was applied to the research target in the hopes of understanding the similarities, applicability, and nature of traditional vs. non-traditional perspectives of new venture assessment in technology innovation management.

Consortia, as vehicles for facilitating the effective cross sector management of innovative technology, are increasingly being shown to be effective vehicles for addressing various kinds of problems associated with corroboration and maintenance of competitiveness (Alrich, et al 1995; Nelson and Rosenberg 1994). These include a

general class of problems whose central challenge is to provide situation diagnostics, suitable resources brokering, and timely venture development.

Taken together, management of technology innovation and new venture assessment form an effective backdrop for framing the theoretical perspective, drawn from the literature, for application in development of the case study. In addition, these perspectives provide an appropriate starting point for examination of consortia development in a non-traditional setting characteristic of public-private initiatives which involve technology innovation management.

General Approach to the Research

Specifically, the research focus was on: (1) development of a literature based framework for technology innovation management and new venture assessment from the traditional (public) perspective, (2) application of the framework to investigate the development and management of new ventures of a public-private consortia nature, and (3) production of a case study of public-private consortia to enhance the sparse literature concerning phenomena associated with these types of ventures.

The particular public-private consortia of concern were those partnerships comprised of universities, government (state and federal), and industry (financial as well as production) sector partners. In particular, the specific research focused on the approaches to the identification and management of a form of partnerships experienced in a specific set of consortia. These partnerships emerged as collaborative efforts of a university, state quasi-governmental agencies, and private sector participants forming consortia to achieve technology innovation management.

Overview: A Case Study Research Approach

For research purposes, an exploratory dissertation research method was developed and applied. This method was best characterized as a single case (embedded) study research strategy was employed (Yin, 1994). The single case study (targeted to the state quasi-governmental agency) with multiple units of analysis (consortia associated with four different technology based initiatives) approach was applied to support the *discovery* objective. The objective was to discover applicability of the public sector literature and perspectives on technology innovation management and new venture assessment as they apply, and were experienced, in public-private consortia management and development.

Theoretical paradigms used to guide the exploration of the case (Maxwell 1996; Creswell 1994; Stake 1995) were those whose relevance to technology innovation management had been previously demonstrated and found to be key to successful development. Of particular focus for this research were aspects of selected technology innovation models shown in the literature to be relevant to the practice of technological innovation management. Here such disciplines as those rooted in the selected sub-fields of commercial enterprise management science are given particular consideration (e.g., in aspects of marketing, new venture economics, corporate strategy, industrial sector, commercial governance and organizational structure and process development, operations research, and human resource management). Similarly, relevant aspects of public sector resource management (e.g., both federal and state or regional agency support of economic development through research and development or other types of infrastructure development support policy) were examined in development of the research perspective. The research streams of interest in technology innovation

management were guided by seminal works of authors including, Utterback (1996), Quinn (1992, 1997), Galbraith (1982), Rosenberg and Nelson (1994), and Mowery (1992). The research stream for new venture assessment was primarily guided by the works of Timmons (1986), and Silver (1987). In particular, the research case concerned consortia comprised of university, industry, federal and state level government agencies. For each unit of analysis of the research, the consortia developed as a partnership focused on development of commercially viable advanced technology research and development partnerships.

Guided by the development of the technology innovation management and new venture assessment literature, the exploratory case study research was undertaken. The case study approach is known to support research contexts that are presented as exploratory in nature with various forms of evidence available and data to be gathered (Stake 1995; Yin 1994). The case data was systematically obtained and analyzed through a case research strategy that built a case database. This database was constructed through multiple sources of evidence, including, archived data and records of semi-structured interviews. These data were used to support development of the multiple units of analysis (or embedded) case study research strategy.

Operational Context for the Case

The state, in which the consortia studied for research resides, is similar to other states in vigorously attempting to fashion policies, programs and expenditures that will produce an advantaged entrepreneurial environment. It is pursuing this objective so that its future economic viability and commercial competitiveness is assured. In particular, in

recent years the State of research focus has implemented a number of initiatives directed to enhance economic viability of the commercial sector:

- a) It has established a set of regional entrepreneurial centers and appropriated funds for program development.
- b) It has provided access to and support for resource networks for critical venture development.
- c) It has made professional consultation to local (i.e., within state) entrepreneurial talent available at nominal cost to the entrepreneur.

These initiatives were all deployed with intentions of improving the State's prospects for enhanced economic viability.

The focus of study for the case is a quasi-governmental agency located in a state in the Southeastern United States. This agency is responsible for assessment of commercial viability for technology innovation of new ventures. In addition, the agency is responsible for development of technology innovation initiatives to enhance economic viability. This agency plays a major role in determination, from potential candidates, the commercial prospects of technologically innovative private-public partnerships. The selected case, along with the embedded units of analysis, provided the basis for application and discovery resulting from application of the literature based framework for management of technology innovation through the mechanism of new venture launch.

Research Purpose and Significance

The purpose of this research is: *using a case study method of inquiry, to develop and identify more effective approaches to the management of advanced technology innovation that are realized as a result of university, industry and governmental agency*

consortia support of new commercial ventures. As has been previously discussed, the management of technology and assessment technology based new ventures has been developed from the private sector perspective. Additionally, there has been an emergence of a new form of partnership based on a non-traditional public-private sector relationship to foster development of technology innovations. The literature and research concerning these new partnerships is sparse. With a lack of theory, the case study research approach is appropriate to begin exploration and delineation of phenomena associated with the new partnerships to produce research based understanding.

The research was significant in four important aspects. First, there was a recognized “gap” in the literature with respect to research conducted on the emerging public-private consortia. In this respect, the research advanced the understanding by the research community with respect to the non-traditional management of public-private partnership based technological innovation. The specific partnerships to which the research contributed understanding are those formed to provide for “commercialization of new venture” sponsored by university, industry, and government agency consortia. Second, the research developed and applied the traditional framework for public sector technology innovation assessment and management to the non-traditional public-private sector partnerships. The development and application of this framework to enhance understanding of emergent phenomena associated with these new forms of partnerships contributed to the sparse literature. Third, the research has identified several areas which are appropriate for further development, exploration, and investigation in future research. This is particularly important because the current understanding of the phenomena associated with the emerging public-private partnerships is immature. With respect to

development of theory in the early definition of a field of study, Huber warns, "It is important to challenge narrow concepts...of any phenomenon early in the history of inquiry, as narrow conceptions decrease the chances of encountering useful findings or ideas." (Huber 1991, p. 89). The research has taken a step in further defining the nature of public-private technology innovation partnerships and identifying boundaries necessary for further investigation. Finally, although not a direct research finding, the research was significant in developing practice implications for assessment and management of the public-private consortia. This is a problematic concern faced by both academics and practitioners in development of theory and practice necessary to guide effective management of these emerging partnerships.

Research Questions

The research was designed to explore and was guided by two primary research questions. The first research question is: *What are the major sources of consortia support for innovative technology-based new venture success?* This question is focused on understanding the nature of the support for the launch and development of the non-traditional consortia. These non-traditional consortia are those based on public-private sector partnership. In particular, these consortia of interest include university, federal agency, state agency, and private sector stakeholders. In addition, the research was focused toward areas of technology-based new ventures. In this sense technology-based implies ventures that involve applied knowledge to industrial or commercial objectives. Innovation implies that understanding of the managerial and other processes be developed in relation to their role in success of new ventures. Finally, the notion of

success is concerned with the nature of commercial viability of the particular venture in question.

The second research question is: *What approaches to managing the commercial viability of advanced innovative technology-based new ventures through partnerships of industry, governmental agencies, and universities are effective?* This question was designed, through the case study approach, to explore the particular approaches used and their effectiveness in managing the partnerships. The importance in the case study approach was the inclusion of multiple perspectives of the various members of the partnerships. Therefore, the research sought a “balanced” perspective of the emergence, management, and effectiveness of that management of the partnership in achieving commercial viability. The perspective was formulated from the different constituents involved to achieve a robust account of the consortia.

Research Document Overview

This dissertation is organized into six chapters (See Figure 1). Chapter I provides an introduction and background for the research. The research topic area, purpose, questions, and a framing of the “research arena” are developed. In addition, the general approach to the research is developed.

The focus of Chapter II is the literature review. The literature for assessment of new ventures from a technological innovation perspective is developed. The thrust of this chapter is to identify the particular aspects of assessment that have been effective in the traditional domain. The result is generation of a literature based framework for application to the non-traditional setting selected for the case study. In addition, “gaps” in the literature were identified with the current research designed to address.

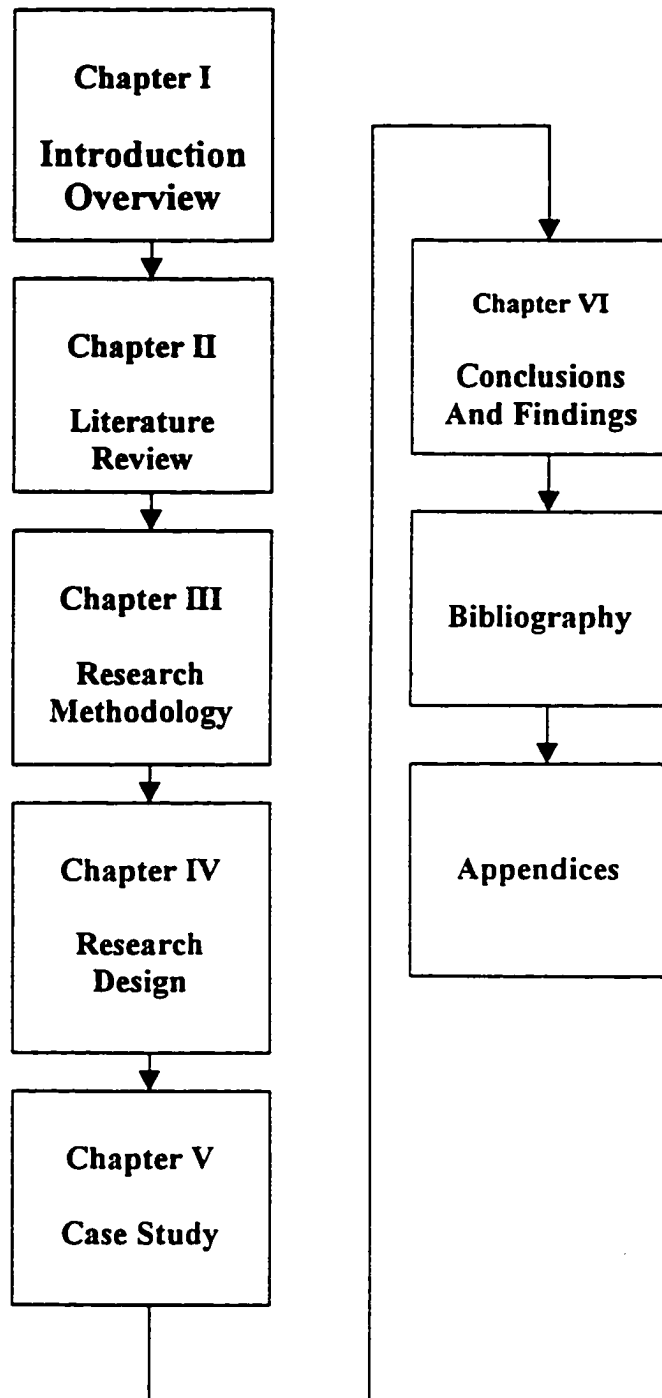


FIGURE 1. Dissertation Structure

Chapter III sets out and critically examines the qualitative research methodology. In particular, the issues, limitations, and appropriateness of the qualitative research approach are developed. This chapter begins with a broad perspective and critique of the qualitative approach and then focuses on the case study method in particular. The result of this chapter is development of the research perspective.

The research design is described in Chapter IV. This chapter traces all aspects of the case study data, analysis, and results from initial selection of the case study method through the final interpretation of the results and implications. In particular, the development of the case database and accompanying procedures for collection and analysis are described.

Chapter V is the results of the analysis of the case data. In effect, this chapter is the case study generated from the case database applying the research design. The case structure is written to follow the technology innovation management conceptual framework used for the data analysis.

The research document concludes with the development of conclusions and implications in Chapter VI. Although the case exists as the “results” of the research and stand alone, this chapter establishes two critical extensions of the research. First, the implications of the research for the understanding and practice in “case similar” contexts are developed. Second, directions for future research in the area of technology innovation management in non-traditional settings are suggested. The document closes with appropriate supporting appendices and references.

CHAPTER II

LITERATURE REVIEW

The literature with potential contribution to the better understanding of technology innovation is multidisciplinary, diffuse, and key (Quinn et al. 1997; Kim 1996; Nonaka 1995; Aldrich et al. 1995; Rosenberg et al 1994; Debresson et al. 1991; Goleman 1995; Drucker 1989; Horwitch 1986; Galbraith 1982; Mintzberg 1979). The associated issue of how best to manage the phenomenon to enhance its economic developmental effectiveness given the options for its management poses an additional challenge (Mansfield et al. 1995; Mowery 1992).

Decision support systems, to be of value, must pass the test of being judged by the intended user as worthwhile. The improved ability to manage the technology innovation phenomenon through the formulation and application of more effective advanced technology consortia venture evaluation and management practices is -- at its best just that: an improved decision support system.

Purpose of the Literature Review

The basis of the dissertation research was to discover the research directions that hold the greatest promise of improving technology innovation management through informed new venture assessment and subsequent enlightened investment decisions. Identification of the appropriate theoretical framework for the dissertation investigation was recognized as key. Moreover, through the review of the literature, not only was the phenomenon under study better defined, but the research agenda and strategy were clarified. This latter result of the literature review is an accepted role for it (Yin 1993).

Literature Review Purpose and Objective

The purpose and objective of the literature review was twofold. First, the primary purpose was to aid in the development of a foundation for better understanding the various issues that previous researchers have identified as significant for a comprehensive appreciation of the factors involved in technology innovation. The second objective of the literature review was to develop a state of understanding of the aspects of the management of technology literature with relevance to clarifying the evaluation and technology innovation management process issues of interest. Of interest in this regard were the management issues associated with devising effective innovative technology-based consortia ventures. Then, employing them in ways that simultaneously provided both regional economic as well as innovative technology advancement.

To that end, it was an objective of the literature review to generate a “theoretical framework to guide the selected research strategy (a case study and analysis). Associated with this objective were the supporting objectives of synthesizing a theoretical framework that provided a synthesis and/or integration of the literature streams that were clearly identifiable. And, secondarily to provide a foundation upon which the traditional venture evaluation and development approaches might be developed to more effectively address an emerging innovative technology advancement organizational form: public private technology commercialization venture consortia.

A secondary aspect of the literature review was to identify gaps in the literature which failed to sufficiently address technology innovation management through public-private consortia. The third object of the literature review had to do with the overall research strategy. By identifying the situation of primary research interest, the literature

review also served to clearly identify what will be referred to in the document as the units of analysis employed in the overall case study exploratory research strategy pursued.

Literature Review Chapter Organization

This chapter is organized such that the primary streams into which the literature were structured is presented. This is followed by a detail explication of each literature stream resulting in 5 distinct sections. This is followed with a summary section that provides an overview of the resulting framework that is advanced as an emerging theoretical conceptual framework for the study of consortia supported innovative technology venture evaluation and management. This is the framework that is subsequently applied to the case to perform the analysis of the case.

Literature Streams Development

The literary streams that appear relevant to investigating improvements in the management of technological (MOT) innovation through informed consortia new venture organizational client (or program/project) selection are graphically depicted in Figure 2.

As the figure shows, the primary literature streams investigated were subdivided into the following streams:

- (a) Technology innovation management literature regarding contemporary market-driven commercial enterprise and its attendant operational contexts. This operational context is one within which both commerce and public service enterprises' approaches to technology innovation management must effectively add stakeholder value (Quinn et al. 1997, Utterback 1996 Horwitch 1986);
- (b) The management of consortia literature (Aldrich et al. 1995);

- (c) Literature that embraced the topic of government roles in research and development management (Yager et al. 1997, Watkins 1985, and Charpie et al. 1978);
- (d) University roles in technology innovation (Rosenberg et al. 1994; Mansfield); and lastly,
- (e) New venture evaluation associated literature (Servo et al. 1995; Goleman 1995; Silver 1985).

These five areas' published research, collectively, may be viewed as constituting the primary research areas (or pillars) that support the research objectives.

In this way, the potentially pertinent source streams -- upon closer inspection -- were found to be somewhat multitudinous. That is, they drew on the disciplines of: macroeconomics (e.g., Utterback 1996; Schumpeter 1939); organizational behavior (e.g., Spekman et al. 1995; Quinn 1992 ; Davidow 1992); human relations (Goleman 1995; Mintzberg 1989; Galbraith 1982), technology innovation management (e.g., Hamilton 1986; Roberts 1989; MacAvoy 1993); research and development management (Rosenberg and Nelson 1994; Charpie 1978); communications (Issacs 1992; Senge 1990); university -industry roles (Aldrich 1995; Mowery 1992); and, venture assessment and investment literature (Timmons 1985; Silver 1985).

This condition generates an initial sense of investigative disquiet until the relationship of aspects of each of these is shown to have direct bearing on developing a more comprehensive understanding of the successful venture support phenomenon.

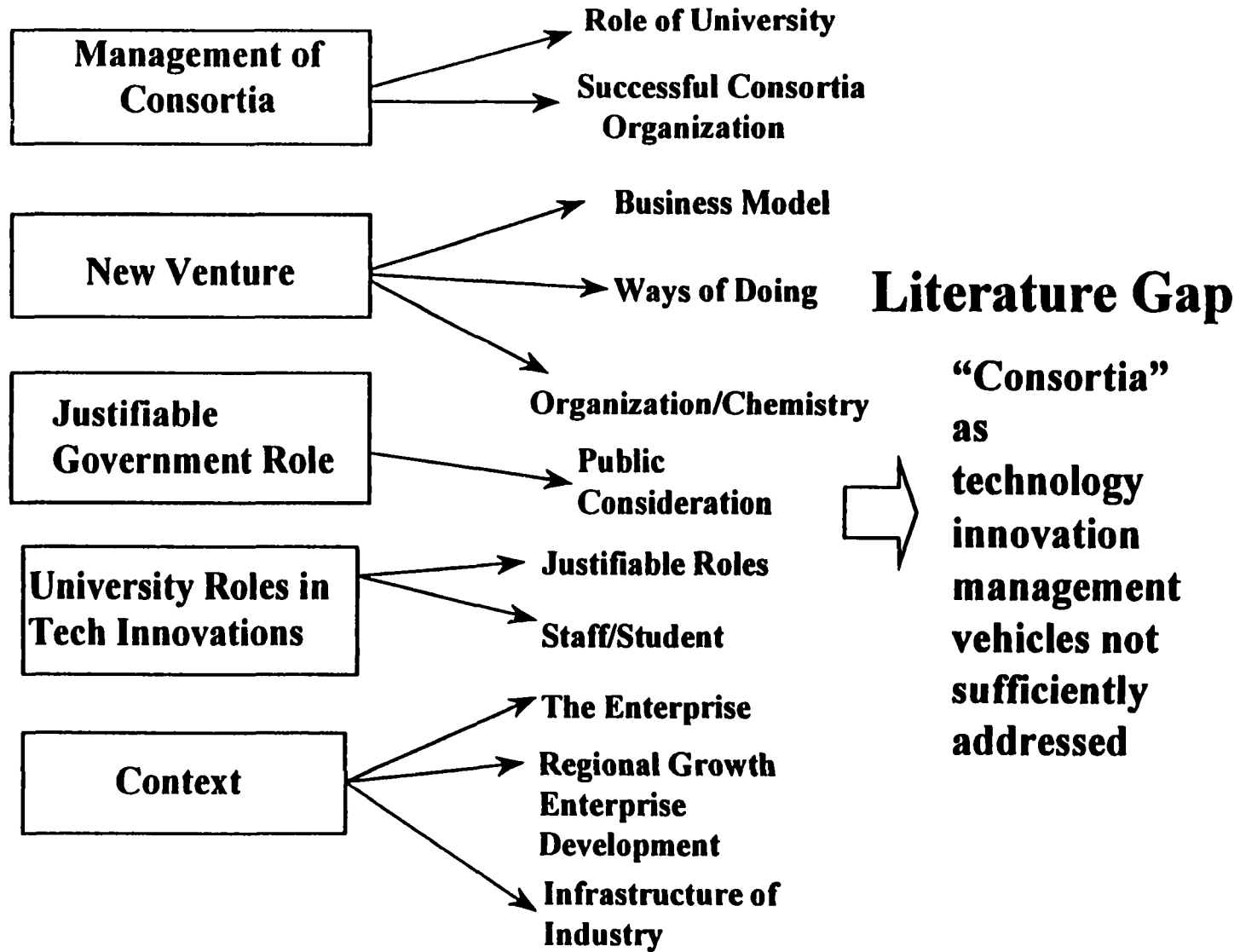


FIGURE 2. Conceptual Map of the Antecedent Literature

Thus -- for example -- to develop a better understanding of how to capture, the impact of developments in Utterback's 1996 paradigm for process and product innovations cycles, or Quinn's notion of industry specific lifecycle durations for new products and its impacts on the adequacy of a new ventures new product and/or marketing plan, the venture evaluator must recognize that multiple levels of situational context. Thus, for example (as the referenced paradigms will assert):

1. The industry under consideration defines the competitive product cycles and R & D organizational structures that must be in place to secure competitive advantage (Quinn 1992; Davidow 1992; and Utterback 1996);
2. The work of DeBresson (1991), Hamilton (1986), and Davidow (1992) suggests that innovation will successfully diffuse to the extent that networks of innovators are in evidence.
3. Galbraith (1982), Drucker (1989), and Minzberg (1989) suggest that organizations must isolate the emerging innovative socio-technical systems within the organization from political and other routine pressures so that innovative cultures will flourish;
4. Aldrich et al. (1995), Rosenberg and Nelson (1994) suggest that the role of the University in the US is to perform certain stages of the research, while the Charpie et al. (1978) report suggests that, what is appropriate for R & D demonstration (commercialization) pre-prototype research is clearly defined by the application product market in question; and,
5. Timmons (1985), Silver (1985) as well as the work of Goleman (1995) on the psychological temperament sufficiency or so-called innovating team

emotional IQ, suggest that team “chemistry” – given all the above being in evidence, is THE “show stopper” with regard to innovation.

This paradigm relationship is shown schematically in Figure 3.

The connections between these logical flows and the specific research questions whose answers were pursued in the course of the dissertation research activity are provided in the appendix (Appendix 2).

The Matter of Technology, Innovation and Its Management

Before addressing each of the major streams researched, it provides context to first discuss the underlying phenomenon whose management is the focus of the dissertation research. That is, what is this matter of technology innovation?

The concept referred to as “technology innovation” is perhaps most universally associated with the work on the so-called economic “Long Wave” initially developed by the economist Schumpeter (1954). Schumpeter postulated that in general there are four economic cycles which collectively capture the major underlying economic processes. For him, these four are responsible for all economic outcomes we experience. Further, Schumpeter asserted that entrepreneurship (which is the primary mode for capturing technological innovation) is primarily a behavioral outgrowth of economic activity which is adopted in an effort adjust to aspects of each.

The general economic cycles were viewed to effectively represent the various characteristic processes of economic development that may be observed to be followed pursuant to any major technology’s innovation. One of these four cycles, in particular, became *the* primary economic cycle of focus when the matter of technology innovation was considered -- namely, the so-called *Kondratieff* cycle. This cycle has received the

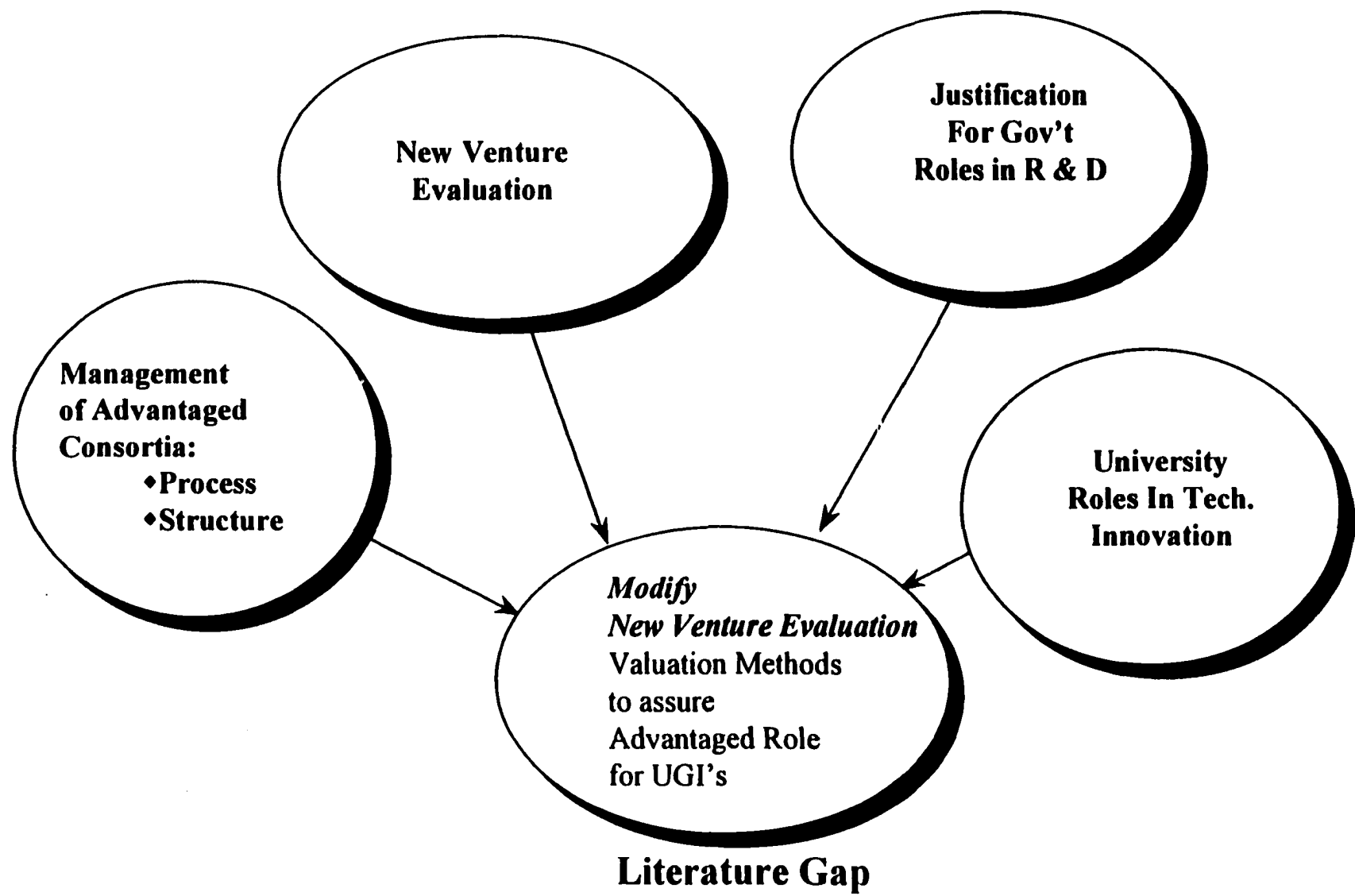


FIGURE 3. Relationship of Primary Literature Streams to Subject Research

greatest degree of research attention in that it is viewed as effectively capturing the generic technology innovative process.

Figure 4 depicts the process from the perspective of a promising idea being converted to a product, to an introduction, to that product's product-market, through to the characteristic associated product-market's growth, maturity and decline phases.

It is argued that the cycle of fundamental application of developments in science typically follows a 17 to as much as 80 year cycle (Renault 1997; Schumpeter 1954). Within that idea-to-"product-market" period, evolutionary development ideas generate a cornucopia of applications. These generated ideas are subsequently winnowed down through the process of subsequent research, development and new product commercialization and market management. The set of products that populate the "markets" at any given time are viewed as those that have emerged from this overall technology innovation process.

This characteristic process of idea screening and selection are represented in figure's 5 and 6 together with indications of the resource demands and "phase of development" associated with it throughout (Booz 1976). When considered at the "idea level" (that is, independent of the vested interests or organizational arrangements developed to provide for the process's completion), Roberts (1989) provided a schematic of the typical phases negotiated by this idea-to-product innovation process.

Noting that:

The process of technological innovation can take as long as 20-30 years; according to some studies, but for most

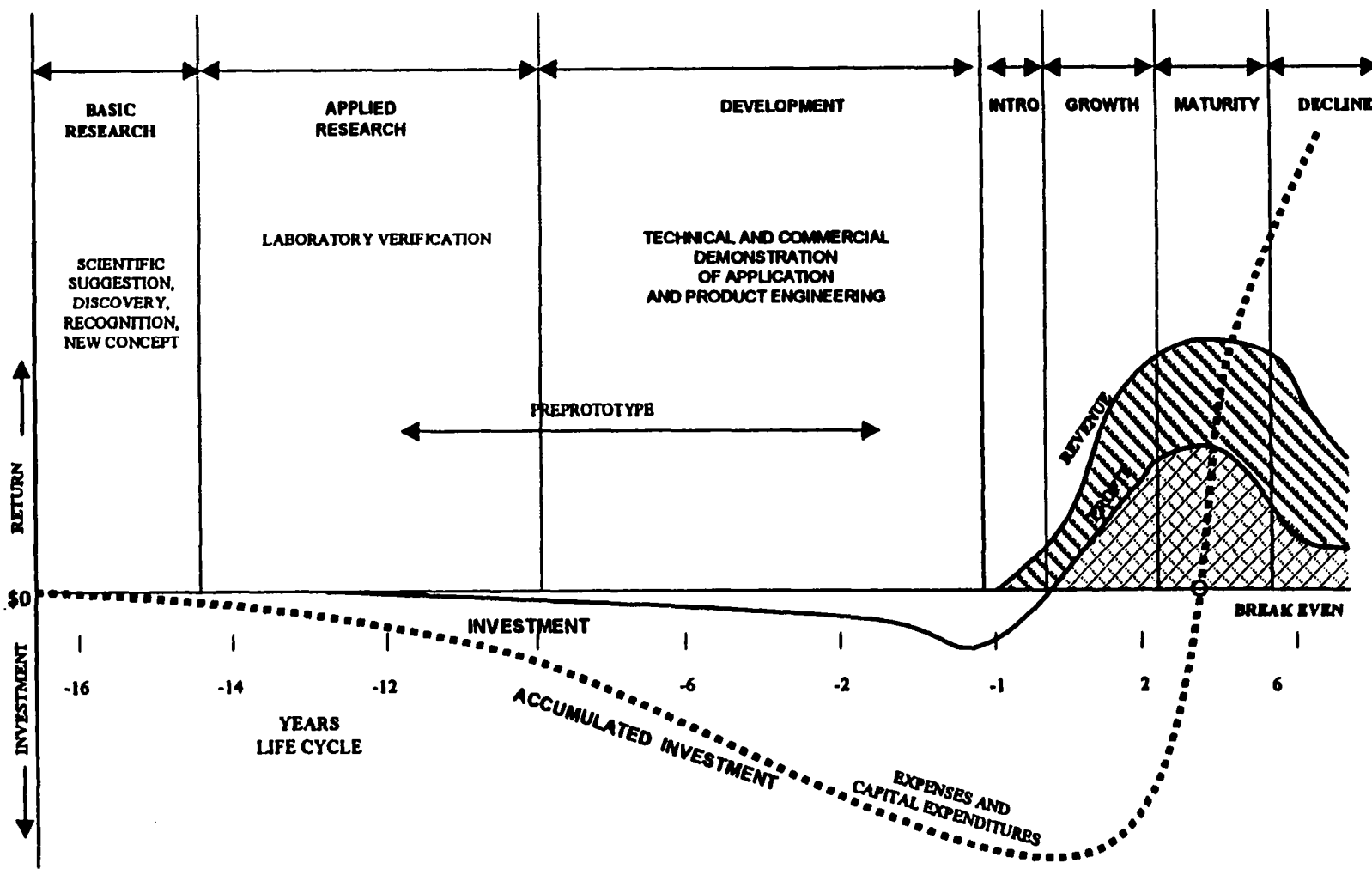


FIGURE 4. Technology Research and Development Process (adapted from Boos 1976;Renault 1996)

industrial product innovations the duration from initial idea to market is more likely to be three to eight years (Roberts 1989).

Key elements of this progression were identified to follow an iterative process whereby the firm's technology monitors in its initial stage of innovation, perceive that there is a potential demand for a what appears to be technically feasible innovation. This is followed in the second stage (dubbed the "Idea formulation" phase) by a procedure in which the perceived demand and technical feasibility are fused into a design (product or process) which is dispatched to a third phase. In the third phase (the "Problem Solving" phase) the team searches various sources of technical information including, experiment and calculation together with all available market information regarding potential uses for the application. In the fourth phase (the "Prototype Solution" development phase), solutions through inventions and/or adoption or adaptation of existing technology is accomplished through a combination of testing and market response examinations. In the fifth phase (the "Commercial Development" phase) Roberts (1989) suggests that any "bugs" or production or application "scale up" complications are worked out with the successful results being transferred to manufacturing. In the final phase, (the "Technology Utilization and/or Diffusion" phase), the innovation has been successfully captured in the product or process and is cleared by the market.

Up to this point, it should be noted that our discussion has failed to address the issue of this overarching process's governance. Process governance (or management) is perhaps the key to properly framing the research questions.

In the United States, there has been established an historical precedence with regard to the way the R & D function is managed and organized. However, the recent returns to relatively more extensive non-federal agency support for the R & D function in the United States (US) of America are causing pervasive reconsideration of that design and execution. This in turn has precipitated a wholesale reconsideration among the various non-commercial agencies designed to address the problem of their structures and R & D functional management processes (Rosenberg 1994).

The diverse literature streams that support any investigation of the key research issues relevant to this research could be viewed as overpowering. For purposes of our reaching objectives, we have focused on the five primary branches that are judged most suitable to support the research objectives.

We now turn to our review of these components of the literature.

The Commercial Sector Technology Innovation Management Process

Facilitating a more optimal management of the phenomena of technology development for economic development has been shown to primarily rest on the designs and processes employed to manage the process (Teece 1987; Galbraith 1982). From the standpoint of recent U.S. history, the basic structure with pervasive influence for innovative product and process innovation has in general, been the federal government. More specifically, defense department expenditures have continued to play a particularly significant role in the U.S. (Mowery 1992).

A nation's defense agencies constitute a dedicated, monolithic customer. As such, the convenience of having a more or less captured product-market has afforded

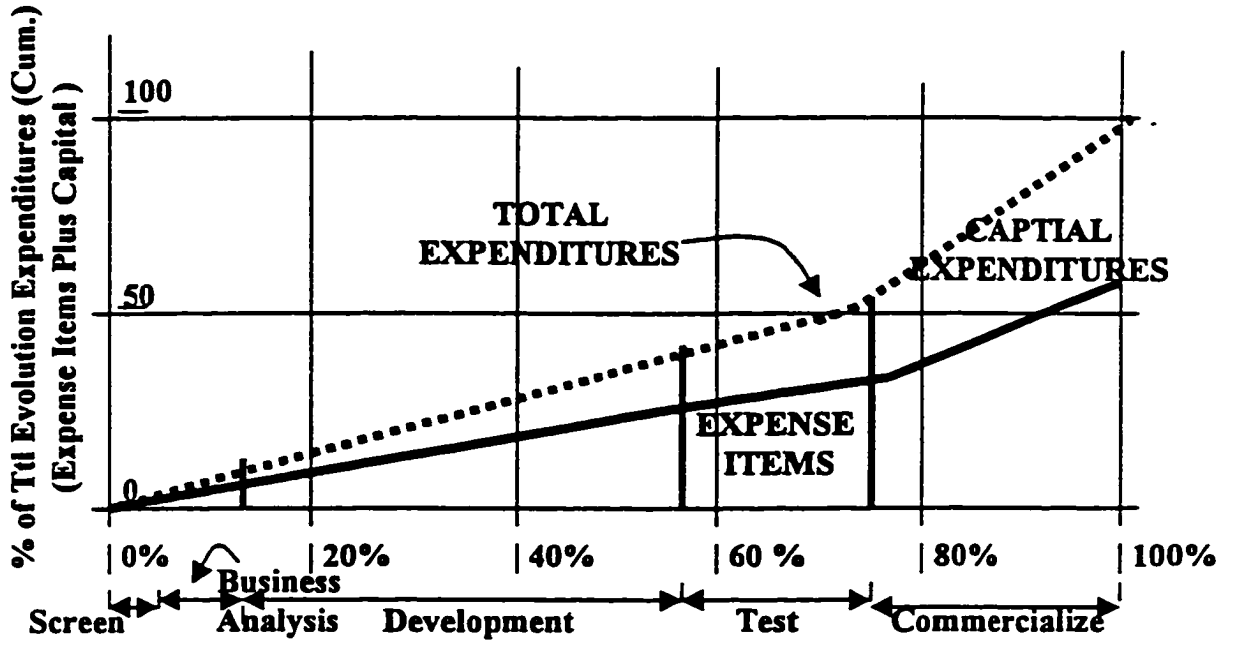
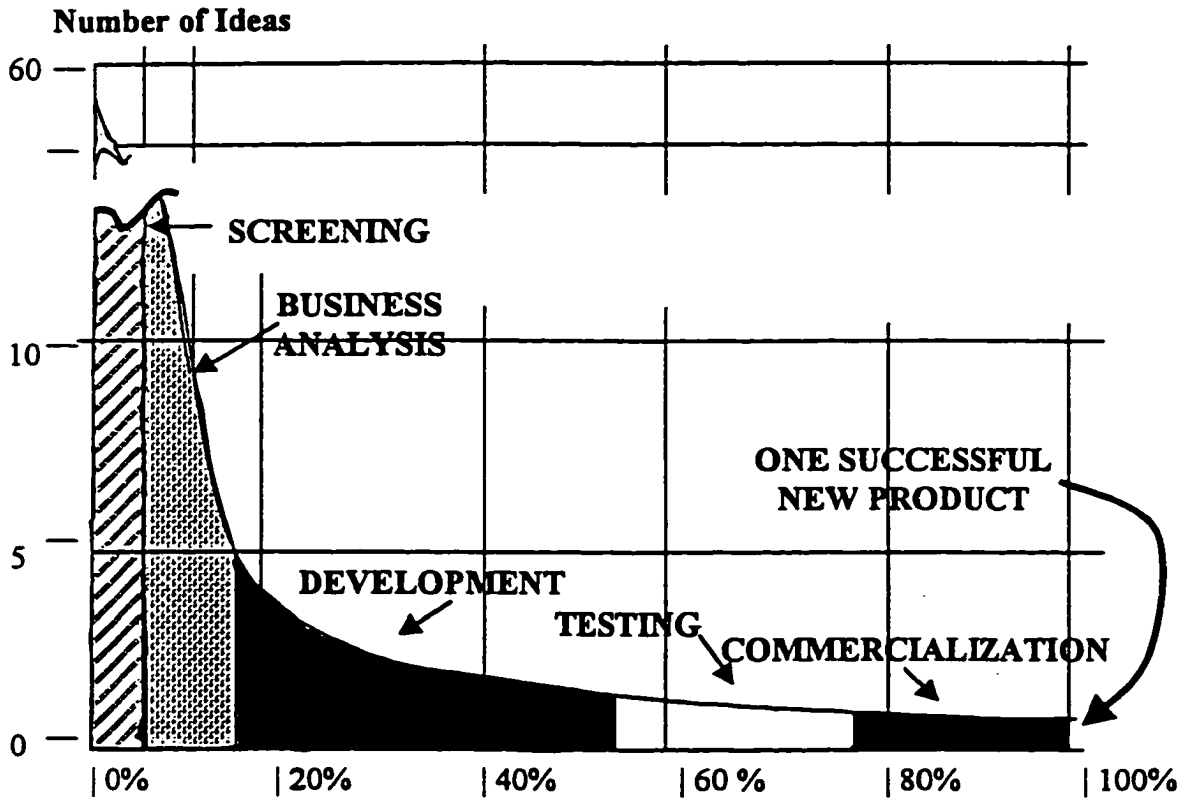


FIGURE 5. Cumulative Expenditures and Time (By stage of Evolution - Industry Average; Booz 1976)



(by stage of Evolution - 51 Companies)

FIGURE 6. Mortality of New Product Ideas (Booz 1976)

organizational, product development and deployment procedural arrangements that are somewhat unique. In this rather unique case, the various operating units of the military both define and serve as the “market defining” purchasers of the ultimately developed and deployed products. These products follow a process whereby internal consensus building proceeds market deployment. It is an arrangement that promotes and rewards organizational structures and procedures that are perhaps an anathema to commercial market realities. Thus, the ultimate customer for whose use the innovative applications were developed in the first place, can be more straight forwardly supplied by a consortia of government research laboratories. These are laboratories whose non-profit oriented commercial units both managed and conducted research for over the course of each of the key phases of research identified in the preceding figures (i.e., Figures 5 through 9).

To gain a sense of how the for-profit, private sector (or “industry”) addressed the phenomenon of the technology innovation and its associated management requirements (organizational and process), it is first necessary to observe that commercial focus has primarily been on the near-term (or commercialization) phase of the innovation process. Given that near-term timeline, perhaps *the* key to developing a commercial perspective on this issue is to consider the market competitive realities (and implied competitive options) as informed by corporate strategic imperatives (e.g., Porter 1985) for the industry being considered.

Firms will always be restricted by the dictum of taking decisions which return maximal “share holder value-added” (Drucker 1989; Hax et al 1986; Horwitch 1986) while assuring strategic flexibility (Harrigan 1986). As such, the options they typically pursue in formulating a technology management strategy are defined by fairly definitive

frameworks of analyses. Each of these frameworks factor in the context of their competitive environment as well as their strategic vision, core competencies, and financial performance requirements. This process is represented in Figure 7.

A key to this understanding is to consider the phenomenon of the technology innovation process from the commercial perspective as offered by a school of thought initially represented by Abernathy et al. (1978). This conceptual model has been extended most recently by the work of Utterback (1996) and others. Under this model, the technology innovation process (as captured in the form of its adaptation in products and production processes) can be viewed as following a characteristic cyclical process. In the process an industry's size, composition (e.g. , concentration) and dynamics of growth is predictable and varies only as a result of unique factors associated with the industry and the kind of product (i.e., assembled or non-assembled) to be manufactured (Figure 8). The dynamics that yield this outcome are described as follows: The initial technological innovation appears in the form of several variations of innovation in products as they are introduced into the marketplace. Each are either product-market substitutes (e.g., the substitution of florescent for incandescent lighting) or product-market defining products (e.g., the appearance of black and white TV in the 1950's). The number of firms addressing the market with a product based on the new technology will expand -- causing general product market expansion as they do. This expansion is also characterized with extensive entrepreneurial driven experimentation. Products are non-standard. Suppliers of product will be characterized by their experimentation in finding

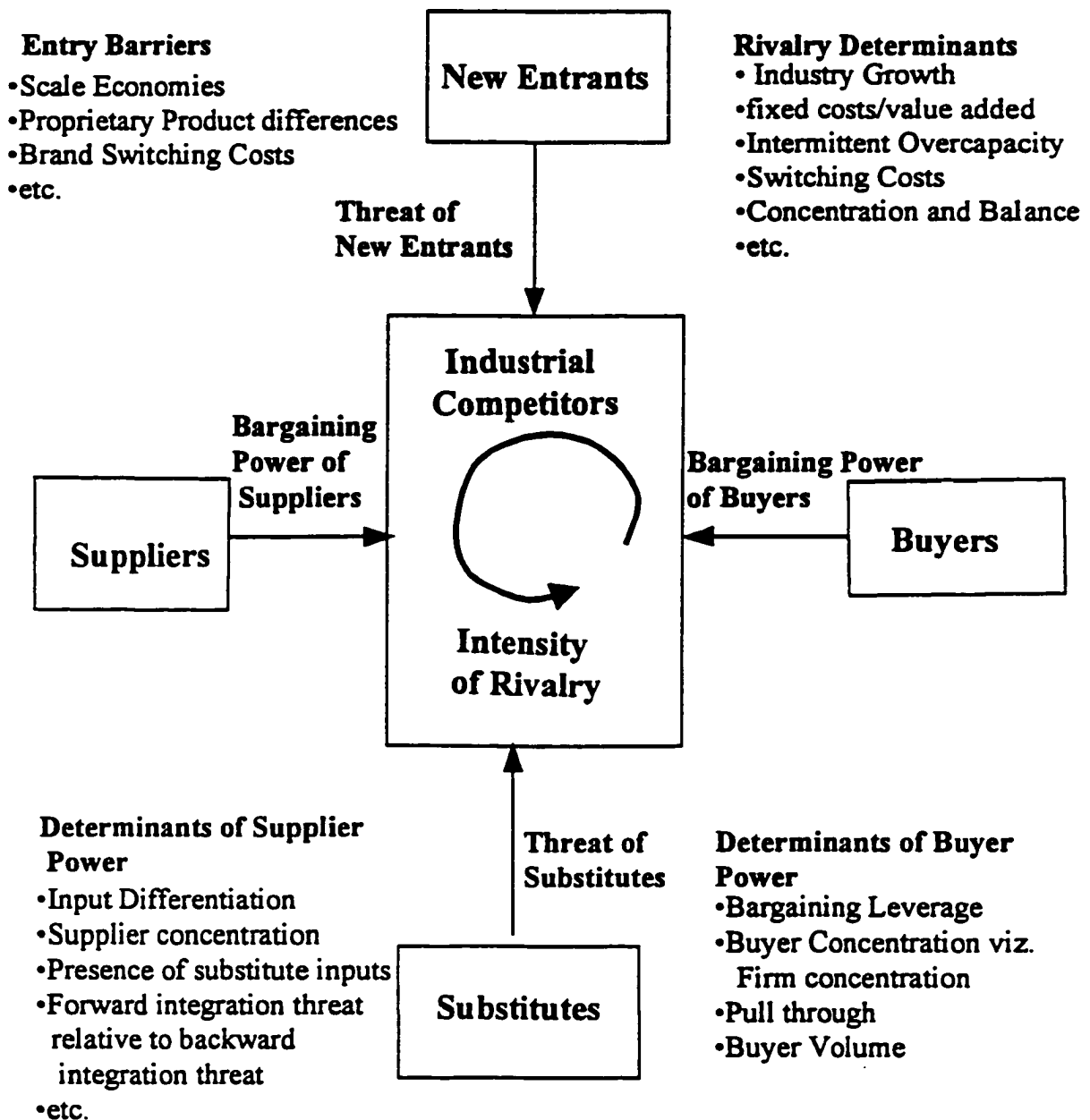


FIGURE 7. Elements of Industrial Structure (Porter 1985)

competitive advantages through marginally distinguishing product features. However, the primary form of discovery will focus on innovation in facets of the related functional areas (e.g., creative new ways of distributing product [*as Sharp did with the electronic calculator*], innovations in customer service, etc.) The market will vote its preferences (i.e., a producer's share of the market will manifest).

Product-market segments will develop *de facto* product standards -- if not legislated ones. Among the early innovators with significant share, some will begin to pursue competitive advantages through innovations in manufacturing. Innovations in this area can have pervasive functional area impact and return cost (and therefore contribution) advantages to the adapters together with other relative competitive benefits.

The lower curve in Figure 8 demonstrates, these manufacturing innovations will follow a similar cyclical form as the product growth curve shown in the figure. Inclusive of this, the oft cited "S-curve" pattern of technology maturation will be assured by the continuously operating process of innovation referred to earlier (MacAvoy 1993) as shown in Figure 9. The result is discontinuities that also yield extensions to product and process cycle life. The latter condition is represented by the dashed lines depicted in Figure 8.

The relationship of controllable resources that must be deployed to optimally address this phenomenon is shown in Table 1 on the subsequent page. This table provides a representation of recommended arrangement for key aspects to be the set of resources at the disposal of firms to realize advantage. As will be discussed subsequently, emerging commercial competitive realities (e.g., those of innovative organizational design and/or advantaged knowledge work team management practices

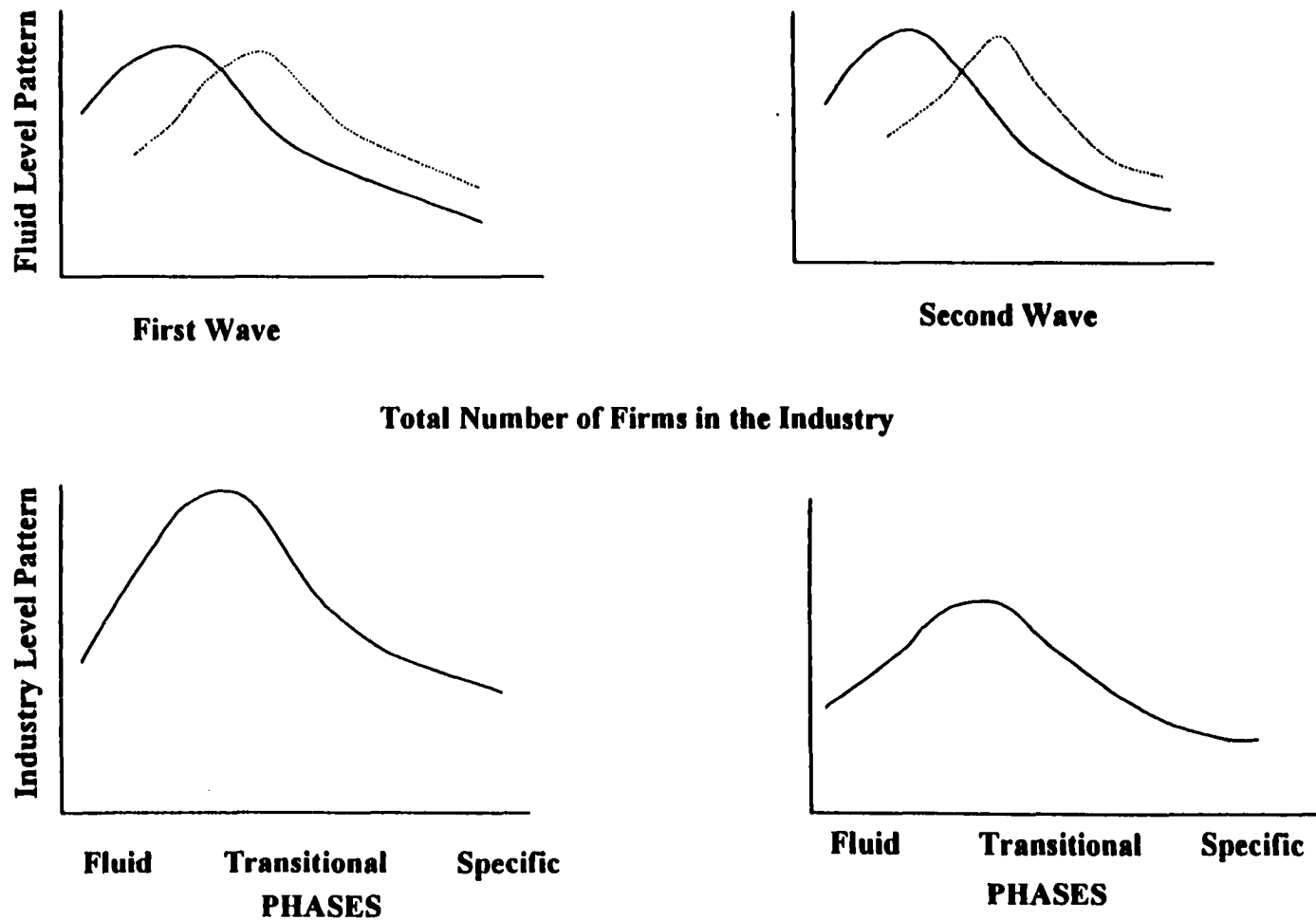


FIGURE 8. Dynamics of Product and Process Innovation (Adapted from Utterback 1996)

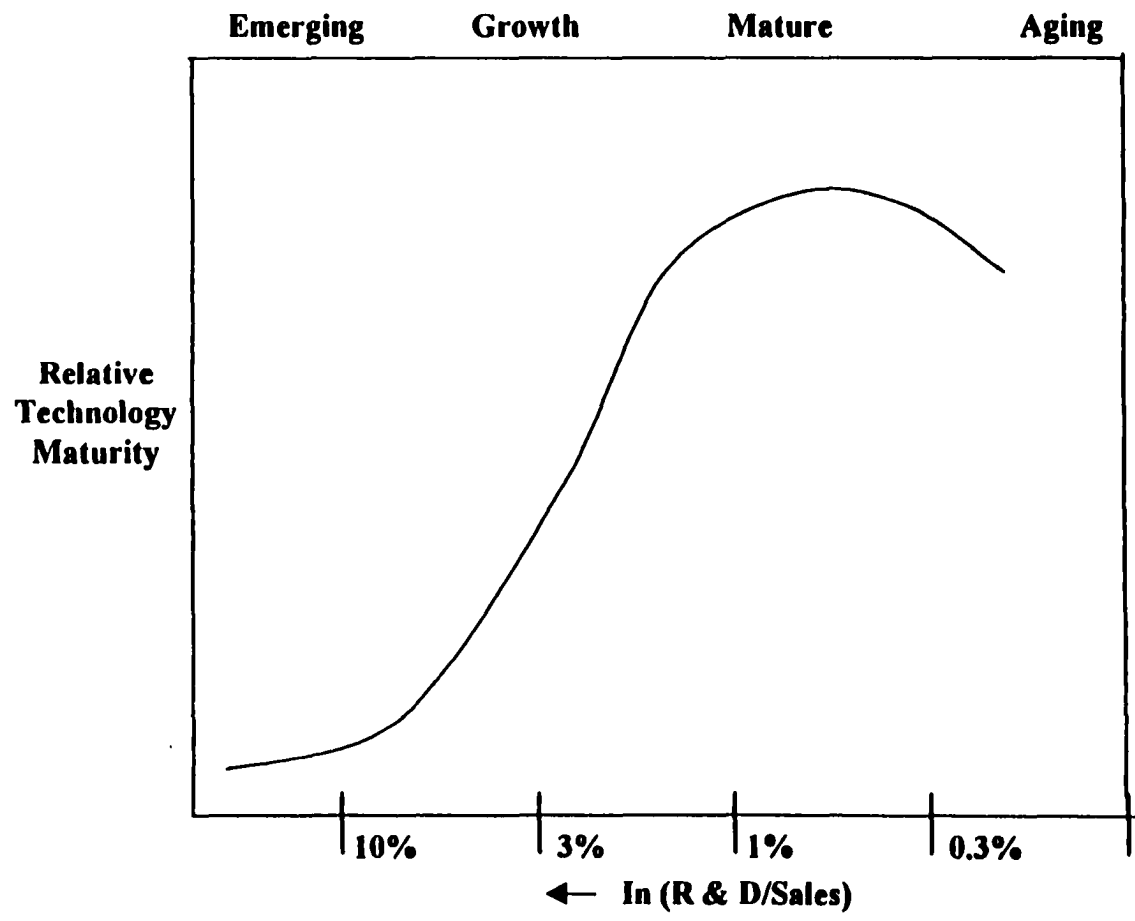


FIGURE 9. The S-Curve, The Product Life Cycle (Adapted from MacAvoy 1993)

	Fluid pattern	Transitional pattern	Specific pattern
Competitive emphasis on	Functional product performance	Product variation	Cost reduction
Innovation stimulated by	Information on users' Needs and users' technical inputs	Opportunities created by expanding internal technical capacity	Pressure to reduce cost and Improve quality
Predominant type of Innovation	Frequent major changes in products	Major process changes Required by rising volume	Incremental for product and process, with cumulative improvement in productivity and quality
Product line	Diverse, often including custom designs	Includes at least one product design stable enough to have significant production volume	Mostly undifferentiated standard products
Production processes	Flexible and inefficient; major changes easily accommodated	Becoming more rigid, with Changes occurring in major steps	Efficient, capital-intensive, and rigid; cost of change is high
Equipment	General-purpose, requiring highly skilled labor	Some subprocesses automated, creating "islands of automation"	Special-purpose, mostly automatic with labor tasks mainly monitoring and control
Materials	Inputs are limited to generally-available materials	Specialized material may be demanded from some suppliers	Specialized materials will be Demanded; if not available, Vertical integration will be extensive
Plant	Small-scale, located near user or source of technology	General-purpose with Specialized sections	Large-scale, highly specific to particular products
Organizational control is	Informal and entrepreneurial	Through liaison relationship, project and task group	Through emphasis on structure, goals, and rules

TABLE 1. Matrix of Technology Innovation Resources Management (Abernathy et al. 1978)

(Quinn et al. 1997; Quinn 1992; Senge 1992, respectively)) are perhaps beginning to dictate the set of specific approaches that one adapts to assure successful technology innovation management.

The Commercial Technology Innovation Management Process – Organization Issues

Organizationally, the tools for the management of techno-logical innovation in contemporary organizations takes on many forms (Teece 1987; Horwitch 1986).

Depending on the conditions of the market -- as well as the subject technology's intrinsic development requirements faced by an innovative product or process venture sponsor, (Figure 10) the tools employed by them perhaps optimally vary from:

- (a) wholly captured (and sponsored) internal product or process research and development to,
- (b) the kind of technology monitoring function embedded in their relatively mundane but routine support of selected staff's professional organization membership (Hamilton 1986).

In addition to the more obvious modes of direct investment in applied research and development in exiting products and process improvement, firms assure technological currency through a mix of these kinds of business practices. These range from patent licensing, the formation of certain strategic alliances, to the outright acquisition of smaller firms that enjoy a commanding lead in the advanced systems technology manufacture or market mechanics (Spekman and Lambe 1995; Mast 1990; Teece 1987).

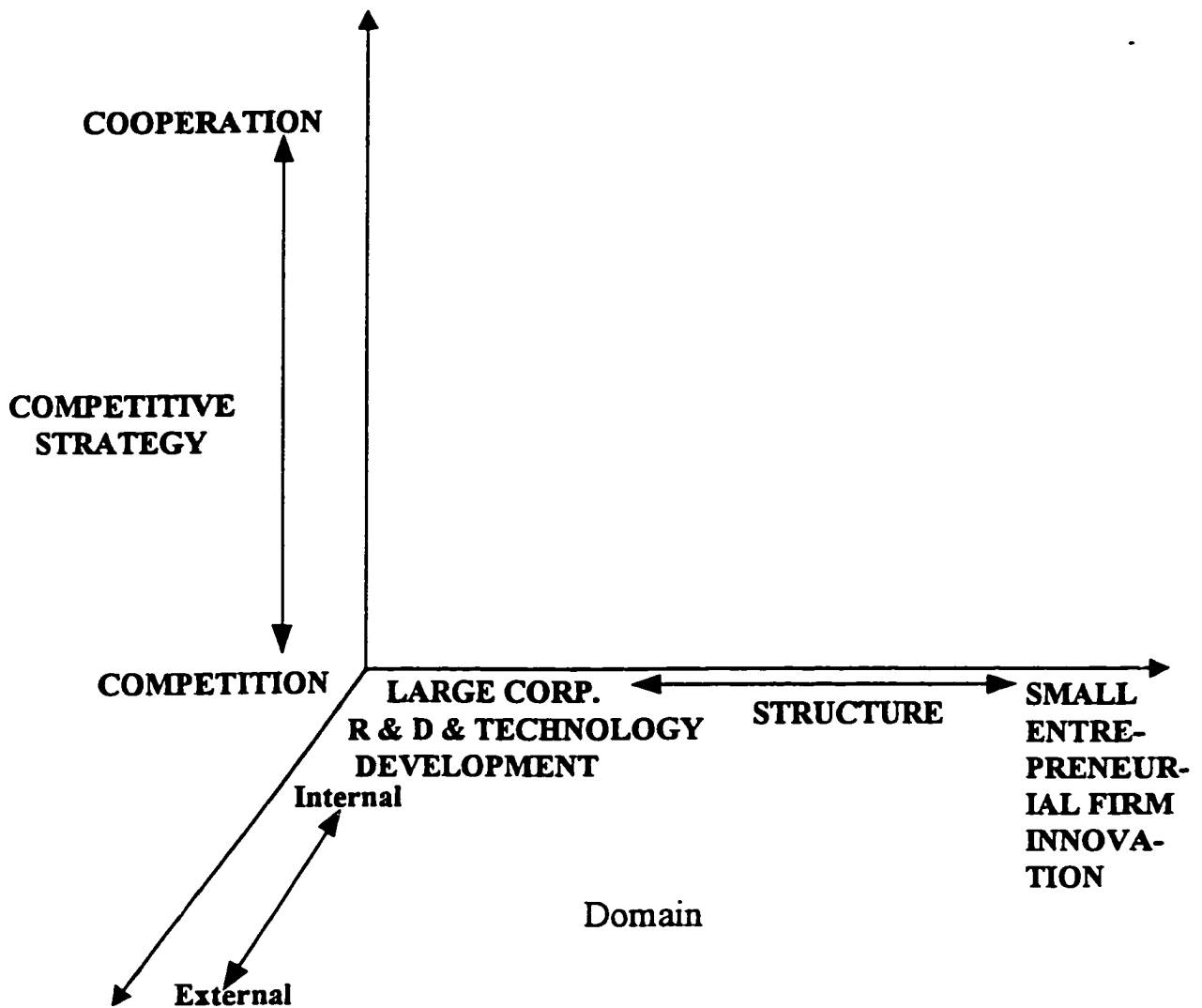


FIGURE 10. Elements of Modern Technology Strategy

(adapted from Hamilton 1986)

The recommended process for arriving at a “well suited” approach for defining the advantaged organizational form to pursue in contemporary commercial technology innovation management practices is shown in Figure 11. In this process, the strategic vision of management of the firm, when filtered through the constraints of company cultural, current core competencies, and the extant base of engineering technology and applicable science, must consciously pursue an approach to product and process technology development that has the effect of supporting the realization of its strategic goals (MacAvoy 1993). As Figure 12 reports, these fall into three generic categories: either a Windows, an Options, or a Positioning Strategy (Hamilton 1986).

Briefly, the so-called “Windows” strategy recommends that the firm follow a strategy of monitoring the technology through the use of relatively low cost practices (e.g., adopting the practice of allowing professional staff to participate in professional conferences, or subscribing to technical journals that cover the area, etc.). This technology environmental scan approach is beneficially used in the case of innovative technology concept applications with high levels of technological uncertainty associated with them.

In the “Options” strategy, firms participate in technology development in a limited way that also avails them of the option of adapting the technology relatively quickly should they decide its use in their products or processes. Thus they undertake such practices as staff exchanges both at the product and potential process technology experimentation level to assure the option of aggressive innovative product or process response.

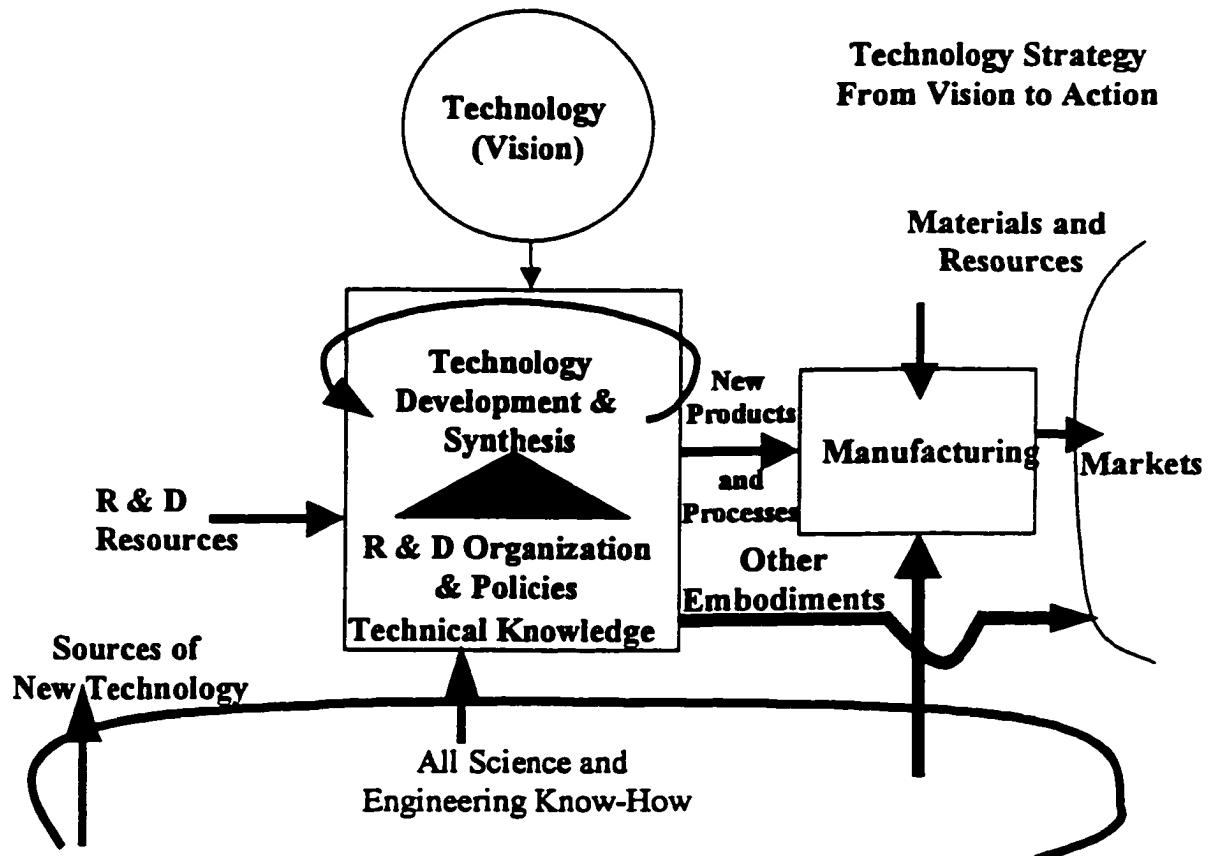


FIGURE 11. Architecture of Commercial Technological Strategy Management

(adapted from MacAvoy 1993)

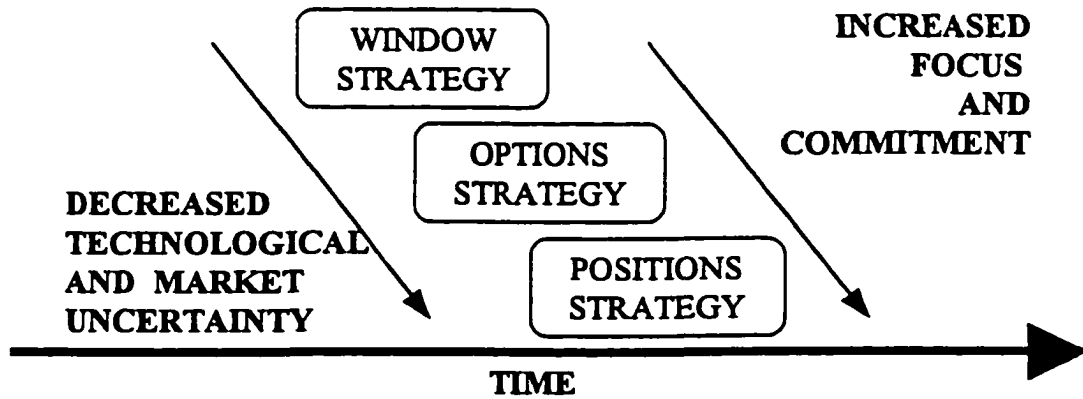


FIGURE 12. Progression of Technology Strategies

(adapted from Hamilton 1986)

The third option (Positioning) speaks to the strategic approach that includes any of the set of partnerships that includes: (a) securing licensing contracts, (b) entering into joint ventures, (c) supporting internal development or (d) undertaking an innovative technology product/process business acquisition. This is the strategy with the highest financial risk exposure, but also with the greatest opportunity for control. It can also have significant market defensive benefits.

Each of these generic strategic approaches can be viewed as viable options adapted by established firms for alliances. Table 2 reports how they are properly associated with specific dimensions of the type of alliance that they support as well as their key characteristics (that is, their benefits and limitations).

With the advent of the kind of dramatic commercial success realized by contemporary organizational "cross boundary" *co-operations*, forging relatively "seamless" innovative structures and operational mechanisms has assumed a clear priority (Womack et al. 1990). As with the application of "Kanban" or "Just-In-Time" manufacturing schemes, competitive advantages garnered through the effective coordination of the "critical-to-success" functional areas found in any given product's resource supply -production-distribution-marketing channel, will not go unattended. The near instantaneous associations of critical commercial partners -- necessitated by contemporary management paradigms -- places increased emphasis on more comprehensive review and appraisal of entrepreneurial ventures (Davidow 1992). This is true for both the more traditional independent start-ups as well as the internally generated new ventures. These intrapreneural activities are increasingly responsible for defining the nature of technological innovation. Whether the focus is on entrepreneurship or its

ALLIANCE	STRATEGY			COMMENTS
	WINDOW	OPTIONS	POSITIONING	
RESEARCH GRANT	✓			<ul style="list-style-type: none"> • Access to pioneering research • Limited proprietary benefits • Not appropriate for targeted R & D
R & D CONTRACT	✓	✓	✓	<ul style="list-style-type: none"> • Complement to internal R & D; minimal resource commitments • Limited control; transfer of technology difficult • Very flexible: focus can range from exploratory to commercialization; often linked to licensing arrangements
LICENSE			✓	<ul style="list-style-type: none"> • Early access to new products/processes; limited initial investment • Dependence on others; long term costs may be high • Focus shifts from technical to market development
EQUITY	✓	✓		<ul style="list-style-type: none"> • Limited initial commitment required; some opportunity to influence R & D directions • Limited control; access to technology difficult • Often associated with R & D contracts/licensing arrangements; may lead to acquisition in long term
JOINT VENTURE			✓	<ul style="list-style-type: none"> • Shared technical and commercial risks; takes full advantage of complementary strengths • Potential for conflict between partners; can require significant financial and personnel commitments • Focus shifts from development to commercialization

TABLE 2. Principle Strategic Roles of Alliances Used by Established Firms (Hamilton 1986)

cousin, intrapreneurship, there is perhaps an increasing benefit to be realized by devising tools to aid the associated venture assessment process (Mast 1990).

Strategic Market Competitive Technology Innovation R & D Implementation and Management – Structure

Quinn's et al (1997)'s compilation of various R & D organizational structures suggests that relatively greater success in “innovative-technology-management-through-R & D-generated” venture support -- on the part of Consortia -- would come from adopting those new venture's whose planned market distribution channel's are well suited to match or feed into what are product-market specific (and known) optimally advantaged organizational structures for commercial R & D. Structures that, in fact, tend to characterize the industry under consideration. These structures capture or reflect:

- a) Existing or emerging industry standard dynamics of product and process lifecycles; and,
- b) Industry defining modes of corroboration (e.g., those dictated by channel management dynamics – as examples, Williamson's (1983) transaction economics scheme, or the “networks literature” in marketing regarding R & D channel management through so-called “tacit” dominant-subordinate channel member capital investments).

Forms of Governance/Ownership (Types of Partnerships)

Appropriate degrees of functional outsourcing as addressed in Chesbrough and Teece (1996), modification of Williamson (1983) along the “Virtual-Integrated Corporation Continuum” or, the governance issues represented by “ tacit technology investments” dimension (low uncertainty and asset specificity vs. high uncertainty and

asset specificity is clearly significant consideration in investing in consortia based venture support activities. As such, issues of whether the sponsored new venture's organization structure is well suited to facilitate corroboration with commercial partners emerge. Additionally, the degree to which the intended product-market's new products development structure will be accommodated by the organization, operations policies or product/services delivery mechanisms employed by the new venture business model are increasingly being seen to be important commercial venture assessment criteria. Also requisite new venture business model design features are important.

The Emerging Role of University-Industry-Government Technology Innovation Management Consortia

Due to shifts in modes of globally based competition, advances in the technology for knowledge generation and management (Quinn et al. 1997), the need for accommodating cross institutional border collaboration has been generally recognized as essential. As a result consortia activities as instruments of innovation management are rapidly emerging as vital.

Extending the work of Aldrich et al.(1995) would suggest that the extent to which successful consortia projects can be shown to have effectively anticipated the need to match up well with the organization and procedural norms is a potentially theoretically rewarding line of inquiry -- norms which characterize the target product market of the championed technological innovation.

An associated development, given supporting field evidence, might be to discover the most effective ways to incorporate this area of assessment into routine venture investment and feasibility methodology in a way that assures that the idea is

addressed during evaluation or captured by specific project support decisions.

Technology Innovation Management, the Virtual Corporation, and the Criticality of “Innovator networks”

Although coined possibly as an outgrowth of work done on the notion of creating a so-called virtual learning team (Senge 1992; Issacs 1992; Schein 1992), perhaps the term “Virtual Corporation” experienced its primary widespread dissemination with the publication of the popular treatment of organization invention associated with the personal computer as chronicled in Davidow and Malone (1992). For them, a virtual corporation was a firm that pursued a practice whereby it would:

... an ideal virtual product or service is one that is produced instantaneously and customized in response to customer demand (Davidow (1992, 4).

A more elaborately description of the notion as advanced by them was as follows:

To the outside observer, it (*The virtual corporation*) will appear almost edgeless, with permeable and continuously changing interfaces between company, supplier, and customers. From inside the firm the view will be no less amorphous with traditional offices, departments, and operating divisions constantly reforming according to need. Job responsibilities will regularly shift, as will lines of authority—even the very definition of employee will change, as some customers and suppliers begin to spend more time in the company than will some of the firm’s own workers. (Davidow et al. 1992, 6)

They continue by adding that:

...This change in the nature of “product’ will cause blurring of functions which are now understood to be manufacturing, design, delivery, finance, marketing – indeed, a new meaning of ‘company’ ... (Davidow et al., 6).

Thus, the idea of the virtual corporation as being one that is product-market specific in its structure and processes is suggested. It trades off flexibility in responsiveness to the market against the organizational rigidity and inertia associated with more traditional corporate practice. There is clearly an assumption of the existence of a trade-off between “product market stability” and order with business model -- as well as product -- inventiveness and experimentation.

As stated earlier, even with this concept as applied to all aspects of corporate operations and structure, our focus is on just one aspect of the general class of corporate functions (Porter 1985) – i.e., the management of technological innovation. From a technology strategy point of view, this outcome was somewhat predicted in earlier work that addressed technology strategy formulation (MacAvoy 1993; Porter 1985, Hax 1985); technology innovation management (Quinn et al. 1997; Galbraith 1982 and, the emergence of consortia for technology innovation research and development management (Aldrich et al. 1995)).

Nonetheless, it was perhaps with the relatively recent ascendancy of the practice of forming so-called strategic alliances to realize technology innovation objectives that a more specific notion of the virtual corporation emerged (Spekman et al. 1996). This is the notion of the virtual corporation being one motivated by its desires to address competitive realities with advantage. As indicated by Chesbrough and Teece (1996) there are a class of contemporary firms that are electing to undertake a mode of innovation that lends itself – in selected circumstances -- to the practice of “...Subcontract anything and everything (decentralize, downsize, forge alliances) to pursue innovation.”

For Chesbrough, the rationale for the phenomenon can be gleaned when the practices' benefits are contrasted with its disadvantages (or "Disbenefits" (Table 1)). Key is the trade-off between incentives and control and organizational form. It will be assumed that the nature of the emerging business practice trend can be suitably represented by drawing the readers attention to the description of the increased reliance on entering into strategic alliances for innovation as articulated in (Spekman et al. 1996; Chesbrough et al. 1996; Aldrich et al. 1995; and DeBresson et al. 1991).

It has been argued (Chesbrough et al 1996; Horwitch 1986) that in the increase in R & D functional area outsourcing is being called upon as a rational response to market uncertainties in interaction with underlying technological uncertainty (see Figure 11, 3).

Quinn (1992) reports the variability of R & D management practice and provides a sampling of organizational structural innovations firms have recently adopted in an attempt to realize competitive advantages. The use of these better suited organizational structures has emerged, given the combination of technological phenomenon, competitor behavior, and supporting R & D structures characteristic of product-markets they face (Quinn et al. 1997; Quinn 1992).

Figure 13 (shown on the following page) shows these results of structural innovations. Consideration given to these results, together with complementary findings of subsequent work published by Quinn et al. 1997 and Utterback 1996, suggest that a key factor in determining the more exact forms best suited to market conditions faced by the venture will depend on a number of factors that must be considered by the decision team. These included: technology uncertainty; where in the cycle of the innovation's

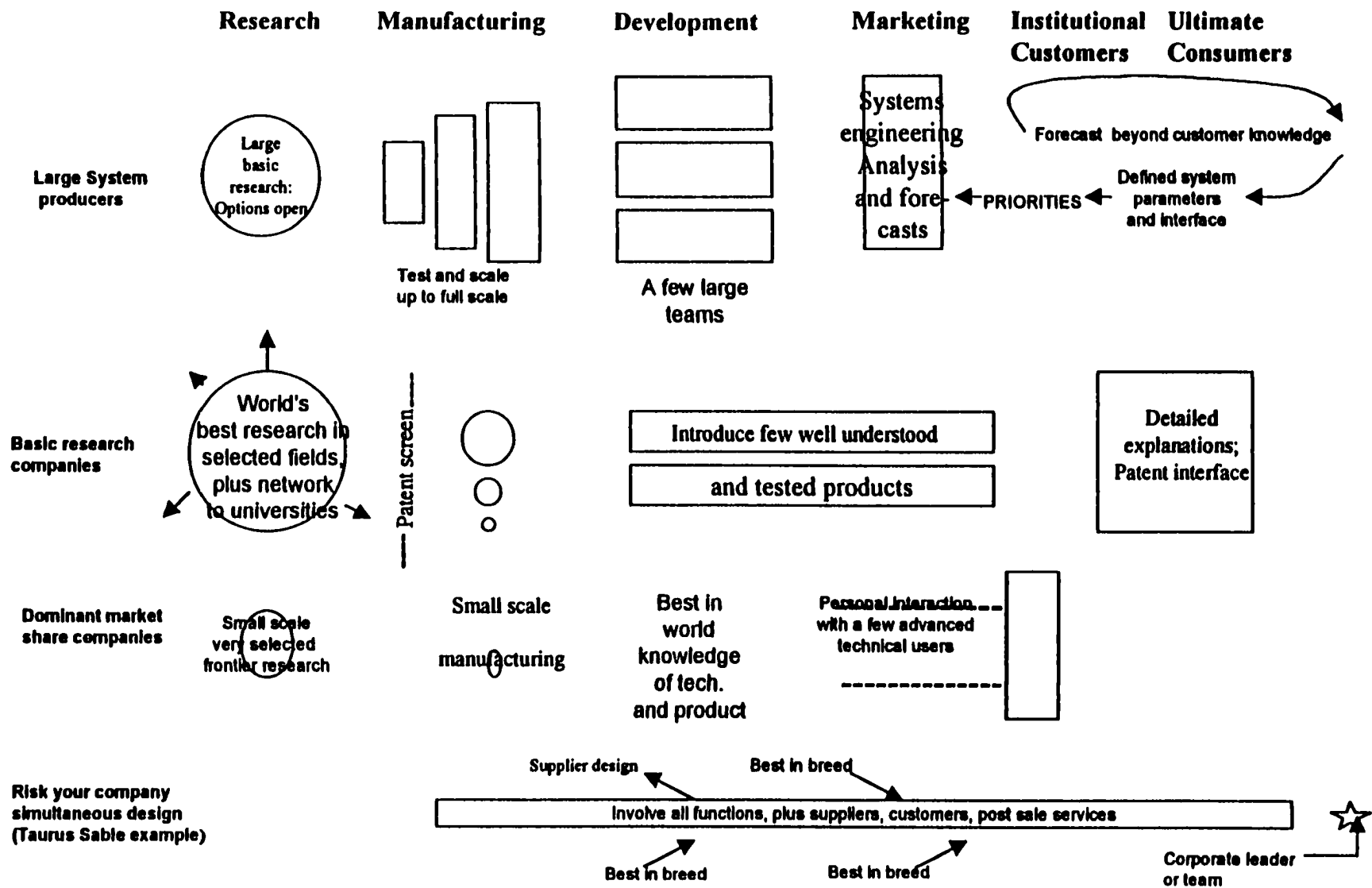


FIGURE 13. Research and Development Organizational Structures (adapted from Quinn et al. 1997)

development the product market is; the structure of the industry in which the innovation is being targeted; the character of the innovation that is being managed (invading or evolutionary, product, or process, etc.); and, the firm's relative market position (e.g., large system producer vs. One-off job shop) together with its chosen view of itself (its core competencies, its cultural pre-dispositions, etc.).

Assuming that there is a desire on the part of contemporary firms to realize relative cost containment and enhanced "product-market responsiveness flexibility", the recorded increases in the R & D functional area alliances observed can then be used to support the primary area of challenge for this dissertation research: That of discovering advantaged commercial venture support management practices for university-federal agency-industry and state government agency consortia.

Matching Organizational Form to Type of Innovation

Chesbrough et al. (1996) suggest that in addition to the particular aspects of the decision to outsource innovation captured in Table 2, the primary specific consideration is more about the dynamics of the structures called for by the overarching economics (i.e., the scope and scale economies concerns as these factors are discussed in Chandler 1990 and Williamson 1983), than would typically be assumed. These are:

- The dichotomy of product/process type (e.g., which of two generic types of innovation are being considered for innovation management):
- Autonomous (turbo supercharger to auto engine);
- Systemic (Instant photography, or realizing "Lean Manufacturing"); and,
- Determine information flow requirements of innovation as key to form selection (autonomous products benefit from industrial standards, systemic

products don't (alliances are called for in some aspect of innovation organization)

The literature suggests that well managed firms – in their outsourcing decisions -- will chose those sources that have the effect of leveraging core competencies in a way that result in these competencies anchoring a network. This condition is key to making it possible to outsource (virtualize) as many elements as possible without loosing the ability to effectively manage the innovation process (Chesborough et al. 1996).

Innovation Networks and Outsourcing.

It was suggested by the literature that, a compelling insight into the phenomenon of contemporary commercial innovation can be better understood when the dynamics that surround the contemporary practice are better understood. DeBresson et al. (1991) compiled a summary of the literature that could be viewed as offering insights into 'how' a paradigm of networks of innovators is useful in gaining an understanding of what works – and what does not.

The “Virtual Corporation” as an Approach to Management of Innovation:

Is a “network of innovators” – as it might be captured through any of the variants of partnership between governmental agencies, quasi-governmental consortia, or corporate and venture start ups (e.g., joint ventures, strategic alliances, etc.) – a legitimate expression of virtual corporation?

As DeBresson et al. (1991) point out in their rather insightful piece: “a network approach enables us to incorporate many complementary and recently developed strands of analysis and aspects of innovation” (DeBresson et al.1991, 369). The sense of the key relationships are shown in Figure 14 on the following page.

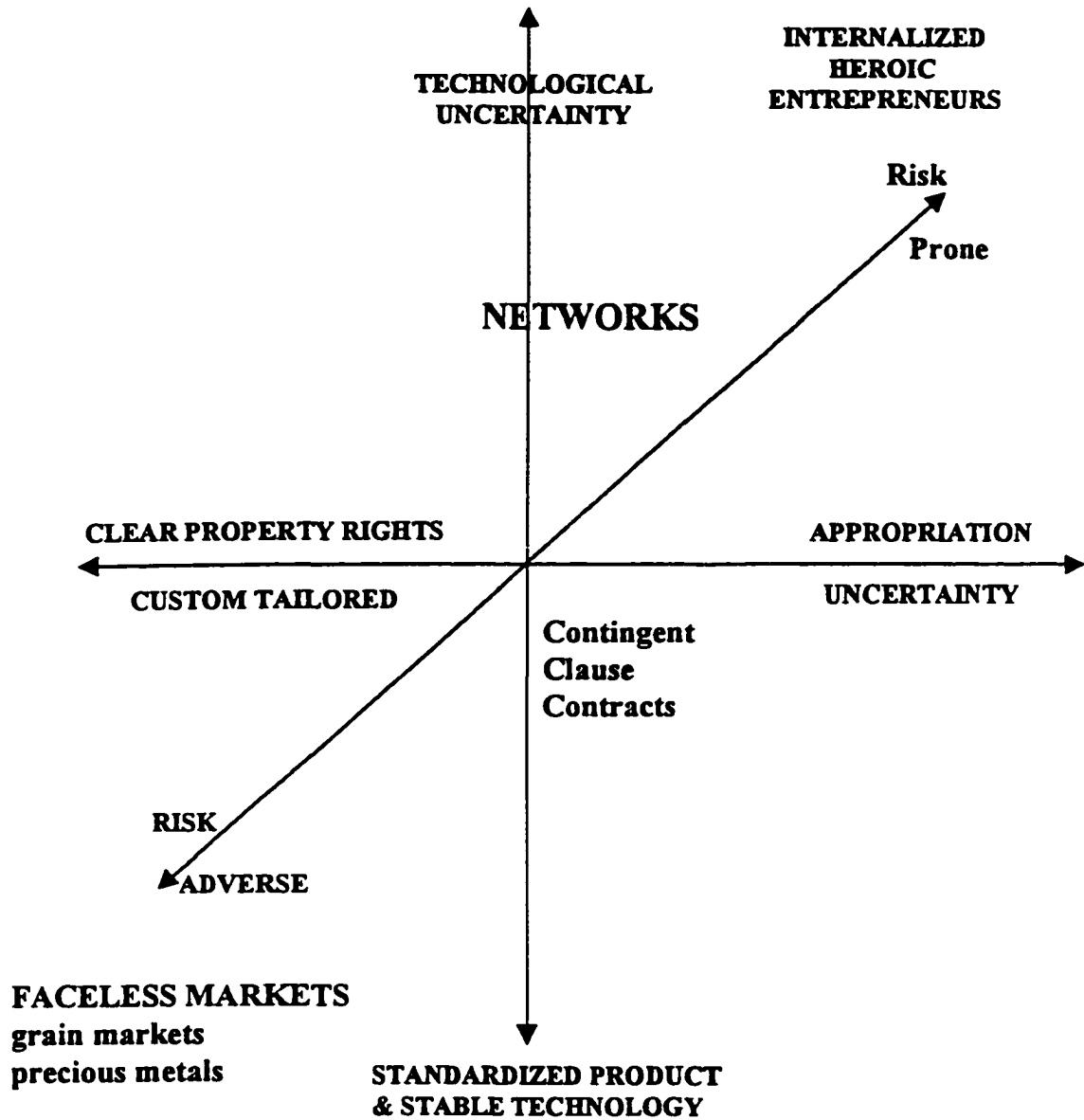


FIGURE 14. Dimensions of Technology Innovative

Networks (Debresson et al. 1991)

A key observation rendered by their work is that technological innovation networks exist outside of organizations. That is, certain types of inter-organizational linkages that are also appropriate for technological transactions. In particular, the set of transactions made necessary in the course of attempts to develop innovations. Although this theme of requisite isolation from the sponsoring agency culture is identified elsewhere, (Chesborough et al. 1996) in Table 1) it was explicitly called for by Galbraith (1982) in his ground breaking study of the organizational requirements for innovation in large organizations. This idea was also underscored by Mintzberg (1979).

It is possible to view a “network of innovators” through a treatment of social organization’s requisite boundary management. Here – as precedence of various new product or process innovation success has repeatedly shown -- the boundary is that defined by the “community of experts” that share a level of understanding of the science and application technology that is required to support the innovation. When the use of the various available strategic choices of innovating organizational schemes (e.g., that of relying on virtual versus vertically integrated enterprises) is considered, the requirement for key venture team staff membership in so-called “innovators communities” is observed to be key. The relationship of staff membership to venture success is an outcome whose importance is not assuaged by commercial competitive circumstance. That is, it is an essential characteristic of success in all enterprises whose innovative business model are based on the application of product, or process technology innovation. And one requirement for success is found not to be altered by or limited to national affiliation, geographic reference, or even academic discipline (Debresson et al. 1991).

Government Roles in Research and Development

Historically, the role of government research and development efforts was viewed as “priming the pump” for the innovation process (Yager et al. 1997; Mowery 1992; Charpie et al. 1976). In this view, the two research and development areas of focus for the federal and other non-commercial enterprise activities predominately centered on the basic and applied research phases (or pre-prototype phases) of any given technology’s development.

A redeployment of the formerly centrally controlled government assets to state, regional, and private enterprise jurisdictions has been discussed in the context section of this literature review. As Quinn’s et al.(1997) research attests, this redeployment of assets affects any given industry’s innovation management resources including those concentrated on the research and development function. This is precipitating significant shifts the enterprise models employed for new product and process development and their multi-sector adaptation.

In addition to the aspects of the shifting role already discussed in the course of the treatment of commercial technology innovation management issues, we take up the further implications of this shift in the following sections.

New Ventures, Technology, and Regionality

Emerging economic realities are placing an increased level of significance to paradigm innovation with regard to the alteration of the more traditional practice of commercial venture assessment (Drucker 1989). Obviously, such concepts manifest themselves at the local level.

To that end, it is at the local-level that supports for ferreting out viable new venture opportunities have a "dotted line" implication to the management of innovation. For it is there (i.e., locally) that technology research and development -- as well as its deployment/dissemination -- will happen. Ventures will be effected by the need on the part of suppliers and/or original equipment manufactures' (OEM) to manage the explosion of complementary technologies. Clearly, the process of launching (with suitable resources) new lines of business directly related to the more effective capture of associated "new technology" research, development and managed innovation is key to protracted competitive success (Porter 1985).

The Network and Local /Regional Innovation Management Literature

R and D management practices (particularly in the United States) continue to be a major focus area for defense systems management. "Venturing", as a practice and academic discipline, has been concentrated primarily in commerce and in academic business studies practice areas, respectively (Mowery 1992). Traditionally, models of the process entail following a path of assessment. It is a path of assessment that includes as a primary phase, the evaluation (judgment) of the plausibility of the business venture -- in terms of its product technological feasibility --together with a perfunctory assessment of the commercial feasibility of the various significant organizational subsystems associated with its economic viability. This process -- in various forms of rigorous exercise -- depicts the venture evaluation and development process.

Research has been directed toward developing more thorough understanding of the process so that decisions might be better taken to improve the process' management. The results have almost universally shown that among the key ingredients to realizing

success is the development of a “critical mass” of local or regional infrastructure and related complementary innovative networks or communities (DeBresson et al 1991; Bianchi and Bellini 1991; Piore and Sabel 1984; Bell et al. 1978).

Concepts of Venture Evaluation--Business Viability

According to a variety of authors treating the subject, the assessment of a venture’s likelihood of success has associated with it some common (perhaps tacit) considerations that do not vary massively given differing perspectives by which they can be (and are) routinely viewed (e.g., Timmons 1985; Silver 1985).

Three distinct -- but related -- approaches seem to be most salient. These are:

- A critical elements adequacy "check list";
- An Assessment of the Ventures' financial viability; and,
- The suitability and sufficiency of the "human capital" team intended to managed and execute the venture from concept-to reality-to success (i.e., a competitively profitable and "going" concern). We considered each in turn below.

Critical Elements adequacy "check list"

Timmons (1985) and Silver (1985) both suggested a process to assess how a specific venture will rate. The rating is for each of the various dimensions that capture the underlying forces that assure success or failure in any new venture.

As is shown by Figure 15, Timmons (1985) suggests that a new venture can be assessed by the confluence of three forces:

- (a) The characteristics of the founders;

- (b) **The nature of the opportunity (technological viability, market predisposition, favorable financial conditions and price/cost advantaged competitive position); and**
- (c) **The degree of command of the requisite resources to effect the business concept.**

Table 3 reports the critical elements that must be addressed as well as the routine manner in which they are integrated.

Assuring that all elements are in place is the task of the venture evaluation team, entrepreneur, and eventually the key venture partners (founding employees, financiers, strategic partners, and to a lesser extent, the intended customers and necessary suppliers). Thus the metaphor of the "Check List" serves to represent that approach. New venture evaluation issues turn on how expert judgment appraises the idea along these dimensions, and as Silver (1985) points out, also on the extent that venture allies (venture capitalist, etc.) have access to key resources missing in the target ventures success equation.

Assessment of a Venture's Financial Viability

The application of the so-called "ratio analyses" methodology of any enterprise bases its primary benefit on the observation that those ratios can be viewed as control or information metrics of the operational "state of being" of the advocated commercial venture. In the case of the research objectives, the venture types of interest are ones advanced through a partnership of investors – be they university, federal and/or state agency and selected commercial organizational sponsors.

In a standard reference document, Merrill Lynch (1973) shows how accountant records can be viewed to define the set of traditional metrics used by corporate managers

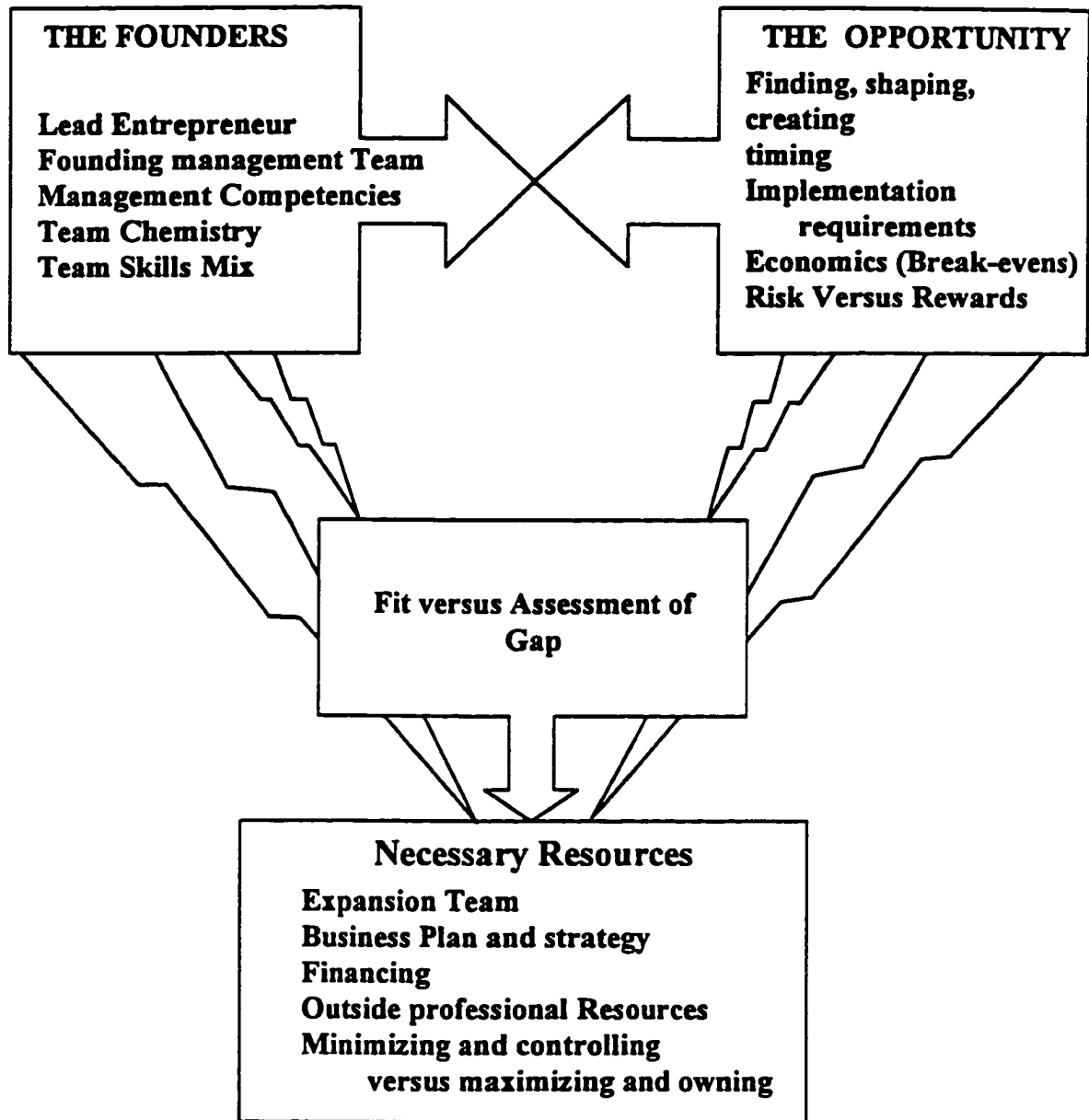


FIGURE 15. New Venture Creation: Driving Forces
(adapted from Timmons et al 1986)

- I. The Industry, The Company, and The Products or Services
- II. Market Research and Analysis
 - I. The Economics of the Business
 - II. Marketing Plan
- III. Design and Development Plans
- IV. Manufacturing and Operations Plan
- V. Management Team
- VI. Overall Schedule
- VII. Critical Risks and Problems
- VIII. The Financial Plan
- IX. Proposed company Offering
- X. Spreadsheets and Financial Exhibits

TABLE 3. The Critical Elements of Venture Assessment Checklist (adapted from Timmons 1985)

and investors alike to take symptomatic measure of an enterprise's financial health. Forecasts of future states tend to derive the likely impact of macro economic, legislative, or regulatory developments on the fundamental operational economics of the nominal firm occupying a subject sector of the economy. These models are based on historical records of firms with known success profiles. Conceptually, new venture enterprises' set of financial statements are appraised for their relative attractiveness viz. a viz. those reported for market defining existing commercial firms that are publicly traded.

Here, the typical analysis begins with a couple of income statements for the venture. From these ratios are calculated for the enterprise (Granof 1985).

Gaps in the Literature

The implications of the preceding discussion of the salient literature streams is that an information and conceptual model for consortia venture assessment and decision making exists. As has been shown, the general area of consortia venture invocation as a means to manage both technology innovation is expected to be increasingly significant to the performance of the function of technology innovation management. In the discussion that follows we address the nature of the deficiency.

Exploratory Research: Implications for Paradigm Modification

The theoretical focus advanced here suggests that Consortia venture support success will be better assured to the extent that their venture participation reflects knowledge or credible judgment regarding of the preceding theoretical and procedural issues identified. In this section, consider the implications of the technology innovation management literature are considered. A framework for assessment of consortia venture development as instruments of technology innovation management is developed. We

treat each area in the order that they have been addressed above in turn below. This is followed with an integrative summary of the synthesis implied by the literature viewed as a whole.

The Phase of Target Market Development

The theoretical focus advanced here suggests that Consortia venture support success will be better assured to the extent that their venture participation reflects knowledge or credible judgment regarding the phase of the target product market into which its products or services are to be injected. As summarized earlier, Abernathy et al. (1978); Utterback (1996); and Kim (1997) assert that commercial markets driven by innovative technology go through three basic characteristic phases reflecting the experimental nature of the unearthed new product-market: Fluid, Transitional, and Specific Patterns of product market behavior as described in the literature section. The Abernathy and Utterback (1978) paradigm of characteristic phase for innovative market development suggests that a key consideration is the phase of the product-market the candidate technology innovation-based new venture. Further, this model of market development suggests that there should be a relatively advantaged underlying business model associated with the phase that will also be best suited for the competitive market conditions it faces at its period of launch. Referred to here is the idea that any commercially competitive “market conditions” faced by the new venture’s products is critical as suggested by the Abernathy and Utterback model. Thus, for example, should the evaluated Consortia sponsored venture face a product-market that is characterized as in a Fluid pattern, the theory suggests that each of the characteristic listed in Table 1 of this chapter would apply. Thus, for example, the organizational interface that would be

most appropriate should be one staffed with researchers and management staff that are quintessentially entrepreneurial in personality. The venture should be operated in a relatively informal organizational context, producing product at a small scale, using general-purpose equipment required to allow frequent major product changes.

Additionally, the venture should be accomplished with the use of a developmental partnership with principal customers. Those customers should be ones who are primarily interested in the delivered product team's ability to provide for a required functional product performance.

When the venture is judged with justification as being in a **Transitional** product-market phase, new ventures alliances sponsored in partnership with commercial partners who enjoy a significant market share become more critical. Products must be targeted to contain features that address the market's preferences for specific forms of application of the innovative technology. The sponsored new venture's production/manufacturing and distribution strategies should be assessed as to whether they address the need to be based on process and other related functional areas (e.g., distribution channel operations) innovations. With respect to the organizational structure and process management mechanisms planned for the consortia sponsored venture, the Utterback theory suggests that partnership arrangements and corporate cultures that are executed through formal project and task groups will be advantaged over other approaches to these issues.

Competing approaches to technology standardization (either in terms of product or process standards) impose some risk. As such, they suggest technology innovation management consortia should invest in those ventures that cover the multiple standards (demanding that it be allowed to invoke contract vehicles which support a "harvest"

investment exit strategy as the market matures and moves away from the particular venture supported). This notion suggests that any project plant supported or proposed should be large-scale, highly specific to particular products, and pursue a major cost reduction objective. The new venture should have the objectives of increasing process efficiencies through R & D.

In the **Specific product phase**, cost reduction for standardized products purchased in large batches is the norm. Organizational control is secured through strong reliance on structure, rules of doing business and performance goals. Plants are typically large, highly specific to a particular product, with specialized materials and special purpose, mostly automated tasks being relied upon to secure critical relative production cost advantages. Innovations are incremental, netting productivity and quality improvements on standardized (effectively viewed as “commodity”) products. Competition is primarily price and assured quality driven, with product lines being mostly undifferentiated except for relatively (for any given industry) standardized product-markets.

Organizational and Process Management Rules for Commercial Technology Innovation Management through Consortia

The literature embraced in this research area suggests that the process of supporting technology innovation is tied to the degree to which an “innovating” corporate culture is created. That this innovative culture is associated with a so-called learning organization has been well established (Senge 1990; Drucker 1989; Chesborough 1996, etc.).

Entrepreneurial teams and environments benefit from being isolated from the culture that produces and distributes existing products. These are often self directed

teams. Referenced in the literature as “Adhocracies” (Mintzberg 1989), or “reservations” (Galbraith 1982), the choice of appropriate vehicle for innovation management is driven by the relative volatility of the product-markets shelf life. Higher levels of rapid innovation / turn over suggests more outsourcing. Also, whether the requirements for innovation entail whole systemic level innovations or are relatively product specific innovations suggest different innovation management vehicles may be appropriate. The higher the risk to large capital stock, the greater the incentives to innovate internally (or to establish well functioning alliances). The centralization for organizations (as a function of risk) ranges across a spectrum of virtual company, alliance, joint venture, corporation with autonomous divisions, and integrated corporation.

The issue for consortia decision enhancement is the extent to which organizational and process considerations are captured by the new venture sponsorship associated with successful ventures.

Central to this literature are considerations of developing conceptual models for the design and evaluation of the various optional forms of partnership that Consortia may adopt. These forms include the following collaborative organizational options.

- Virtual Corporation (where pre-prototype services were contracted out by the industrial/commercial Consortia partners);
- Alliance (where limited coordination but composed of members are driven to enhance their own relative positions);
- Joint Ventures (a separated legal distinct organization jointly invested in by the partners in terms of money, personnel (fixed temporary assignments), and/or other in kind investments); and,

- Variations on Corporation Governance (autonomous divisions – e.g., a wholly owned subsidiary) or a unit contained “within” the corporation.)

Both Davidow (1992) and later Chesbrough et al. (1996) suggest that the so-called “Virtual Corporation” calls for relatively flat new product development governance structures. Davidow (1992) and Hamilton’s (1986) modes of technology strategy scanning (e.g., monitoring through memberships, consortia sponsored pre-prototype R & D projects participation, demonstration or technology transfer market entry joint ventures, etc.) work, suggest that relative competitive advantages can be realized by taking advantage of communications technology innovations and commercial cultural shifts. These developments support the ability to quickly assemble “R & D-to-new-product-launch” project work teams comprised of expertise which resides in various organizations. This notion suggests that the relative likelihood of experiencing new venture success for consortia will come from those new ventures which can be shown to appropriately take advantage of this innovative approach to R & D process management.

Assessment of Quasi-State Governmental Agencies, Universities-led Consortia

Commercial Ventures

There is a significant network of public-private, and quasi-governmental agencies charged with evaluating the commercial potential of innovative technological applications. That economic development is closely tied to effective regional level support for technologically innovative new venture success has received increased attention at all levels of government and research (Malechi 1984 and 1983; U.S. Congressional Office of Technology Assessment (OTA) 1984). Efforts to garner regional comparative commercial advantages for constituent commercial enterprises has

resulted in a veritable “groundswell” of state level agencies being established. These agencies have as their primary mission fostering their constituent industries’ regional economic viability through effectively leveraged and judicious investments in advanced technology based innovations. With federal legislation that allowed pre-prototype corroboration among companies and universities, this group of agencies has attempted to better facilitate university-industry-governmental agency commercially relevant research and development partnerships (Watkins 1985).

The following is a summary of the relevant literature whose contribution appear to have direct relevance on the subject at hand. In addition to the broad theoretical review addressed in the earlier portion of this literature review section, we will now provide a more detailed summary of the key research streams as they relate to it.

Quasi-Governmental Agency Appropriate Roles: Universities in Consortia.

University associated consortia -- consortia per se (i.e., commercial variants on pre-prototype research associations) have only been a recent development in the U. S., brought on by contemporary legislative initiatives. Considerations of the advantaged roles for universities and/or government agencies in association with garnering any national or regional commercial competitive advantages and viability for the business community served has been given increased attention (Aldrich et al. 1995; Mansfield 1995; Mowery 1992; Teece 1987). The theoretical prognosis of this stream of research suggests that appropriate roles for universities fall into the following primary areas:

- Supporting basic research of the science leading to a phenomenon level of understanding of the fundamental science at work in a recognized application area ;
- Concentrating academic program development in areas that support the regional

commercially advantaged business community, extending its competitive edge by providing a source of appropriately trained science, engineering and trade skilled future employees; and,

- At the contract project level, providing non-tenure rewarding applied research support to area businesses that could not otherwise afford have any turn key level research performed.

Out of the first two areas for university and federal agency supported consortia, innovation it supported indirectly. Ideas are germinated in the professional corroboration that accompanies such training and scientific investigative activities. Out of the third, the best role a university can play is to let the persistent request of the business community it serves help clarify areas of academic concentration that provide a the long term return an area global or comparative downstream advantage (Porter 1986).

Management/Structural Requirements of Advantaged Commercial and/or Non Commercial Partnerships/Joint Ventures

Commercial Joint ventures “work” -- according to this line of research (Spekman et al. 1996 -- to the extent that:

1. The partners have well stated objectives at the outset of the venture;
2. That realistic shared expectations regarding the core competency contribution of each partner are held by all parties;
3. The joint venture’s leadership takes the necessary steps required to effectively create an organizational environment– which of necessity must be distinct – and develops a corporate culture that effectively synthesizes partner organizations while allowing the new venture’s staff esprit de corps to thrive; and,

4. **Establishment of clear exit strategies on the part of the sponsoring partners with venture participation “sunsets” for all parent organizations. These arrangements must be captured in the associated staff compensation packages developed for the new venture employees. These compensation packages must support both the entrepreneurial and security needs of the new venture’s employees and leadership.**

Nuances related to these conclusions are suggested for public-private partnership joint ventures. That is, the primary research issue here is how must these tenets of joint venture management must be modified for consortia whose sponsoring partnerships are composed of federal, university, state economic development entities, and industrial/commercial partners all sponsoring the new venture.

Primary Integrated Conceptual Frame – Summary

The focus of the research is to provide insight and advance the management of technology innovation in non-traditional consortia. While the literature reviewed in the course of the preceding sections suggests that the specific institutional forms vary, a better understanding of just how to take advanced technology-based venture investment decisions still remains an elusive goal for researchers and practitioner alike. Figure 16 provides a schematic of the relationship of the research streams discussed in this chapter. The relationship of these multi-disciplinary streams of research may seem illusive at best. It is asserted that this is due to the inherent multi-disciplinary nature of the phenomenon surrounding management of technology innovation in non-traditional consortia.

R & D Consortia are the principal units of analyses researched in this study. To summarize the framework developed, it includes the set of considerations of appropriate and compatible alignments each of the evaluation criteria a they have been captured in

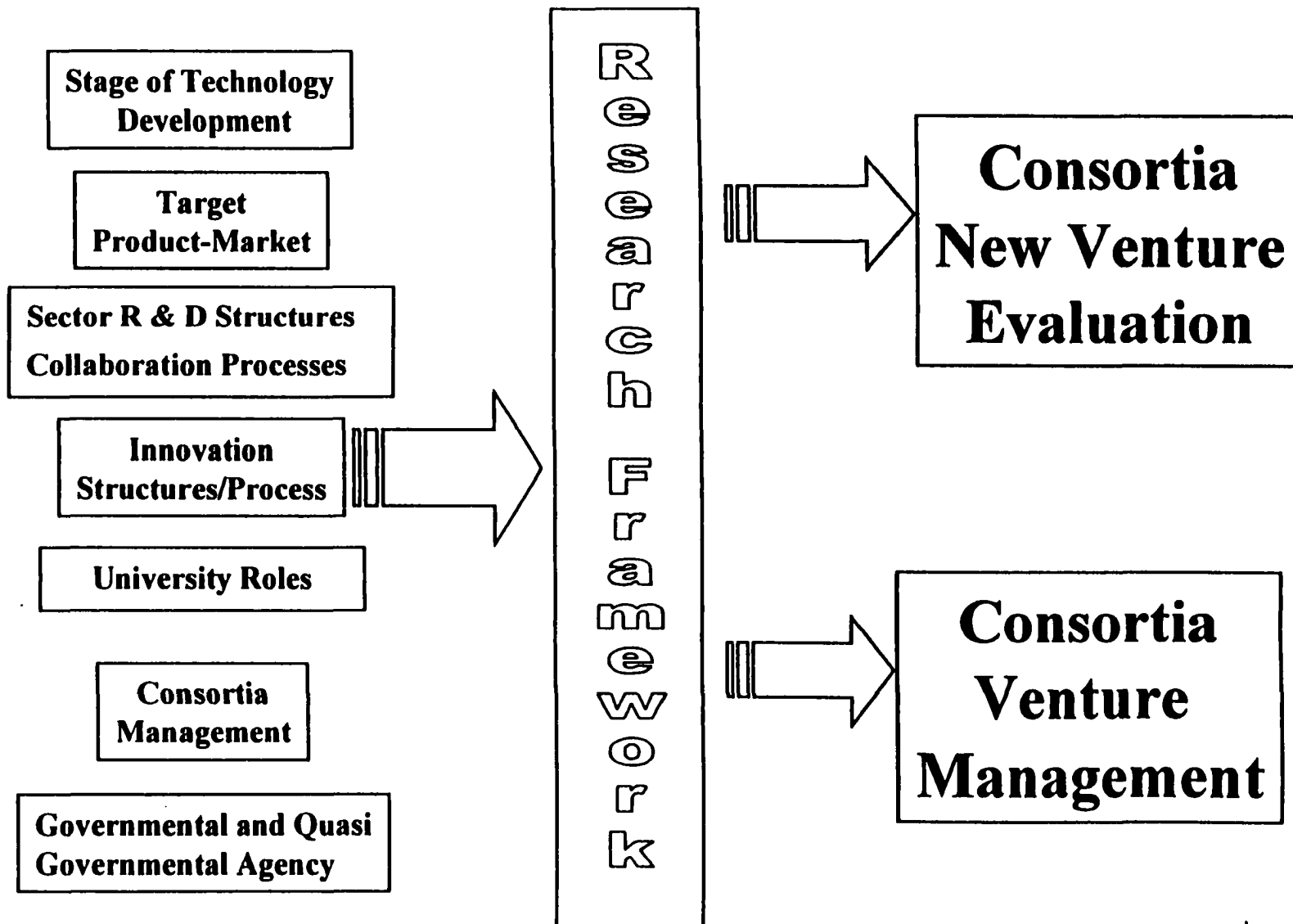


FIGURE 16. Exploratory Research Stream Conceptual Framework

the theory-based paradigm (appendix 2). Thus it is noted that consortia commercial venture success/failure outcomes must be researched in a way that will serve to better illuminate the issues associated with the success/failure outcome's dependency of the following key factors:

- (a) The inherent physical characteristics of the technology;**
- (b) The stage in its evolutionary development;**
- (c) The unique set of economic dynamics that establish the factors for success which influence success in the commercial environment faced;**
- (d) The target product-market's industrial structure and dynamics; as well as,**
- (e) The soundness of the proposed ventures business model and specific assembled resources which are designed to capture the "innovation").**

The compilation of specific set of questions developed in association with each of the various theoretical paradigms discussed during the literature review, appear in appendix 2. Collectively they reflect the conceptual framework developed, and through their application during the course of the research, support the exploration and discovery focus of the research.

CHAPTER III

RESEARCH METHODOLOGY

All research must have a design to achieve the aims of the research. However, in development of the research design, the research must also rest upon a foundation established by a particular research perspective. This perspective is developed within the accepted research traditions of the academic discipline informing the research, the philosophical stance of the community which will “accept” the research, and ultimately the ontological and epistemological perspective of the researcher in relation to the question(s) being researched. The perspective, in some sense might be characterized as the “research paradigm”. The nature of a research paradigm has been suggested as:

...(1) serves as a guide to the professionals in a discipline, for it indicates what are the important problems and issues confronting the discipline; (2) goes about developing an explanatory scheme (i.e. models and theories) which can place these issues and problems in a framework which will allow practitioners to solve them; (3) establishes the criteria for the appropriate “tools” (i.e. methodologies, instruments, and types and forms of data collection) to use in solving these disciplinary puzzles; (4) provides an epistemology in which the preceding tasks can be viewed as organizing principles for carrying out the “normal work” of the discipline. (Filstead 1979, p. 34).

In essence, the qualitative paradigm might be considered a driving force informing the methodological stance taken with respect to this research. Guba (1990) crystallizes the suggestion that the development of research perspective, or paradigm that guides researchers in their endeavors of inquiry:

...can be characterized by the way their proponents respond to three basic questions, which can be characterized as the *ontological*, the *epistemological*, and the *methodological* questions. These questions are:

- (1) *Ontological*: What is the nature of the “knowable”? Or, what is the nature of reality?
- (2) *Epistemological*: What is the nature of the relationship between the knower (the inquirer) and the known (or knowable)?
- (3) *Methodological*: How should the inquirer go about finding out knowledge? (Guba 1990, p. 18)

The purpose of this chapter is to establish the methodological foundation for the research design. However, in development of the methodological stance for the research, the ontological and epistemological positions must be developed. Since a qualitative stance is taken with respect to the case study research approach, a critical examination of the qualitative research paradigm will serve to establish the foundations for the specific research design which follows in Chapter IV. To develop the methodological perspective for this research study, this chapter has four primary objectives. These objectives are to: (1) develop the research perspective from issues concerning the philosophy of science, including the epistemological and ontological perspectives taken with respect to research, (2) examine the nature of, and distinctions between, qualitative and quantitative research design strategies, (3) elaborate and identify issues in application of the case study research as a serious and rigorous research design strategy, and (4) establish the appropriateness, strengths, and weaknesses of the case study research method in relation to the research questions presented by this study.

Foundations for the Research Perspective

Concerning research methods in science, the selection of the appropriate research perspective is dependent on the particular research context (Yin 1994; McGarth 1992). The research process can be thought of as logically deterministic in the sense that research follows a rather uniform pattern of logical activities. These activities are, by

design choice, intended to support the goal of revealing evidence which will serve to achieve the research purpose by appropriately illuminate research questions or phenomena of interest. These logical steps are outlined in Figure 17.

As Figure 17 depicts, these components of the so-called “Cycle of Empirical Research” (McGarth 1992) should be viewed as being composed of a spiral of activity in that the circle is never actually closed. That is, good research always yields more rigorously stated follow-on research questions or future objectives. Ultimately, the researcher must address the issues concerning selection of a research methodology deemed appropriate to “research” the particular phenomena in question within the contexts which define the “acceptable” standards, approach, and conduct of research. The methodology selected might be based on a qualitative, quantitative, or a mixed research design.

In adhering to the notions of good science that one must address in the course of making a selection of the guiding research methodology, as Campbell (1962) suggests, it must be remembered that the fundamental point of the scientific method is:

“...not experimentation per se but the strategy connoted by the *phrase plausible rival hypotheses*. This strategy may start its puzzle-solving with “evidence” in the context-independent manner of positivistic “confirmation” (or even of postpositivistic “corroboration”), it is presented instead in extended networks of implications that (while never complete are nonetheless crucial to its scientific evaluation.” -- (Yin 1994, p. ix)

The literature consistently suggests that there is a requisite research methodology to which the researcher must adhere for viable scientific knowledge development and investigation (Potter 1996; Yin 1994; McGarth 1992). By making philosophically consistent decisions regarding the specific research design, the researcher remains

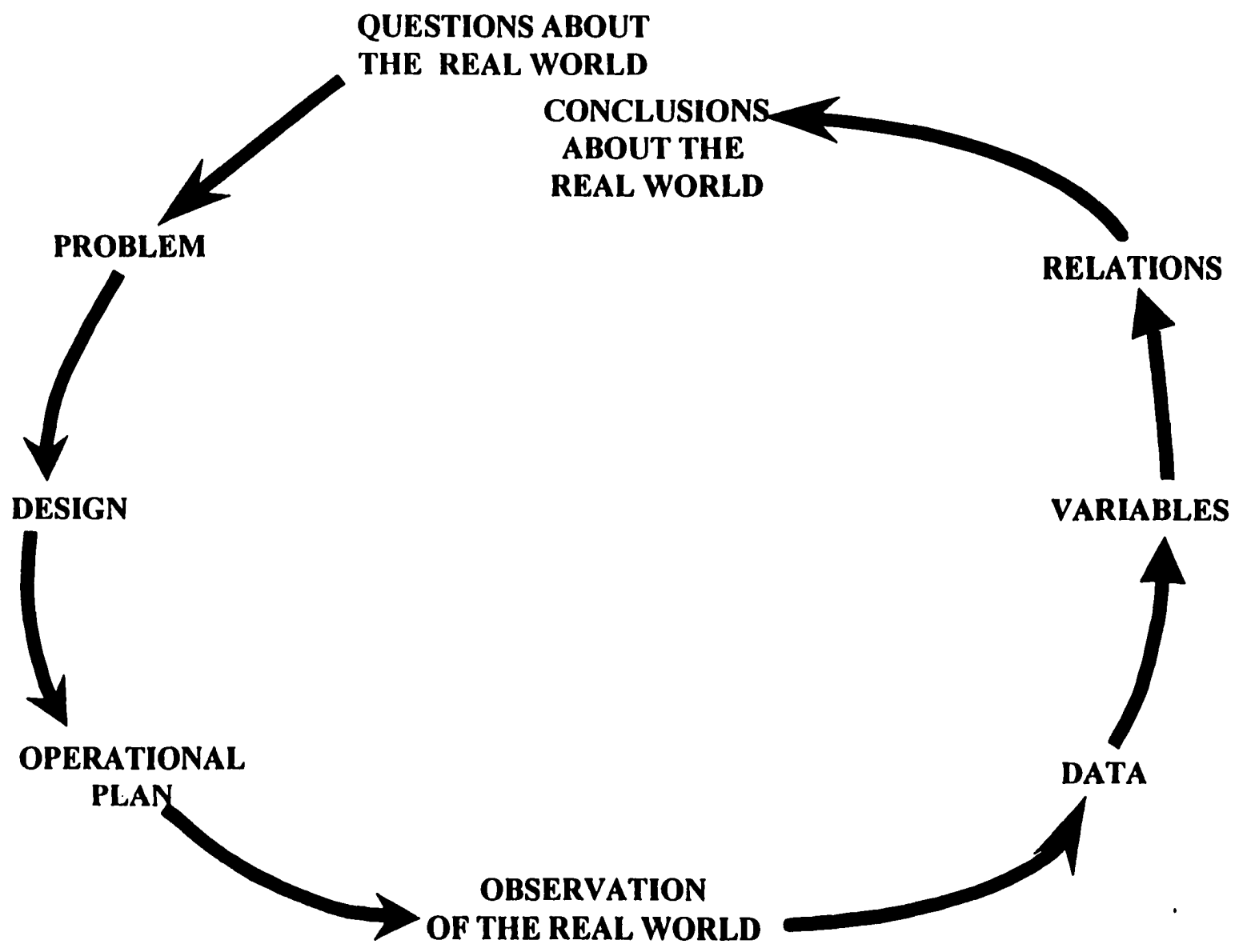


FIGURE 17. Research Process (McGrath 1992)

consonant with the methodological framework driving the research design and ultimately developing the response to the research question(s).

It follows that fulfilling the goal of realizing 'good research' is largely a matter of securing the desired logically consistent framework. Logical consistency which assures that the researcher will develop a specific research procedure that reflects an "appropriate" -- or consistent -- research perspective and design based on the "acceptable" methodological disposition. The determination of "acceptable" in this sense rests with the research audience, academic discipline, and the researcher.

The Research Perspective

The choice of the appropriate methodological emphasis to be applied by a researcher is fundamentally contingent upon the researchers' philosophical view of "reality" and "knowledge", the nature of the problem, and the acceptance of methodological stance within the domain which will ultimately determine the "utility" of the research. The researcher's philosophical stance with regard to questions concerning the nature of knowledge (epistemological foundations) and the nature of "reality" (ontological foundations) and is absolutely key to selecting an appropriate approach among available alternatives for the conduct of research.

Potter (1996), Guba (1994), McGath (1992), and Creswell (1994) all point out, that the researcher's philosophical frame with regard to their ontological and epistemological position -- either consciously or implicitly -- is brought to bear during the selection of specific aspects of all research efforts that are geared toward knowledge development and investigation. Thus, the matter of assessing the relative "soundness of research" turns on the extent to which that individual researcher succeeds in (a)

identifying; and, (b) maintaining *logically consistent* positions across the various phases of the selected research methodology. This logical consistency is itself determined by the degree to which philosophically consistent perspectives with respect to ontology and epistemology inform the research design, conduct, and reporting.

Epistemological Perspectives

To conduct research with any degree of clarity and effect, the researcher must invariably address the matter of their philosophical perspective regarding the concept of “knowledge”. That requirement compels the researcher to become clear with respect to personal belief structure (or philosophical assumption set) that forms the basis upon which they generate their individual view of “knowledge”. The matter of judging the suitability of any approach to research is, to a large degree, dependent upon the fundamental philosophical notions of how the researcher might respond to the question, “What is the nature of knowing?”. This has been posed from a qualitative research perspective as, “Can an observer come to ‘know’ the phenomenon [under study]”? (Potter 1996, 39) and alternately as, “What is the nature of the relationship between the ‘knower’ and what can be known?” (Guba et al. 1994, 108). It is evident that the perspective developed by the researcher with respect to the epistemological questions constrain the development of the research design, its execution, and interpretations drawn from analyses.

In responding to the epistemological question, a range of epistemological positions is provided in tables 4, 5, and 6. As is evident from the range of positions, it is plausible to view a range of epistemological positions capable of being taken by a

**Major Points of Thinking Across the Alternative Positions
on the Ontological and Epistemological Issues**

The Ontological Continuum				
Materialism			Idealism	
Mechanistic Materialism	Dialectical Materialism	Actionalism	Idiographic Idealism	Solipsism
The Epistemological Continuum				
Realism			Constructivism	
Pure Objectivity	Intersubjectivity			Pure Subjectivity

FIGURE 4. Foundation of Contemporary Research Strategies (adapted from Potter 1996, 37)

Basic Beliefs of Alternative Inquiry Paradigms

Item	Positivism	Postpositivism	Critical Theory et al.	Constructivism
Ontology	Naive realism – “real” reality but apprehendable	Critical realism- “real” reality but only imperfectly and probabilistically apprehendable	Historical realism – Virtual reality shaped by social, political, Cultural, economic, Ethnic, and gender Values; crystalized Over time	Relativism – local and specific constructed realities
Epistemology	Dualist/objectivist; Findings probably true	Modified dualist/ Objectivist; critical tradition/community; Findings probably True	Transactional/ subjectivist; value-mediated findings	Transactional/ subjectivist; created findings
Methodology	Experimental/ manipulative; verification of hypotheses; chiefly quantitative methods	Modified experi- mental/manipulative; Critical multiplism; Falsification of hypotheses; may include qualitative methods	Dialogic/dialectical	Hermeneutical/dialectical

TABLE 5. Qualitative Methodologies as a Research Strategy (adapted from Guba et al 1994)

Paradigm Positions on Selected Practical Issues

Issue	Positivism	Postpositivism	Critical Theory et al.	Constructivism
Inquiry aim	explanation: prediction and control		critique and transformation; restitution and emancipation	understanding; reconstruction
Nature of knowledge	verified hypothesis established as facts or laws	nonfalsified hypotheses that are probable facts or laws	structural/historical insights	individual reconstructions coalescing around consensus
Knowledge accumulation	accretion—"building blocks" adding to "edifice of knowledge"; generalizations and cause and effect linkages		historical revisionism; generalization by similarity	more informed and sophisticated reconstructions; vicarious experience
Goodness or quality criteria	conventional benchmarks of "rigor": Internal and external validity, reliability, And objectivity		historical situatedness; erosion of ignorance action stimulus	trustworthiness and authenticity and misapprehensions;
Training	technical and quantitative; substantive theories	technical: quantitative and qualitative: Substantive theories	resocialization; qualitative and quantitative; history; values of altruism and empowerment	

TABLE 6. Research Strategy Practical Issues (adapted from Guba et al. 1994, 112)

researcher. Therefore, one end of the epistemological continuum might be defined by assumptions of “positivism”, identified by Potter as:

There is the knower (the researcher) and the object of study, and these two can be separated. Social science must not be context bound and must find broad principals that would span across large groups. (Potter 1996, 46).

On the other end of an epistemological continuum we might place a pure “empiricism” perspective which suggests, “...the belief that knowledge is gained from experience and observation” (Potter 1996, 47). We note that the epistemological assumption driving the qualitative research perspective is that the researcher is in interaction with that which is the object of study (Creswell 1994). The qualitative research perspective has been characterized as stemming from a “constructivist” paradigm (Creswell 1994) which, although not rejecting traditional science, tempers scholarly inquiry as subject to the process of socially constructed meanings, not independent of the researcher (Potter 1996). It is this constructivist perspective that forms the epistemological foundation for this research. In effect, for this research study the epistemological assumptions are stated as: (1) the generation of knowledge is a socially embedded process, and (2) there is not pure objectivity in separation of the researcher from either the process of discovery or those phenomena about which the researcher seeks to construct knowledge.

Ontological Perspectives

Potter (1996, 36) offers the following form of the ontological question: “Whether the world exists, and if so in what form?”. As an alternative form of the ontological question, Guba et al. (1994, 108) asks: “What is the form and nature of reality and therefore, what is there that can be know about it?”

The researcher's response to these ontological questions, either tacitly or explicitly, imposes limitations on all aspects of the research. How the researcher answers these ontological questions *must* be based on fundamental personal *belief and assumptions* which neither the research design nor the researcher perspective can escape. The debate concerning the ontological question has not, and will not, be resolved. Therefore, the researcher is left in somewhat of a quandary since there continues to be varied but equally accurate, debatable, and logically justifiable positions for the various ontological perspectives that have been routinely advanced (Potter 1996; Guba et al. 1994; McGrath et al. 1992). It is certainly not an objective to resolve the ontological question within the scope of this research. However, the ontological position can be established to enhance understanding of the research design, conduct, and interpretation.

Over the history of western scientific inquiry, varying and equally valid positions with regard to "what indeed is reality" have been advanced. Table 7 expands on the key concepts whose understanding informs this matter. Due to their equal philosophical validity, any of the positions on this continuum may credibly be held by a researcher.

At one end of the ontological spectrum is what Potter (1996) identifies as 'Solipsism'. This is the belief that nothing exists outside of the individual and that all perceptions are false signals. The other extreme on the ontological spectrum is 'Mechanistic Materialism' which holds that not only does everything have a physical existence, but that everything that happens in the world is determined by prior physical causes acting according to invariable laws. Interim positions held include those of Idiographic Idealism, suggesting that although something does exist apart from the individual, no objective experience can be had because it is limited by the individual's

Epistemological Continuum Terms

Key [Philosophical] Question: To what degree are humans limited from knowing (making meaning) about the Phenomenon?

Alternative Answers:

Objective: Researcher can approach an objective interpretation through the use of systematic methods.

Intersubjectivity: Researchers can never be purely objective, but they can demonstrate that people share interpretations.

Pure subjectivity: it is not possible to be objective, and qualitative researchers can only provide their own idiographic, subjective interpretations.

TABLE 7. Key Epistemological Terms/Positions (adapted from Potter 1996, 46)

cognitive apparatus; Actionalism -- or the belief that that humans, as active agents possessing goals, are capable of taking actions that are goal maximizing; and, 'Dialectic Materialism' or a constantly changing material reality defined by continuously evolving objective reality (Potter 1996).

This brief explanation of ontological perspective is not intended to approach completeness or to suggest the appropriateness of one position over another. On the contrary, for the credible conduct of any scientific research activity, the researcher, either tacitly or explicitly, designs, conducts, and interprets research in ways that are ontologically consistent with their perspective. This ontological imposition limits the set of research strategies -- together with their associated analytical methods--that are *philosophically* appropriate to be employed in support of realizing any specific research objective.

By way of illustration, it should be clear that the view of the reality as an "objective truth" is key to the assumption of parsimonious nature of knowledge about a phenomenon. The routine research practice of operationalizing a construct through hypotheses and defining variables to allow quantifiable measurement suggests an ontological assumption that the phenomenon under study is not affected by the perspective of the observer, the act of measuring, or the aspect of the phenomenon being measured. Thus, it can be argued that the very act of conducting research based on some operational definitions for experimental variables that are to be measured to test a hypotheses' truth or falsehood, requires the implicit "ontological" assumption/belief of reality being legitimately characterizable objectively and independent of the researcher.

If one holds, as a significant portion of recent human behavioral researchers have been shown to (Potter 1996; Steier 1995; Hunt 1994), that knowing is by necessity only meaningful within the context of each individual's sense of the world, then that person maintains the position that we each construct what is "real". If, on the other extreme of the knowledge spectrum, the researcher ascribes to the notion that truth is "absolute", not varying but instead universally discernible, then the philosophical position has come to be described alternately as "Positivism" by McGarh 1992, or Mechanistic Materialism in Potters (1996) schemata. Regardless of which position taken it is absolutely key that the position assumed be recognized. This is the case because, as has been shown [Tables 4 and 5], that this position *defines* the specific logical frame with which the matter of the credibility of any given approach to the applicable methods of scientific research becomes defined. This is a direct result the requirement for a suitable degree of logical consistency.

The ontological position of the researcher resolutely informs the investigator's judgment as to what the appropriate methodology and research design will be to achieve the research aims. Given this judgment, both the ontological and epistemological stance of the researcher will guide the range of decisions with respect to choices in research design. The key considerations faced by the researcher in choosing to adopt a quantitative or qualitative research methodology also turn on these philosophical underpinnings. Thus the answers to the ontological and epistemological questions collectively bound what are plausible research objectives, purposes, and supporting methodological structure and procedures.

For this research, the ontological position might be suggested as subscribing to the notions that: (1) people are subject to contextual forces that influence choice and interpretation, (2) a relationship exist between the object and the knower of the object, (3) because the nature of people in relation to events and objects changes over time, absoluteness desired in the physical sciences is an unobtainable proposition in the understanding of human phenomena, and (4) the determination of objectivity is in itself subject to the range of human subjectivity, values, and emotions that serve to establish the objective domain of understanding.

Qualitative - Quantitative Research Distinctions

Qualitative research methods have a long standing tradition of being questioned in the scientific community in terms of their relevance in serious scientific inquiry (Guba and Lincoln 1981; Sandelowski 1986; Whitt 1991; Strauss and Corbin 1990; Creswell 1994). The objective of this section is not to resolve the long standing academic debate concerning the legitimacy of qualitative research. However, we can elucidate the distinctions in the qualitative and quantitative paradigms that is instructive in development of the research perspective taken for this particular study.

Basic Distinctions in Qualitative and Quantitative Approaches

The perspectives of qualitative and quantitative approaches to research methods are based upon the types of data gathered, the methods of analysis, the nature of research findings and the interpretation of those findings. In the past, the primary distinction between approaches was basically from the perspective of variables. Quantitative variables are those that can easily be assigned numerical values and are capable of being reduced for mathematical analysis. The numerical values can then be managed by

application of mathematical techniques, thereby taking much of the subjectivity out of data analysis (Kerlinger 1986). The tradition of use of quantitative variables stems from the physical sciences and is considered an integral component of the scientific method. Using numerically based variables provides rigor in the experimental research process which is considered the mainstay of the scientific method and the “positivist” research tradition. The tradition of positivist based research perspective, with respect to ontology, epistemology, and methodology has been succinctly described as:

Ontology: *Realist* -- reality exist “out there” and is driven by immutable natural laws and mechanisms. Knowledge of these entities, laws, and mechanisms is conventionally summarized in the form of time- and context-free generalizations. Some of these latter generalizations take the form of cause-effect laws.

Epistemology: *Dualist/objectivist* -- it is both possible and essential for the inquirer to adopt a distant, noninteractive posture. Values and other biasing and confounding factors are thereby automatically excluded from influencing the outcomes.

Methodology: *Experimental/manipulative* -- questions and/or hypotheses are stated in advance in propositional form and subjected to empirical test (falsification) under carefully controlled conditions. (Guba 1990, 20)

Experiments which are based on numerical measurement, using mathematics as their language, allow the results to be verified by other researchers through numerical data analysis and repeated experiments. Poplin (1987) summarized the basis for quantitative methods stemming from the positivist perspective as: (1) the data must be amenable to mathematical analysis which requires the study of variables that can be quantified, (2) separation between the researcher and the subject as well as isolation of the subject from influences beyond the control of the researcher, (3) objectivity on the part of the

researcher, (4) the necessity of a hypothesis for testing and deductive analysis, and (5) the ability of data treatment to be replicated to be considered valid.

In contrast to the positivist science perspective, the behavioral and social sciences have, in some circles, began to adapt a modified research perspective. This perspective characterizes a primary distinction between the qualitative and quantitative based approaches to research. A primary distinction is that the variables the behavioral and social sciences deal with are not, in most cases, measurements of physical phenomena. Instead, they are complex issues of human and social behavior. In most cases, the inquiry concerns behavioral data that is not generated as a direct physical measurement. Instead, the data on the evaluation of variables that do not lend themselves to description in numerical terms or to mathematically based inquiry. These types of variables have been termed qualitative. As such, qualitative research designs have been argued to be appropriate to address organizational phenomena that are complex and not readily quantifiable for mathematical reduction (Peshkin 1988; Searight 1989).

In order to deal with qualitative variables and still maintain rigor in the research design, behavioral and social researchers have established a tradition of designing their research such that variables could be transformed into some numerical values that could then be analyzed mathematically, most often through statistical analysis. Handling qualitative variables in this manner provides research a structure that can closely emulate research done in the traditional sciences based on a positivist perspective. This allowed independent verification of the data analysis through mathematical methods. Therefore, research rigor was achieved through research designs amenable to replication. It does not, however, imply that there is repeatability in the entire process because the initial data

collection and the coding of the qualitative data into quantitative terms is still subjective. In fact, Denzin and Lincoln (1994) have argued that the establishment of hypotheses and variables is, in effect, a subjective act in itself. Poplin (1987) points out:

The generation of explanatory or relational hypothesis is basic to quantitative inquiry. This statement contains all of our biases; it represents a subjective guess ready to be verified. It requires the narrowing of data for analysis and thus denies or avoids implications of other contextual data. It is drawn from the experience of the authors (Poplin 1987, 35)

This is also consistent with Steier's (1993) recognition of the inescapable influence of the researcher and the contention that research is reflexive in nature since it is constructed by the researcher.

Kerlinger (1986) notes that in many cases the term qualitative is used to describe what he terms categorical variables. There are, variables for which the data that can be analyzed by sorting it into two or more categories which can then be easily transformed into numerical form. This is in contrast to quantitative data which is in the form of measurements on some continuous scale. Kerlinger questions whether the former is really a separate classification of just a subset of quantitative methods (Kerlinger 1986).

In further development of the qualitative perspective, there still exist the question as to whether categorical data can accurately describe the behavioral phenomena that the researchers are investigating. Much of the contextual richness in the data due to its inseparable embeddiness may be lost in the coding process.

Similar to Poplin (1987), Patton (1990) concludes that traditional quantitative researchers are limited by *hypothetico-deductive* methodologies which come from the natural sciences and predominates social science. It is the tradition in science that

hypothetico-deductive methodology, which involves experimental design involving quantitative measurement, and some form of mathematical analysis is the only one that can be considered good science (Patton 1980). For it is only these methods that one can provide valid, reliable and reasonable results in the scientific tradition (Patton 1990). Although the debates concerning research that does not use traditional scientific methods continue, the qualitative approaches have been increasingly accepted as serious scientific inquiry (Potter 1996; Denzin and Lincoln 1996; Yin 1994). In fact, it is also recognized that the acceptance and role of qualitative research to explore phenomena is expanding (Potter 1996; Denzin and Lincoln 1996; Marshall and Rossman 1995; Miles and Huberman 1994; Guba 1990; Patton 1990).

The expansion of qualitative research approaches recognizes there is a need to investigate phenomena and behaviors that do not lend themselves to traditional scientific inquiry. The positivist based hypothetico-deductive paradigm, which relies on quantitative methods, seeks to predict social phenomena. In contrast, Patton (1990) describes the *holistic-inductive, anthropological* paradigm which utilizes qualitative methods and is focused at understanding the phenomena.

Based on the previous discussion concerning the nature of inquiry the research undertaken for this study derives its foundation from the qualitative perspective. The determination of the appropriateness of this perspective is developed in the following section.

Appropriateness of Qualitative Methodology

Patton (1990) developed themes characteristic of qualitative based inquiry. These themes can be used as indicators of the applicability of qualitative methods to particular

research situations. The consideration of these themes with respect to this research is particularly instructive in developing the logic supporting the qualitative research perspective. These themes, and their appropriateness to this research study are developed in Table 8.

It is evident that the nature of this research is well fit to the qualitative research perspective. The following points capture the nature of this research with respect to the qualitative paradigm:

- Desire to study consortia naturalistically in their “real world” setting without the ability to manipulate, identify, or control variables of the context
- The objective to perform inductive analyses to build understanding of phenomena not fully understood, articulated, or previously explored.
- Consideration of the phenomenon from a holistic perspective, not attempting to artificially isolate or constrain the complex system(s) generating the phenomenon of interest.
- Concentration on developing data through an iterative process of inquiry into the perspectives, documents, and events attempting to “appreciate” and capture the richness of the context of inquiry.
- Appreciate that the researcher is not unbiased theoretically, methodologically, ontologically, or epistemologically in approaching, developing understanding, and accounting for the research phenomena. This is taken not as a weakness, but as a strength to be accounted for, exploited, and factored into the data collection, synthesis, interpretation, and reporting.

Theme	Characteristic	Dissertation Research Conditions Faced?
Naturalistic Inquiry	Natural Setting Phenomena	• Yes
Inductive Analysis	Explore not Test	• Yes (Objective is to Explore)
Holistic Perspective	Meaningful interdependency	• Yes (Understanding Contextual Decisions is THE focus)
Qualitative Data	Perspectives Key	• Yes (Varying Insights Where Essential)
Personal Contact and Insight	Data Access	• Yes (Unique Access was essential and available)
Dynamic Systems	Process is key	• Yes (Innovation Management is a Process)
Unique Case	Situation Specific	• Yes (Specific Consortia Studied were Unique)
Context Sensitive	Difficult Generalization	• Yes (Results Only Reflect Situation Researched)
Emphatic Neutrality	Understanding is key	• Yes (Focus is on Understanding)
Design Flexibility	Multiple variations	• Yes (Selected Method Accommodates many forms of evidence)

TABLE 8. Characteristic Themes of Qualitative Research Based Scientific Inquiry (Patton 1990)

- **Maintain a “sense” that the research context is dynamic and subject to constant change during the evolution of the research.**
- **Accept that the particular case which is being studied is in fact “unique” and therefore generalizability beyond the specific research context is not the primary objective of the research.**
- **Appreciate the context sensitive nature of the inquiry, recognizing that the data, analyses, and interpretations are context bound to the geographical, political, time, and cultural context within which they have been generated.**
- **Recognizing that complete objectivity is impossible and therefore actively seeking not to lay claim to objective free research, but to take a nonjudgmental stance toward data and appreciate the role of the researcher in bringing experience, insight, and expertise to facilitate new levels of understanding.**
- **Maintain flexibility in design during the research period with the ability to make shifts based upon understanding emergent during the research process.**

Although these aspects of the qualitative research paradigm are not presented as all inclusive, nevertheless, they provide an effective articulation, and demonstrate appropriateness, of this perspective to the research of the phenomenon of interest in this research study.

Range and Nature of Qualitative Inquiry

There are at least five (5) research strategies routinely used in the course of conducting qualitative research in the social sciences: case studies, experiments, surveys, historical analysis, and computer based analysis of archival records. Although each is a way of collecting and analyzing empirical evidence, there is a logic of selection

that recommends under what conditions one appears to be more appropriated suited for the research task at hand than the other. The primary considerations are the relative situational requirements, the resource demands, the research questions, and the inherent advantages and disadvantages each has with regard to fulfilling the specific research objectives.

Yin (1994) suggests a logical frame of choice that recommends which to chose. As noted earlier, research can be grouped into either exploratory, explanatory, or descriptive research. Each type has a different orientation and particular question of interest to be addressed.

Exploratory research is a type or form of research that reflects the interest on the part of the principal investigator to develop a sense of the issues at work in a particular context. These issues result in a social phenomenon that has come to his or her attention and as a result has shown itself to be unclear and therefore, of interest to the researcher. The purpose of this research is to develop answers to the so-called “What” questions which are intended to unearth or discover the nature of a phenomenon of interest. The goal of exploratory research is to develop pertinent hypotheses and propositions for further inquiry. Case study methods are particularly well suited for this approach. However, if the alternate form of the what question is used-- the one that asks how much or how many, clearly survey, or archival data analysis strategies are favored over case study analysis. Although exploratory experiments, exploratory surveys and exploratory case studies have been performed, the question is which research design returns the richest insight into the phenomenon of interest.

Explanatory research (or causal research) is the type of research in which the primary objective of the research is to permit the building of a logical model of the contributing dynamics or causes at work that generate the phenomenon of study interest. The primary form of research questions most suitably addressed by this type of research are ones characterized by “how” and “why” question. If the researcher desired to know “who” participated or “how much” was done, a researcher might be chose to survey or examine records. But to discern “why” the outcome obtained, a case study my prove more rigorous and, provide a better research design.

Descriptive research (or so-called phenomenological research) is a type or phase or social science research conducted with the primary interest of allowing a rich description of the full dimensions and nature of a phenomenon to be developed. It is not judgmental or analytical, rather the objective is to conduct the research in a way that permits a faithfully description of the phenomenon of interest.

Challenges and Responses to Qualitative Research

Qualitative methods have been challenged by proponents of more conventional scientific methods. However, qualitative research is not quantitative research and a direct comparison between the two is inappropriate. Regardless of methodology, there is the general consideration that “good research” should adhere to the scientific canons that, irrespective of qualitative or quantitative orientation, should be addressed. Corbin and Strauss (1990) suggest that for qualitative research:

“...the usual canons of science should be retained, but require redefinition in order to fit the realities of qualitative research, and the complexities of social phenomena that we seek to understand. The usual scientific canons include: significance, theory-observation compatibility, generalizability, consistency,

reproducibility, precision, and verification.” (Corbin and Strauss 1990, 250).

Marshall and Rossman (1995) suggests that all research must be sound and must respond to the canons of science by addressing the following questions: (1) What is the credibility of the particular research findings and how will those findings be judged?, (2) To what degree are the results transferable and applicable to context beyond the local research?, (3) What assurances are there that there is replicability of the research if it was performed again?, and (4) How can it be established that the findings of the research are not a result of the subjectivity of the researcher? Although the canons of science are sound, there is a research audience that suggests the usual interpretation of these canons, from the positivist perspective, are not appropriate for evaluation of whether or not qualitative research has succeeded in fulfilling the canons of research. The canons of science translate into the constructs of internal validity, external validity, reliability, and objectivity from a traditional (positivist) perspective (Lincoln and Guba 1985). In response, following Lincoln and Guba (1985), echoed by other scholars (Marshall and Rossman 1995; Whitt 1991) suggest four alternative constructs, from a non-traditional qualitative perspective to meet the canons of science. These alternative constructs include: (1) *credibility* as opposed to *internal validity*, or assurance that the research has accurately identified and described the subject of the research effort, (2) *transferability*, as opposed to external validity, or the confidence in the applicability of the research findings to other contexts “similar” to those bounding the research initiative, (3) *dependability*, as opposed to *reliability*, or the accountability for dynamic conditions changing the nature of the research based on shifts in understanding of phenomena being researched, and (4) *confirmability*, as opposed to *objectivity*, or the provision that the

findings of the study could be reached by another researcher. Therefore, both the quantitative and qualitative research traditions attempt to adhere to the canons of science. However, they differ with respect to the interpretation of the canons and the particular strategies to aspire to the canons.

In development of the qualitative distinction with respect to the canons of science, the criticism and challenge to qualitative based research approaches stem from three primary areas. These areas include researcher influence on the research outcomes, the ability to generalize research findings, and reproducibility of the research in other research contexts.

Qualitative methods with their reliance on non-numerical data and analysis based on interpretation and explanation are vulnerable to researcher influence and bias. The researcher must be cognizant of potential bias issues while developing a research design and use procedures that mitigate its effects. The question of the research method to be used brings with it other issues with respect to the researcher and the phenomena being studied. Researchers in the physical sciences can make the assumption, with some degree of confidence, that they can remain objective and that the subjects of research will remain relatively unaffected by the act of being studied. However, researchers in the social sciences must assume that the researchers and their subjects are in a constant state of interaction. Furthermore, from an epistemological point of view, researchers in the social sciences, especially those using qualitative methods, cannot be considered truly objective (Potter 1996).

However, qualitative research utilizes the researcher as its primary instrument.

This permits an advantage to the qualitative perspective not available to quantitative research:

The researcher as instrument is responsive to the context; he or she can adapt techniques to the circumstances; the total context can be considered; what is known about the situation can be experienced through sensitivity to nonverbal aspects; the human instrument can process data immediately, can clarify and summarize as the study evolves and can explore anomalous responses. (Merriam 1988, 19).

The researcher's "familiarity with the phenomena", "ability to draw on intuition and tacit knowledge", and their his "insights ideas, and impressions [become] part of the data of the study and inform the process of data collection and analysis" (Whitt 1991, 408). As Poplin (1987) points out, a primary distinction between qualitative and quantitative approach is how they view researcher influence. The quantitative tradition views researcher influence as something that should be minimized with a goal of total elimination and accountability for researcher influence. However, the qualitative tradition accepts the inevitability of researcher influence and the inherent strength that influence can bring to the research. The researcher influence enables rather than constrains the research effort.

Another criticism of qualitative methods is that the results are not generalizable beyond the local context where they were generated (Keating 1993). The criticism is due, in part, to contrasting qualitative methods with quantitative methods where a sample, correctly chosen, can be shown to be statistically generalizable to a larger universe (Yin 1994). In qualitative methods generalization is done by generalizing the results to a broader theory through multiple replications of similar studies (Yin 1994).

Although the goal of generalizability, supporting external validity, is inherent in research traditions based on the positivist perspective, it does not have the same emphasis in the qualitative tradition. Each qualitative research study accepts the contextually boundedness which, by necessity, works against the notion of generalizability of the findings to “other” contexts. The context is “transferable” to other context based on those who choose to make the contextual transfer.

Reproducibility is a common concern with all types of research. The issue of reproducibility for quantitative methods implies that another researcher can replicate an experiment and obtain precisely the same results from the procedure on data set. However, the events and phenomena studied in qualitative research are unique and cannot be repeated. Reproducibility in terms of qualitative methods means that another researcher can analyze the study data using the same procedures and might reasonably understand how the researcher was able to come to the interpretations and findings generated by the study. Reproducibility in qualitative methods can be maintained by careful attention to detail in research design and data collection. In qualitative methods, measurement data is in the form of descriptions or narratives. The data is analyzed in its original form to protect its richness and depth. It deals with the thoughts, attitudes and beliefs of people and records them in their own terms (Patton 1990). The use of multiple data collection techniques, as well as multiple sources of data, infuse rigor in the process through triangulation and serves to increase the validity of the results, making it more acceptable as serious scientific inquiry (Patton 1990).

Patton (1980) also discusses the issues of intellectual rigor in qualitative research. He states that:

... The thread that runs through [the] procedures and techniques for verifying and validating qualitative data is their dependence on intellectual rigor of the evaluator. There are no clear-cut rules on how to proceed. The task is to do one's best to make sense out of things. A qualitative analyst returns to the data over and over again. To see if the constructs, categories, explanations, and interpretations make sense, if they really reflect the nature of the phenomena. Creativity, intellectual rigor, perseverance, insight— these are the intangibles that go beyond the routine application of scientific procedures” (Patton 1980, 339).

There are multiple strategies to introduce “rigor” into qualitative research and develop the criteria against which qualitative based research should be evaluated. The establishment of rigor in qualitative research has been suggested by scholars to be captured in the ideals of “trustworthiness” (Guba 1985; Erlandson et. al., 1993; Whitt 1991) and “soundness” (Marshall and Rossman 1995). Figure 18 depicts the various research strategies that might be employed to enhance the rigor of qualitative research.

The differences between quantitative and qualitative inquiry can be summarized in their purpose, the role of the researcher and how they come to create knowledge. Quantitative research seeks to explain phenomena with the ultimate goal of learning to measure and understand it. Qualitative research is interested in understanding complex relationships in the phenomena being studied. Quantitative researches attempt to limit personal interpretation until all of the data has been gathered and analyzed. Qualitative research requires that the researchers make choices and judgments about the data and the subject while in the process of gathering data. Quantitative research seeks to construct knowledge from information structured by the bounds of the research design and the variables included in the analysis. Qualitative research discovers knowledge by including as many variables as possible in the interpretation of events (Stake 1995).

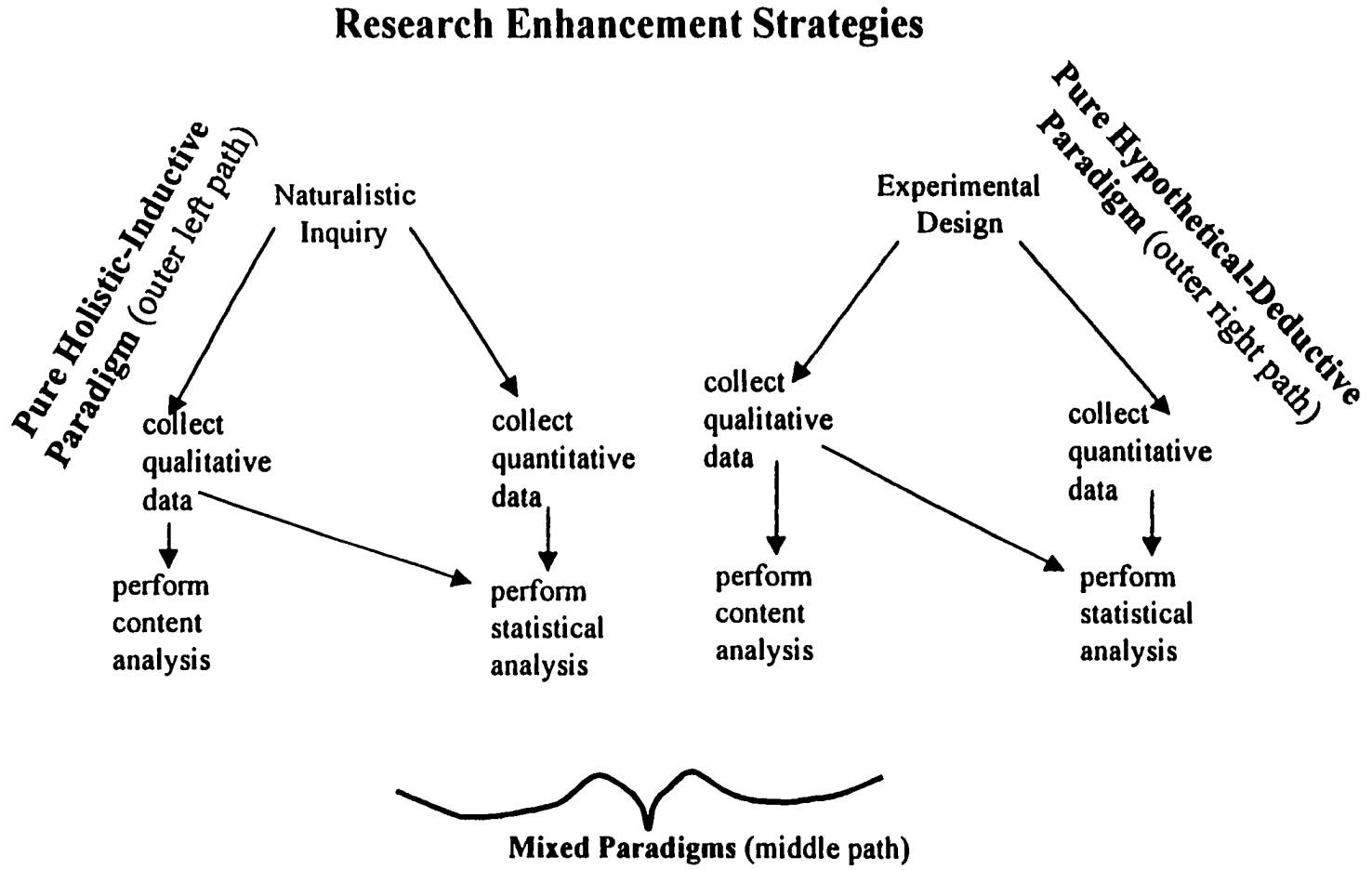


Figure 18. Qualitative Methodological Research Strategies (Patton 1990, 195)

Therefore, in qualitative research, the data, research context, and researcher are inextricably linked in the development of interpretation of data.

Thus far, discussions with respect to qualitative methods have been addressed in general. However, these foundation examinations also apply when discussing more specific qualitative methods. The qualitative method chosen for this research is case study. A more detailed discussion of the case study method and its applicability to this research follows.

Case Study Research

The previous discussion on qualitative and quantitative methods is background for a more detailed discussion of research methods in general and case study research, in particular. There are numerous research strategies used in the study of social and behavioral phenomena. These include experimental strategies, survey research, archival analysis and history. Each strategy has situations where it is appropriately suited. The strategies can be classified by which types of research question they are best designed to answer, whether or not they require control over the events being studied, and whether they focus on contemporary or historical events (Yin 1994).

When confronted with the requirement to provide theoretical justification and clarification for its use in scientific research, one is perhaps the best advised to respond to the issue by providing a clarifying discussion of what the literature suggests are the critical areas of concern associated with its use.

Specifically these are: (1) What are the types research appropriately addressed by case study methodology; (2) What are the attendant challenges, limitations, and issues concerning the case study approach as a rigorous research method, and (3) What are the

generally accepted research strategies available to address those challenges, limitations, and issues associated with the case study approach to research?

Nature of Case Study Research

Case study, as a research method, has received very little serious attention by authors on social science research methods. When case study is discussed, it is usually as a preliminary stage or data collection technique used with other research methods that the authors consider more suited to the conduct of serious social or behavioral research (Isaac and Michael 1981; Sjoberg, Williams, Vaughan and Sjoberg 1991). In many instances discussion of the case study method is combined with other methods such as ethnography or participant observation. With regard to participant observation, it should be noted that in many instances, case study includes the use of participant observation as a data collection method. However, the case study method has, from traditional research perspectives, been characterized as: (1) limited to a few units and, therefore, narrow in focus, (2) lacking generalization beyond the specific context, and (3) subject to researcher bias (Isaac and Michael 1981). Although these challenges are formidable, they do not preclude case study research from being a research method capable of producing knowledge.

Yin (1994) and Stake (1995) have both published seminal texts concentrating on case study as a serious research strategy. Yin especially has defined case study as a research method. He defines a case study as “an empirical inquiry that investigates a contemporary phenomenon within its real life context, especially when the boundaries between the phenomenon and the context are not clearly evident” (Yin 1994, 13). He goes on to explain that case study is useful as a serious research strategy when the

context surrounding a phenomenon is vital to understanding the phenomenon itself.

There are other strategies that can deal with context, but the case study is uniquely suited for studying context that is pertinent to the phenomenon. In order to consider case study as a research strategy itself, and not just a method supporting other strategies, Yin further clarifies the definition of case study by describing some of the technical characteristics of a case study mode of inquiry. He states that the case study is of particular value in researching situations where there are many more variables than available data points (Yin 1994).

Case study is best suited when the research question requires the study to explain or explore complex events and relationships. The techniques used in data analysis and the written form of case narrative are flexible enough to deal with issues of context and relationships among individuals and groups required to answer these types of questions in social or behavioral research. Unlike other behavioral research strategies, case study does not require control over events in the phenomena being studied. The focus on case study normally involves contemporary events where there are a variety of data sources available.

Appropriateness of Case Studies

Yin (1994) points out, case study research strategies have been successful employed for each of the three forms of research (descriptive, exploratory, expanatory). However, the case study research method has its strongest applications is in the area of exploratory research.

The case method is advantaged when: (1) the investigator has little or no control over behavioral events; (2) when the phenomenon under consideration is contemporary;

and, (3) When the research question is fundamentally and primarily exploratory (although it may be used for explanatory and descriptive type research as well).

This case study advantage is due to -- what the literature suggests [Maxwell 1996, Yin 1994, Miles and Huberman 1984) --the case study research strategy's ability to accommodate and benefited from multiple sources of evidence. With its focus on compiling the evidence via the use of multiple layers of analytical rigor -- which range from counting, to data clustering, to "noting the relations between variables", to the sophisticated process of pattern matching, the case study method's flexibility with regard to applying multiple sources of evidence in the pursuit of its research objective, enhances the ability to conduct rigorous research.

A key to the relative advantage of the case study method lies in the comparative rigor with which the case study field research is conducted in a way such that it assures various forms of validity are provided for. Generally speaking, this is done: (a) through the use of various forms of triangulation of evidence; and, (b) with the use of the options of employing a "multiple case" and "unit of analysis" case study design. The latter is evoked to better address concerns regarding external validity of case findings.

By way of a summary, the case study method is the preferred strategy to adopt for social science research when the investigators primary research question is a "how" or "why" question, when there is little control over events, and when the focus is on a contemporary phenomenon within some real-life context. Where the type of research is its more traditional application area of explanatory type research case studies are less appropriate. Case studies are also appropriate for exploratory as well as descriptive type of research.

Types of Case Study

One method to classify case studies is through the type of phenomena that is being studied. Yin (1994) identifies five primary classifications of the case study method: *Explanatory* case studies can be used to investigate the causal links in real life situations that may be too complex to be studied by more traditional strategies. *Descriptive* case studies describe the events of a case and especially their context. *Illustrative* case studies focus attention on certain elements of larger phenomena. *Exploratory* case studies are used to investigate phenomena that do not have a clear set of outcomes and are often used as pilot studies to determine the best strategy for a more focused investigation. *Meta-evaluation* case studies investigate the outcome of other evaluations or interventions (Yin 1994).

In review of the research questions undertaken in this research effort, it is clear that the exploratory case study type is appropriate. The phenomena associated with consortia are not well understood, the literature is silent with respect to exploration or articulation of the associated phenomena, and a clear set of outcomes (questions or hypotheses) for the research are not capable of being predefined. To manage this type of research situation a case study must rely on multiple sources of evidence and triangulation for the data to converge (Stake 1994; Yin 1994). Because Yin considers case study as a serious research strategy he notes that, as in all serious research, a rigorous case study should be based on a theoretical framework that is used to structure the data collection and analysis (Yin 1994).

Another criteria for case study is based on the premise that a phenomenon that is being studied for its uniqueness can only be investigated using a case study strategy.

The detailed study of a single bounded system must be a case study (Smith, 1979). In order to be studied a case must be an integrated system of working parts. By this definition, individuals, organizations and programs may be cases while their relationships and policies can not (Sjoberg, Williams, Vaughan and Sjoberg 1991; Stake 1994; Stake 1995).

Research Rigor in the Case Study Research Method

As noted previously, case study is not a universally accepted strategy for serious scientific research (Orum, Feagin and Sjoberg 1991; Yin 1994). When comparing case study with more conventional research strategies, Yin (1994) comments that many authors have noted perceived weaknesses. Only recently have proponents of case study begun to respond.

The most commonly cited criticism of case studies is the suggested lack of rigor (Yin 1994). Because case study often uses qualitative methods, a common criticism is that it is particularly vulnerable to bias on the part of the researcher (Orum, Feagin and Sjoberg 1991; Yin 1994). Also, qualitative methods in general can be prone to the influence of equivocal evidence (Yin 1994). Lack of research rigor, researcher bias, and equivocal evidence are actually more appropriate criticisms of the researcher rather than the strategy used. Rigorous research design, disciplined inquiry and diligence on the part of the researcher can overcome these suggested weakness just as it does with other research strategies.

It is also pointed out that the study of a single case fails to provide sufficient basis for scientific generalization. Again, this can be true of other research strategies where the research design is based on a single experiment. Like these other strategies,

case study is generalizable in that it adds to the weight of evidence supporting or conflicting with theoretical propositions. A single case is not in and of itself sufficient for statistical inference (Yin 1994).

In general the criticisms of case study are not without merit. In the past many case studies have lacked rigor in design or have been performed haphazardly which has spread doubt about the validity of all case study research. Also, there is some confusion between case histories, which are written as instructional stories, and serious case studies that are designed as research.

The approach to overcome many if not all of the potential weaknesses of a research project utilizing case study, or any other research method for that matter, is to start by developing a rigorous research design. Unlike more conventional research strategies, there has not been a sufficient number of rigorous case study research projects to develop a series of successful designs that can be emulated (Yin 1994). The case study method has been confused with or only considered a component of other research strategies (Sjoberg, Williams, Vaughan and Sjoberg 1991; Yin 1994). Lately, however, authors such as Yin (1994) and Stake (1995) have begun to treat case study itself as a serious research method.

Another dimension of the unit of analysis that must be considered is the time frame. This determines the limits of the data collection effort. In some case studies the time frame is set by the initiation and conclusion of a particular set of events. For ongoing phenomena the researchers are forced to set time boundaries for the research that they feel can expose the particular behaviors or relationships to adequate study.

The research design should include a method to analyze the data then link the results to the theoretical propositions (Yin 1994). There is very little case study literature that sheds light on this subject. Many case studies have relied on pattern matching as a data analysis technique. Other analysis techniques that have been used in case study include explanation-building and time series analysis. However, for case study research based on a specific theoretical framework there may be methods that are generally recognized as appropriate for research using that framework.

Case Study Design to Enhance Rigor

Yin (1994) defines the research design as the steps that need to be taken to progress from the initial research questions to the answers or conclusion. He mentions five components of design that need to be addressed for case study. These components include: (1) research questions, (2) propositions, (3) units of analysis, (4) the logical link between the data and the propositions, and (5) criteria for interpreting the findings. The researcher must carefully develop the research questions before choosing an appropriate research strategy.

The study propositions connect the research questions to theoretical issues. This step in the design focuses the research on the collection and analysis of data that is relevant to answering the research questions. This is important to ensure the validity of the research.

The unit of analysis as defined by Yin (1994) identifies the boundaries of the case study. Stake (1995) uses the term *case* in place of unit of analysis. The appropriate unit of analysis is determined by both the research questions and the study propositions (Sjoberg, Williams, Vaughan and Sjoberg, 1991; Stake 1994; Stake 1995). The unit of

analysis can be as small as a single individual or as large as a whole organization (Yin 1994). Yin also includes organizational change and processes as a possible units of analysis. On the contrary Stake suggests that individuals or groups of individuals can be cases but excludes relationships or interactions between individuals or groups as being possible cases (Stake 1995). The selection of the unit of analysis must include consideration of the individuals to be specifically included and those who will be specifically excluded. If the case is in an organization setting determining the individuals to include in the unit of analysis may be a simple task. However, if the unit of analysis is more nebulous, such as an industrial setting, the process of determining the appropriate unit of analysis will be a major undertaking. Case study designs can be either single or multiple. Within each of those the studies can be conducted as either holistic or embedded investigations. The single case study can be used when it is robust enough to represent a critical case in testing a theory. For this type of case, the single case is analogous to a single experiment. In a single case, the case results can further support the theory's propositions, or it can suggest doubt concerning the theory, possibly showing evidence to support a rival theory. A single case study is also appropriate when the case being studied is extreme or unique.

The single case is the weakest of the case study types. A risk in using a single case study design is that while performing the study, the researcher may find out that the case is different than it first appeared. Thorough investigation of the circumstances surrounding the case should be done during the design phase to eliminate the need to abandon the research in later stages or to redesign it (Yin 1994).

A single case study can be designed with only one unit of analysis, holistic, or it can have multiple units of analysis, embedded. The holistic design focuses attention on the entire case and not on components of it (Orum, Feagin, and Sjoberg 1991). This design is appropriate when there are no significant sub units or when studying the sub units would distract the researcher from the research questions that have to do with the case as a whole. However, if the theoretical framework for the study is holistic in nature then a holistic study is probably the most appropriate choice for case study type.

Holistic designs have some of the same disadvantages as single case studies. Although one concern is that the global nature of a holistic design may not allow the researcher to focus on specific details that might be critical in the case. Another concern is that a holistic design tends to be abstract without hard measurement or data. This opens the case study up to many of the common criticisms concerning lack of rigor in data collection and analysis. Also, similar to the single case study, the focus may shift during the course of the study without the researcher necessarily realizing it (Yin 1994).

If there are logical sub units that can be studied within a case, then an embedded design may be a suitable alternative. Examples of appropriate sub units are individual projects within a larger program that is being studied or individual decisions made by an organization that is being studied. Studying sub units can have the effect of focusing the study on particular aspects. However, there is a danger that the study can get stuck at the sub unit level (Yin 1994).

One alternative in case design is development of a multiple case design. In essence, a multiple case design is in reality a series of individual cases. The individual cases can either be holistic or embedded; however, the two designs should not be mixed

within one study. Mixing designs might restrict useful contrasts during data analysis. The advantage of a multiple study is that the evidence from a multiple case study does not suffer some of the weaknesses of the single case design. Multiple case designs are less likely to be criticized due to problems with external validity since they provide larger data sets upon which findings rest.

The cases for a multiple case study must be selected to follow some replication logic. Literal replication logic can be used when the cases are chosen because they are expected to produce similar results. If the cases are expected to produce conflicting results, then theoretical replication logic is used. The replication logic chosen must be in concert with the theoretical framework on which the overall research is based. If the results of the study are not predicted by the framework then the framework must be modified (Yin 1994).

Stake takes what Yin calls a single case study and breaks it down further. He defines the study of a critical or unique case as an intrinsic case study. A single case study that will yield results that can be generalized within a larger framework, he calls an instrumental case study. The multiple case strategy, he terms a collective case study (Stake 1994; 1995).

Case Study as Rigorous Research Method: Challenges, Limitations, and Issues

To provide rigor and aid in the research design, Yin (1994) recommends that theory development be included in the research design effort. This is consistent with other authors' (Maxwell, 1995; Marshall and Rossman, 1995; Miles and Huberman, 1994) recognition of the role of theory as a foundation for conducting qualitative research. The best course would be to use an existing theoretical framework from

literature, if possible, rather than spend the large amount of time required to develop new theory. Articulation of the theoretical basis in the early stages of the research design guides the data collection. A sound theoretical framework will also become the basis for generalization of the case study results (Yin 1994).

Questions of Validity in Case Study Research

Case study research, as other forms of qualitative research, must stand up to the same standards of validity as other strategies to be considered a method for doing rigorous investigation (Orum, Feagin, and Sjoberg 1991; Yin 1994). Criteria for validity normally used to determine the quality of research designs include construct validity, internal validity, and external validity.

A limitation of case study methodology is assuring that the phenomenon under study is being observed in a way that is reproducible and not an artifact of the unique aspects in which the study is being conducted. This is the matter referred to as construct validity. If suitable steps are not taken to address this area of vulnerability the research quality could be compromised. In the section that follows we will discuss how this concern may be addressed through the study design and protocol.

The matter of internal validity address the credibility of the study design in investigating the phenomena of interest and the strategies devised to ensure credible investigation. An example this area of vulnerability that is routinely identified is that of interviewer bias.

Research is ultimately conducted to add to the body of knowledge. Central to this research objective is the ability to make statements regarding a phenomenon understudy that where not understood prior to the research. The extent to which there is

a threat to doing that, the matter of how research conclusions can be appropriately projected to situations outside of the research boundaries is the concern of external validity. This is perhaps *the* major area of vulnerability to the quality of case study research perceived in the larger scientific community. By considering the philosophical context of the research as well specific design strategies, threats to external validity can be managed and attempts made to investigate those threats. These strategies will be discussed specifically in chapter IV.

Reliability in Case Study Research

The area of reliability addresses the issue of the repeatability of the research analysis and findings. That is, given the manner in which the research was conducted, would other researchers obtain the same results and have a suitability sufficient basis to draw the same conclusions? Having said that, it must be noted that it is critical that case study research strategy be used in appropriate research conditions. The primary concern of reliability is to be sure that given the same data and the same procedures the results of the case study will be the same. The ultimate goal is to remove bias from the study results.

Again, Yin (1994) is attempting to modify a generally accepted notion, in this instance reliability, to suit case study. Authors have questioned if the concept of reliability is applicable to qualitative research designs (Orum, Feagin and Sjoberg 1991; Yin 1994). Other authors have advocated the use of another concept, termed auditability as being the qualitative counterpart to reliability in quantitative research (Guba and Lincoln 1981). Sandelowski defined the concept of auditability by saying:

“A study and its findings are auditable when another researcher can clearly follow the ‘decision trail’ used by the investigator in the study. In

addition, another researcher could arrive at the same or comparable, but not contradictory, conclusions given the researcher's data, perspective and situation." (Sandelowski 1986, 33)

The common theme in discussions on reliability in qualitative research, and therefore case study research, is that while it is not possible to ensure complete reliability, it can be enhanced by designing it such that the readers can precisely follow the research (Keating 1993).

Stake (1995) mentions another type of validity termed consequential validity by Messick (1989). This deals with the ethics surrounding the use of the measurements and results of the case study. He posits that the researcher is responsible for the consequences of the results of the study being used by others if those results can not be shown to be valid. He goes on to say that the researcher has an ethical responsibility to minimize misrepresentations and misunderstanding resulting from his work (Stake 1995).

Addressing Research Strategy Criticisms

As a primary assault upon the case method is its vulnerability to the external validity issue, it is critical to place that debate in the proper context. Figure 19 shows that the External validity may be viewed as an issue of analytical generalization: that is, what is the relative extent that inference drawn from case study research are "universally" valid.

The primary issue is overcoming the perception that a "case " is not a universe -- in the statistical sense and therefore cannot support scientific inquiry aimed toward making discovery that has universal (read scientific) relevant. Although it is certainly true that a case is not a statistical representation of the universe of events out of which

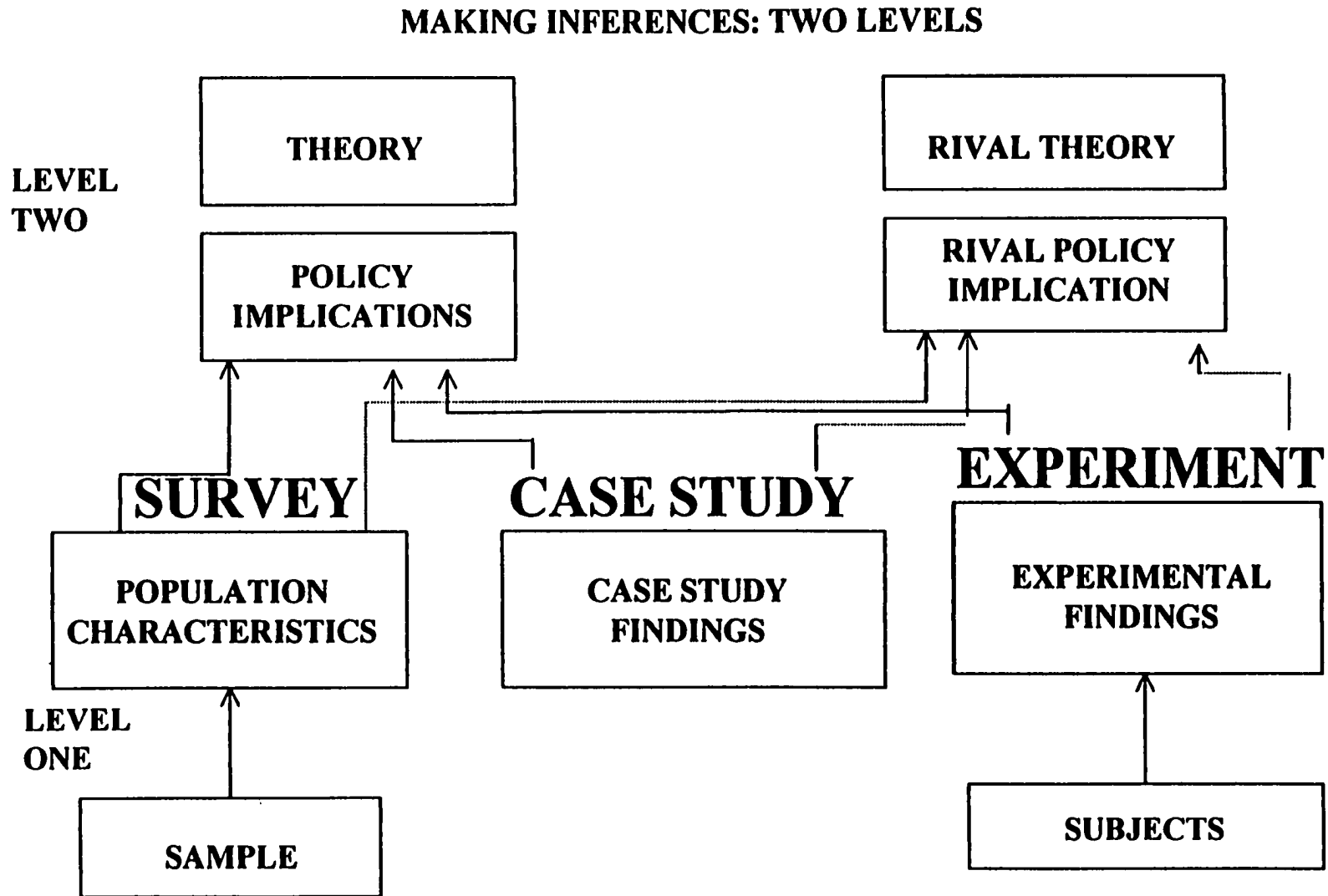


FIGURE 19. Inference and Case Study Research (Adapted from Yin 1994, 31)

the phenomenon of interest is possible, by considering the epistemological objective of the research it has been noted that depending on the design , external validity may be supported by such a strategy.

One criticism of case study research is that the data collection techniques are considered subjective. Has sufficient attention been paid to whether the measures used and the data collected actually describe the phenomenon being studied or, are they merely a reflection of the investigator's subjective judgment? Three tactics are available to ensure construct validity in case studies. First, using multiple sources of evidence enhances validity by providing data triangulation. Second, maintaining a solid chain of conclusive evidence provide for consistency in conclusion (Stake 1994; Yin 1994; Stake 1995). Both multiple sources and chain of evidence increase construct validity by ensuring that the conclusions drawn can be definitively supported from evidence in the database. A third tactic is to have some of the subjects of the case review the case draft for accuracy (Yin 1994). This adds support for the accuracy of the case study constructed from the data.

Internal validity is only an issue for explanatory case studies where the object is to determine if a certain phenomenon is caused by a particular variable. A possible threat to internal validity is that another variable, that has not yet come to light, is the actual cause of the phenomenon. Another possible internal validity problem occurs when the researcher must infer that a particular event occurred based on previous events. The internal validity issue is addressed in the data analysis phase. The data must be analyzed in systematic fashion to ensure that rival explanations can be ruled out (Yin 1994).

External validity is harder to achieve in case studies since it deals with generalizing the case study findings. Many of the criticisms of the case study strategy stem from problems of generalization. As stated earlier the aim of generalization in case study is analytical generalization where the goal is to generalize the case study results to a larger theory. In a sense, a single case study is analogous to a single experiment that provides evidence to support or refute a theory. Replication logic through a multiple case study technique on embedded units of analysis can be used to increase the weight of evidence in support or opposed to a theory (Yin 1994). The arguments made by Yin attempt to modify the generally accepted notions of external validity and generalization to better suit qualitative research in general and case study in particular. Patton (1986) takes another approach to discuss validity by noting that generalizability in qualitative research might better be explained in terms of what he calls 'reasonable extrapolation'.

He states:

“...Unlike the usual meaning of the term ‘generalization’, an extrapolation clearly connotes that one has gone beyond the narrow confines of the data to think about other applications of the findings. Extrapolations are modest speculations on the likely applicability to other situations under similar, but not identical, conditions. Extrapolations are logical, thoughtful, and problem-oriented rather than purely empirical, statistical and probabilistic...” (Patton 1986, 7)

In case methods, external validity is secured in terms of the analytical generalizability. This implies that, to the extent that the convergence of evidence supports conclusions advanced by the paradigms under investigation, the study results are said to support analytical generalization. Triangulation of data is a primary mechanism relied upon to enhance internal validity.

Yin notes that in case study research the issue of reliability can only apply to a specific case. The method for ensuring reliability is to fully document data and procedures used to analyze the data. In that way another researcher, using the same data base and the same procedures, should develop the same results (Yin 1994). This is consistent with Sandelowski's (1986) notion of auditability.

Central to the overcoming the limitations identified in the preceding section is the fact that multiple sources of evidence are accommodated in case study research methods. In addition to selecting the appropriate type of research to employ the case study method (e.g., exploratory) is key to a defensible outcome. Moreover, with its focus "on building the evidence" from these multiple sources so that the research may draw inferences relevant to the research question, case study research methods structural ability in this regard is the key to overcoming important aspects of each of the limitations.

Summary

The discussions in this chapter were designed to provide a methodological basis for the research design. The chapter included discussions of research perspectives of epistemology and ontology, qualitative-quantitative research distinctions, and development of the case study research method. Throughout, the chapter focused on issues concerning the controversy, interpretation, and appropriateness of qualitative methods, and in particular, the case study research approach. It concludes that qualitative methods cannot be judged by criteria that were originally designed for quantitative methods. The criteria used to judge the quality of a qualitative research design must take into account the unique nature of the specific methods applied and the

nature of the phenomena to which they are applied. The case study research method is an appropriate research method when the nature of the phenomenon to be investigated is not amenable to more “traditional” methods. The appropriateness of the research methodology and specific research design must ultimately be judged on their ability to effectively address the research problem and achieve the specific goals of the research.

The method used in this research is best described as an exploratory case study developed from a qualitative research disposition. This is a response due to the research questions explored, the phenomena of interest, and the relationships among the participants within a specific research framework (Orum, Feagin and Sjoberg, 1991; Yin 1994). Since the results of the study are to include theoretical and practical implications for use beyond the immediate context, the research method could also be considered an instrumental case study (Stake 1994; 1995).

CHAPTER IV

RESEARCH DESIGN

The phenomena explored in this research are the mechanisms that result in the enhanced management of innovative technology accomplished through informed state level agency participation in partnerships that can be clearly defined as consortia. The consortia in question are those that provide technology development through the judicious outlay of support for the commercialization of advanced technology applications for innovation in products, production, or distribution systems.

The issue of focus is the discovery and clarification of effective approaches and conditions for the management of technology innovation. This innovation is realized through state level agency avocation done in partnership with other forms of government, commercial industrial partners and universities.

Overview

This chapter provides a detailed description of the form and procedures of the research design. Thus, in keeping with sound qualitative research methodology, in this chapter the research design is developed and discussed.

As was shown in chapter II of this document, meaningful areas of conceptual uncertainty and underdeveloped literature exist concerning the emerging role of collaborations or partnerships formed to realize commercial gain while also effectively managing technology innovation. Such partnerships -- or Consortia as they are referred to in this research -- pose an operational as well as theoretical challenge when it comes to

understanding how to evaluate their potential, design and chose their form, and effectively manage them. As has been noted, the objective of the exploratory research conducted was to address this gap in knowledge and discover, through research of the phenomenon as it occurred in the field, what works and how best to manage the process. As was noted in chapter II, while it is true that various lines of academic inquiry have relevance, the literature is essentially silent on the matter of the pertinent theoretical implications for consortia venture creation as an instrument of technology innovation management. Further, the need for practical consortia management guidance when technology innovation management is intended to be effected through the creation of consortia based commercial ventures remains.

Chapter Purpose

The purpose of this chapter is to develop the design of the exploratory field research that was conducted to respond to the research questions. The chapter also provides a detailed description of the case study research design followed for the research.

The research design is developed in conformance with that advanced in the relevant literature on qualitative and case study research (Stake 1995; Yin 1994,1993; Patton 1990). A detailed description of exactly how the research questions/issues were addressed through each of the principal elements of the selected research design is provided. This is supported through a discussion of the specific considerations addressed in each of the following design elements:

- a) Development of the theoretical framework used to guide data analysis,

- b) Considerations and decisions that were associated with the research resources secured and allocated;
- c) Specific case study research design (i.e., the logic of the inquiry followed);
- d) Identification of the selected empirical field (i.e., the site selection process);
- e) Procedures followed for data collection, analysis, and case construction.

The process and guide to the discussion of each of these essential elements of the research design as well as the associated analytical procedures employed to support the research results are schematically represented in Figure 20 found on the following page. Each area will be discussed in turn and the rationale for the specific form of the general case study research design followed in the conduct of the research is described in this chapter.

Chapter Organization

The chapter is divided into four board areas. The first area addresses the specific issues one must be concerned with in arriving at a credible research design. Here the issues surrounding the choice of the type of case study applicable to the realizing the research objective are embraced. Also, the logic that supported the ultimate choice of the design adhered to is presented. This is followed by the second area, a discussion of the specifics of the design in terms of the choice of the units of analysis that collectively with the Case Agency infrastructure came to constitute the “case” in the case study.

The third major area addressed in the chapter was the matter of case data collection. Here, the subjects of:

- (a) the case database,

the sources of data used in the case study,

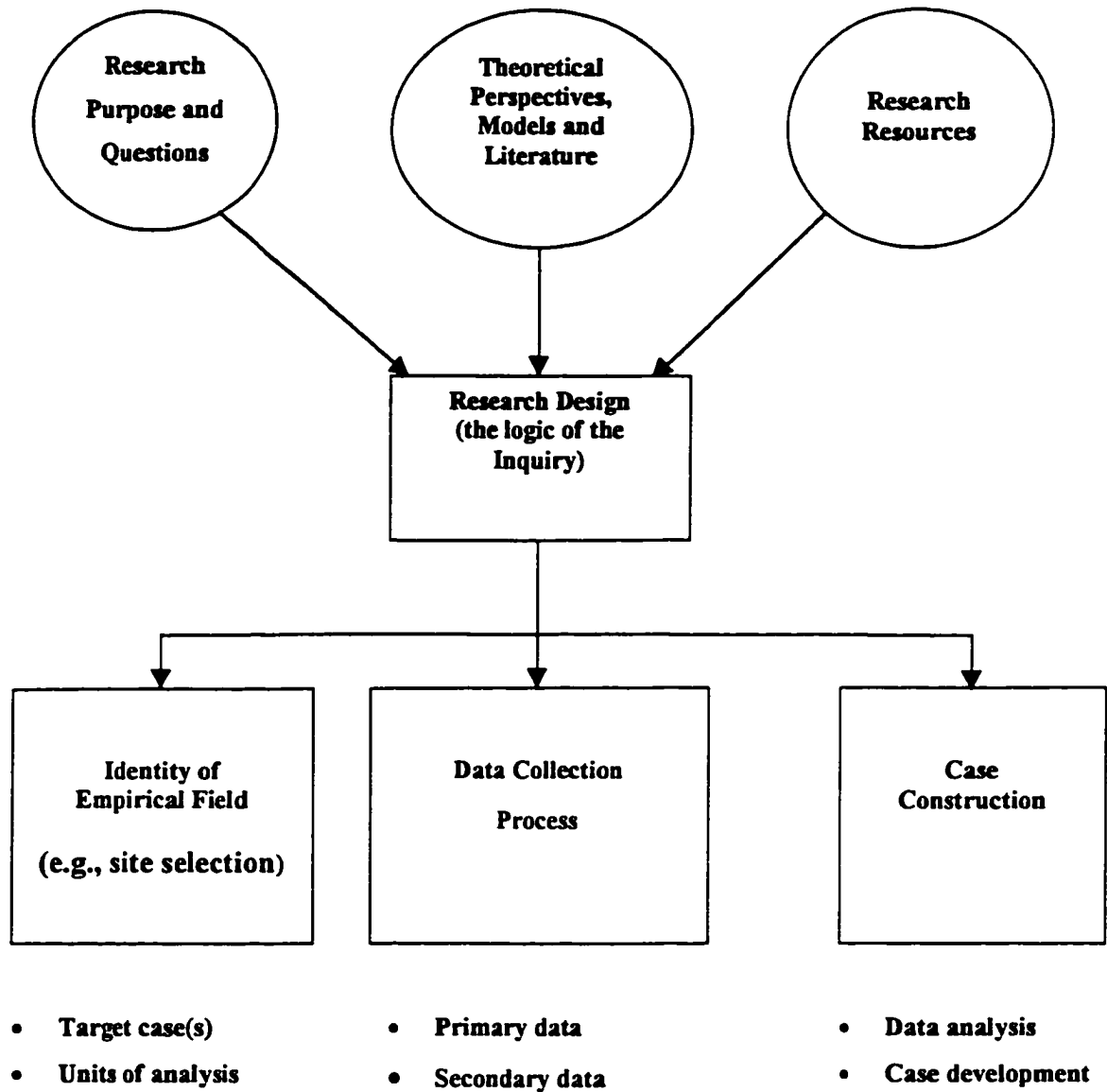


FIGURE 20. Central Function of a Research Design (adapted from Yin, 1993)

- (b) the methods of data collection followed,**
- (c) the design of the data collection procedures including the matter of what data were collected as well as how that data was secured; and,**
- (d) the research study issues of research validity and reliability as well as the overall integrity of the results are addressed.**

In the fourth major subsection of the chapter, the methods and rationale of the case data analysis upon which the conclusions are base are discussed. In this subsection the details of the procedures followed in the conduct of the case analysis are presented and the rationale that served to support the soundness of the analysis performed is presented.

The Consortia Venture Case Study Research Design

The practices and structures of research interest are those found to be prerequisite for successful new commercial ventures. The consortia studied were those with which a particular form of state agency (e.g., a not for profit, state funded and chartered institution also referred to as “quasi-governmental agency”)². This agency acted in partnership with private, university and federal agencies to provide the resources necessary to effectively establish successful new businesses. These were businesses distinguished by the fact that they rely on technologically unprecedented enhancements to products and/or business system processes. As such, by that development, these ventures exploit “advanced technology” in ways which constitute “innovative” applications.

The primary interest in this research was gaining a better understanding of the management of the organizational functions associated with the successful execution of the research, development and commercial market acceptance activities required for technologically innovative new product, product manufacture and distribution processes. Success in these circumstances was establishment of commercially viable enterprises.

The weight of the literature suggests that successful creation of commercially viable technological innovations is a phenomenon that is characteristic for any given industry (Quinn et al. 1997; Utterback 1996; Aldrich et al. 1995; Hamel et al. 1994; Horwitch 1986; Hax et al. 1985). The same literature suggests, further, that regardless of industry involved, it continues to be the case that the effective management of that specific industry's technological innovation commercialization process is a practice confronted with the challenge of "redefining" the function of the technological innovation and commercialization process. That is, there is a need to devise innovative inter-organizational approaches to manage technology innovation in response to fundamental industrial structural and process shifts being experienced in all markets.

Granting these assertions, a principal focus of the research was to examine and explore technology innovation management through state level agency programmatic practices shown to be followed for a specific form of consortia. The practices of interest were ones whereby the Case Agency provided its support by engaging in programmatic practices that:

² The so-called "Case Agency" is a not-for-profit, state funded, and chartered institution. In the course of this dissertation, it will also be referred to as "quasi governmental agency"

- (a) were consciously targeted to enhance the commercial business community's infra-structure developments; and,
- (b) appeared to garner or extend comparative strategic advantages to commercial concerns electing to reside in the sponsoring state's boundaries.

Specific Issue to Be Investigated

As exemplified by the research questions, the specific issue to be investigate is the phenomenon of the management of technological innovation. In particular, the specific focus is on the management of technological innovation when it is accomplished through the vehicle of successful new commercial venture development that is realized through university, federal agency, state level technology management agencies and private industry partnerships (or referred to herein as Consortia). Again, the research questions were:

Q1: What are the major sources of consortia support for innovative technology-based new ventures that seem to work?

Q2: What approaches to managing the commercial viability of advanced innovative technology-based new ventures through partnerships of industry, governmental agencies, and universities are effective?

Overview

As has been shown in chapter II of this document, there are many streams of literature pertinent to the exploration of the management of technology innovation through university led consortia partnership sponsorship of commercial support (or infrastructure) ventures. The specific form of case study followed is represented in

Figure 21.

As shown in Figure 21, it can be seen that the research was designed to be conducted in three major phases as are identified. These phases were:

1. **Phase One:** Define and design the research;
2. **Phase Two:** Prepare, collect and analyze the data, from each of the total four units of analysis researched; and,
3. **Phase Three:** Analyze the case and report the outcomes relevant to the case and to the research questions that are suggested by the multiple sources of evidence collected.

In phase one the research questions served to inform consideration of the literature that addressed the general topics of technology innovation, its management, and university, government and industry consortia. The establishment of the relevant theoretical foundation clarified the specifications for organizational units that were well suited to support an investigation of the research questions. The literature also served to suggest promising modes and means of topical inquiry.

In the second phase, strategies for data collection, data analysis and data interpretation that satisfied the research methodological requirements, within the field data collection realities, were developed. Here the matters of clearly identifying the units of analysis, the protocols for data collection and the suitable methods for analyzing the collected data were established in a way that would maximize the reliability and validity of research results.

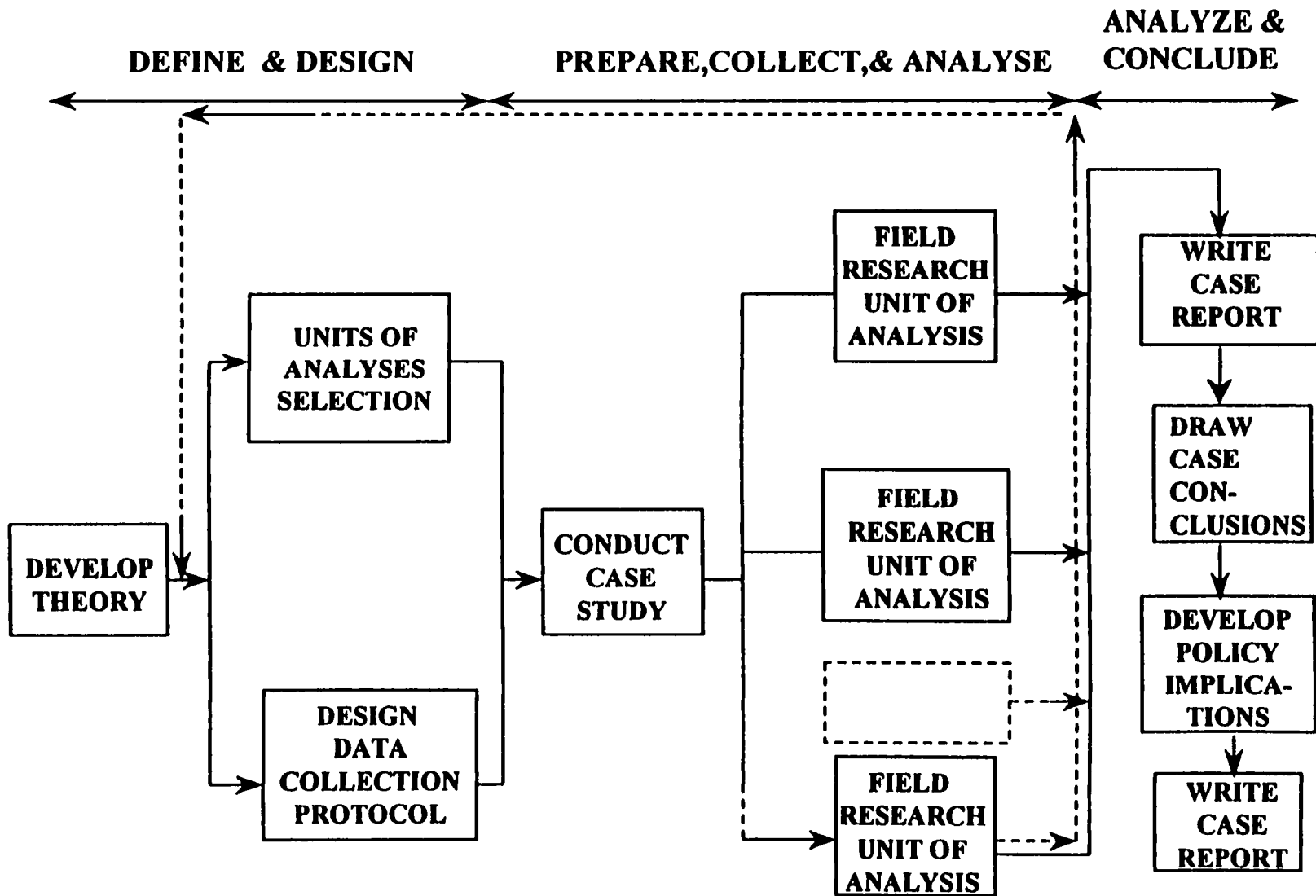


FIGURE 21. Dissertation Case Study Design Schematic

In the third and final phase of the design effort, the methods worked out in phase two were applied. Thus the conclusions from the case were drawn and study implications for subsequent investigations relevant to technology innovation management theory were generated.

The analysis was intended to provide the basis for research conclusions as well as operational implications.

Rationale of the Research Design

Further consideration of Figure 20 above serves to provide a roadmap of the sequence of design issues that will be addressed below.

The overarching rationale for the research design was to achieve the general scientific research objective to adhere to logical consistency (Potter 1996; McGarth 1992). The integrating theme for the outcomes of each of the key design elements identified in Figure 21 is that the logical consistency must be preserved through each element of the research design as they are shown in Figure 20.

As Figure 20 suggests, logical consistency must include discussions of: (1) the influence of the research objectives and questions on the design selection; and (2) the role of the theoretical perspective and paradigms in restricting and providing design direction. These considerations are followed by treatment of the impact of research resource limitations on the adapted design. In addition, the selected logic of inquiry and the schemes for site selection, data collection and the processes whereby the research was managed are developed.

This normative approach was followed in development of the specific research design to maintain logical consistency.

Research Requirements – Assumptions

There were two primary assumptions necessary for the research. These were:

1. The forms of venture development intervention found throughout the field research area typify a representative range of technology innovation ventures initiatives.
2. Venture capital and conventional sources of venture funds are included in the class of private sector venture support that also is occupied by the subset of private investors known as “angels” and “vultures”.

By adhering to well considered qualitative research methods as discussed (Yin 1994; Patton 1990) in the preceding chapter, maintenance of research soundness, in terms of the issues of validity and reliability, have been incorporated into the research design.

Specifics of The Dissertation Research Design

To understand the questions guiding the research, the design included the four units of analysis embedded in one case. This design was capable of achieving the purpose of the research in terms of its potential contribution to the literature and to the case organization’s efforts to improve its effectiveness in management of technology innovation.

Instrumental Case

As Stake (1995) suggested, the choice of the implicit objective of case studies may be viewed as falling into either of two distinct orientations: “Intrinsic Study” or “Instrumental Case Study”. Thus, by way of explanation of this dichotomy, a research objective might legitimately be to gain insight into the question or questions of interest by studying a particular case. In this respect, the case study is said to be following a so-called “instrumental case study” focus, one that should serve as the logically consistent

basis for the selected case study design followed in the research. For the “Intrinsic Study” orientation, Stake (1995) points out that the research focus is solely on understanding issues at work in the particular case as it is researched because the object of the research is viewed as interesting in and of itself. Thus it can be seen that a key consideration of any case design has to be awareness of its ultimate research purpose. In the subject research, the research questions and the phenomenon were collectively viewed to suggest that the emphasis should be on an instrumental case focus. For the area of technology innovation management the research was designed to better understand:

- The phenomenon of technology innovation management in general; and,
- given university industry federal and state-level government agencies acting in partnership with industry, what seem to be advantaged approaches to technology innovation management issues that suggest improved commercial venture support selection and operations management.

This, together with the set of research conditions presented in the preceding chapter, not only recommended and justified the methodology, but also influenced the specific research design based upon the methodology.

Exploratory Case Study Design

Yin (1994) suggests that, of the case study research strategic options, the exploratory case study has distinct advantages when various research resource conditions exist. If multiple sources of evidence are available or there is relative ease of access exploratory case study is particularly effective as a research strategy.

As Yin (1994) points out, it is the form and nature of the research objective and supporting research questions that define the appropriate phase (or kind) of qualitative research to be performed. Accordingly, Yin (1994) suggests that qualitative research method is highly recommended under the following conditions:

- (a) When an understanding of what occurred is viewed as the primary research objective; and,
- (b) the occurrences of the situation of interest is key but rare; or ,
- (c) when it is clear that the desired situation can be readily availed to the researcher; or,
- (d) when research is recognized as being a necessary step to advancing the body of knowledge regarding a phenomenon to be studied; and, finally,
- (e) when gaining an appreciation of the universal (as opposed to the unique) mechanics at work.

Further, when these conditions are faced in the course of addressing all of the research objectives or constraints, then performing qualitative research is recommended.

As our treatment of the literature attests, gaining a better understanding of how to manage technology innovation through the vehicle of consortia supported commercial venture development is not well understood. The same observation applies regarding the appropriate roles of such ventures in the emerging economic and social realities that characterize contemporary technology development environments for commercial, academic, and scientific enterprises. For the research arena, the opportunity to explore the phenomenon associated with consortia development of technologically innovative

ventures presented itself sufficiently on at least four relatively unique occasions. These occasions became the focus for the case study.

Recognizing that, to address the research questions, as well as theoretical research concerns, it was deemed rational, procedurally appropriate, and theoretically justified (Yin 1994, Potter 1996, Maxwell 1994, Stake 1995) to adapt an exploratory case study research strategy.

Role of Research Objectives and Questions in Case Study Design:

Given the exploratory nature of the research, as well as the objective of the research being to provide support for further clarification of the key elements of the relevant theoretical constructs that hold promise for viable subsequent research agendas, a specific problem could be set. In the case of the research, the specific problem investigated was viewed as having been effectively represented by the research questions.

The two primary research questions take the form of qualitative research question that Yin's (1994) models as being so-called "how" questions.

In a related consideration, Stake (1995) suggests that it is in the kind of qualitative research in which a case study methodology has been adapted that one will find that there are two fundamental demarcations of research: intrinsic case study or instrumental case study. For any given specific type of case study approach selected, Stake (1995) argues that the particular structure and procedure followed in the course of the conduct of the research depend on which particular outcomes desired. For example, in situations where there is a curiosity about a specific unit of analysis (organization, individual, group, etc.) in terms of how it works or does what it does, then the researcher's interest is primarily

directed to learning about that particular situation or case. In this instance, the appropriate form of case study, and associated design, to follow is a so-called “intrinsic case study” (Stake 1995). The emphasis of this formulation of the research is to find out how the unit of analysis, or the focus, of the research, behaves or does “what it does”.

Thus the researcher’s focus is limited to object of the study itself.

Moreover, in addressing the matter of the particular forms of case study design best suited to underscore logical consistency throughout the design, Yin (1994) provided further considerations. In particular, as Yin (1994) suggested, the matter of which research phase (or kind), option (confirmatory, exploratory or explanatory/phenomenological) to adopt to extend logical consistency of the research design, it was found that the so-called “How” questions largely suggest conducting research that is explanatory in nature. That is, it is clearly understood “what” occurred. It is less clear by what sequence of events or “how” the outcome was realized. A review of the present research questions suggest that the research questions are concerned with “How” and “Why” form questions. Simply put, we were conducting an exploration. Therefore, the exploratory case was selected as the most appropriate form.

Given that the exploratory case study research strategy was adapted, the design issues to be addressed were the matters of:

- (a) The appropriate logic of inquiry;
- (b) The identity of the empirical field (i.e., the organizational unit to select as the case organization);
- (c) The selected process of data collection; and,
- (d) The research management process: that is,

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- The matters of linking data to propositions; and,
- Criteria for interpreting the study findings.

In other words, viewed collectively, these design issues served to define the composition of that case organization, as well as the study protocol and methods of analysis for the research.

The Role of Theory

According to the relevant aspects of the case study literature (Creswell 1996; Yin 1993; Patton 1990), consideration of the theoretical perspective associated with research has a set of specific roles to support the research design. These were followed in the case of this research. The role of the theoretical perspective in case study strategy regarding the dissertation research design included guiding:

- a) Selection of the cases to be studied in first place, regardless of ultimate design.
- b) Specification or definition of the characteristics of the case or the phenomenon being studied. For example, depending on the kind of case study (exploratory, descriptive, or explanatory), theory's role in case studies can be as follows:
 - In exploratory case studies, theory specifies what is being explored when you are doing exploratory case studies
 - In descriptive case studies, theory defines a complete and appropriate description
 - In explanatory case studies, rival theories are stipulated
- c) Generalizing the results to other cases.

In sum, theory for this exploratory research case study served to provide a framework for exploration of technology innovation management. The theoretical development from the existing literature provided a starting point for exploration.

Type of Research: Theory and Design Rationale

According to the work of Aldrich et al. (1995), Rosenberg and Nelson (1992), and Mowery (1990), the level of misunderstanding of the key ingredients in formulating and managing consortia of industry, universities, and governmental agencies is relatively high. This is due to the fact that the universe of consortia is ill defined at best and proportionately rare.

As discussed earlier, given that success in the management of technological innovation in general and more specifically in the case of technology innovation management through university-led consortia has been shown to be:

- A context dependent result;
- The phenomenon of technological innovation is itself accomplished via socio-technical systems (Bateson 1978) and thus by its very nature is a phenomenon of social science (Kim 1996; or Utterback 1996),
- Highly complex and characterized by disproportionate data deficiency in situations where it can be conveniently studied; and,
- Characteristic of scenarios which favor case study methodologies and approaches.

The schematic of the specific literature-based framework that was adopted in this research was presented in chapter II. It also served to suggest key characteristics of the

case selection as well as guiding selection of the units of analysis that would be found suitable for the research focus. It is shown in the diagram on the following page.

Theory and the Determination the Unit(s) of Analysis

As has been stated, in this research, the strategy selected as appropriate for the research objective was the exploratory case study research strategy. The next design issue was to determine the case organization. To accomplish that selection, it was necessary to identify the associated key organizational components that were required so that the case organization would be adequately represented. This aspect of the design included the need to develop definitions of the appropriate case organization, its associated units of analysis and the criteria whereby candidate situations were selected. These design considerations included matters such as the programmatic elements to research, the particular organizational perspective, and the key aspects of the available phenomenon capturing units (in our case the units of analysis researched).

The state of theoretical development of technology innovation management clearly suggested that the research needed to focus on specific types of relatively unique technology innovation management situations. These were situations characterized by commercial ventures done in partnership with other commercial partners such as those associated with joint ventures, strategic alliances for specific functional areas, licensing agreements, mergers and acquisitions, and the like.

Selection of The Case Organization

The various streams of literature – shown in Figure 22 -- suggested that it was important to research organizational units where the phenomenon of consortia advocated commercial venture developments, that were based on innovative technology projects,

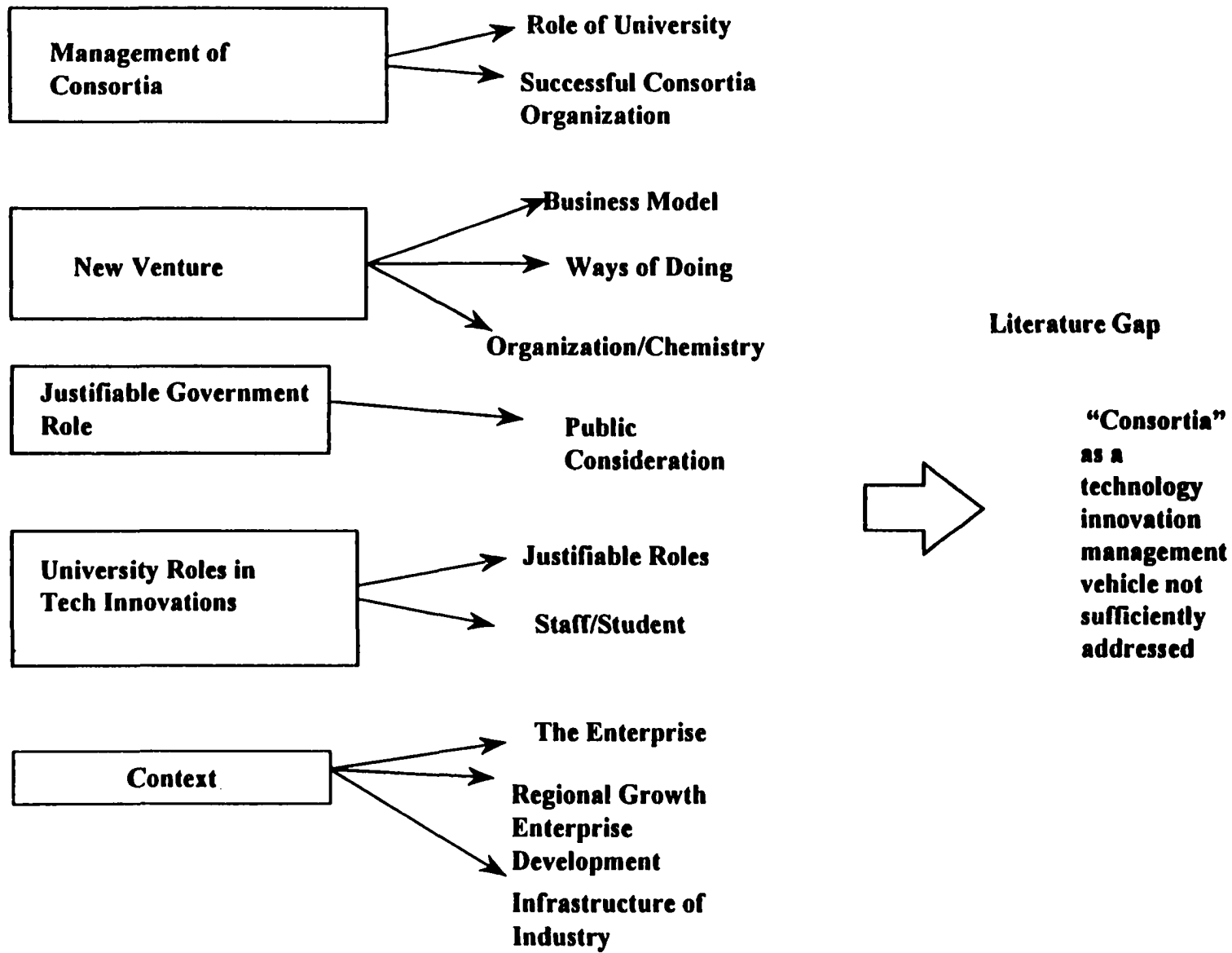


FIGURE 22. Source Streams in the Literature: An Expanded View

had been pursued. Moreover, it was necessary that such units be researched in a way that the key sources of evidence regarding their developmental and operational outcomes, where available and could be researched. Given this observation and the selection of an exploratory case research strategy, the next design feature to clarify was the number of units that would be required to fulfill the chosen research methodology.

Yin (1993) provided guidance based on theory and the logic of inquiry in development of the case study. Thus, given that the options for case study strategies are as follows:

- **Exploratory Case Studies** are aimed at determining the feasibility of the desired research procedures, or at defining the questions and hypotheses of a subsequent study (not necessarily a case);
- **Descriptive Case Studies** presents a complete description of a phenomenon within its context; and,
- **Explanatory case study** presents data bearing on cause-effect relationships, explaining which causes produced which effects;

there are 6 different types of Case Studies Design options which exist.

One can adapt either one of the options shown in Figure 23. Thus, given this design framework, coupled with the case organization and research questions, it would be suggested that the choice of employing multiple cases to examine phenomena would be most desirable. This would provide research designed to explore the issues associated with the management of technology innovation through consortia sponsorship of commercially successful ventures “multiple case design”, because it would offer a

	Single	Multiple (Two or More) ¹
Exploratory		
Descriptive		
Explanatory		

Figure 23. Matrix of Case Study Design Options

¹ When one adapts a “multiple-case” studies approach, the cases should be selected so that they are replicating each other (that is, they are “exact (direct) replications or predictably different (systematic) replications”).

strategy of observation of “successful” outcomes across multiple replicated instances. However, this was not the situation that applied for the exploratory research study objectives associated with the phenomenon of interest for this study.

Selecting a single case unit of analysis is appropriate when:

- (a) The theory calls for characteristics of the phenomenon of interest to be isolated sufficiently to be tested in that situation; or, that
- (b) The case [*organization is*] selected for study [*when it*] is viewed to be the best “fit” example for the phenomenon being studied to be researched (Yin 1993).

The issues of access to the data, as well as Yin’s (1993) comments with respect to single case study, collectively suggested the selection of a single case organization as the appropriate design for the research.

The Single Case Exploratory Research Study Design

The sole case explored was that found in a Mid-Atlantic regional state within the United States of America. The subject agency’s state-wide program is one that is intended to nurture advanced technology-based economic development. The so-called “Case Agency” pursued this objective by engaging in a variety of support mechanisms. Through various forms of allocation of its resources, the Case Agency participated public-private partnerships, and thereby attempted to realize the mission objective of technology based economic development.

Due to the Case Agency’s pervasive and varied modes of new venture development participation, the proposed research design to explore its efforts to manage innovative technology through new venture support is viewed as being most accurately characterized as single case with multiple units of analysis design (Yin, 1994). The

selection of this design is supported by virtue of the fact that the agency's role has been politically assured by the state legislature. This role for the state quasi-governmental non profit agency (the Case Agency) was established through legislative fiat. Therefore, to adequately study the phenomenon of regional governmental level efforts to manage technology innovation, as it is attempted in the research arena, necessitated viewing those initiatives from the perspective of the sole agency granted the range of governance that suited the research agenda.

Research Resources and The Choice of Research Design

The primary interest in this research was to gaining a better understanding of the management of the organizational functions associated with the successful execution of the research, development and commercial market acceptance activities required for technologically innovative new product, product manufacture and distribution processes which are also commercially viable. The weight of the literature suggests that phenomena associated with success are characteristic for specific industries. Also these phenomena being redefined as a result of fundamental industrial structural shifts faced by all.

Granting these assertions, it was the principal focus of the dissertation study to examine and explore those practices of consortia support which:

- (a) where consciously targeted to enhance, the commercial business community's infra-structure development; and,
- (b) could be viewed as having been able to garner or extend comparative strategic advantages to commercial concerns electing to reside in the sponsoring state's boundaries.

This focus clearly resulted in significant research resource constraints being imposed on the research design in terms of:

- The applicable data, the associated sources of data; and, given the fact that all case study research is faced with limited resources (Stake 1995),
- The process and protocols to be followed in the conduct of the research.

These outcomes significantly contributed to the ultimate form of research design that guided the study.

In the unique case of the region and university of focus for the research there were two main programs that the university's entrepreneurial center maintained. The first was a tutorial-based program which provided business assistance to individual companies that were starting, expanding, or attempting to turn businesses in different or more profitable directions. The second was targeted to develop the kind of regional infrastructure that could routinely serve to support local entrepreneurship and the successful launch of innovative companies. That included the set of activities associated with locating and creating risk capital funds, running small business assistance programs, conducting management training programs, acting as an information clearinghouse, providing community education concerning economic development, and linking regional higher education resources to the private sector. Just to provide a sense of scale of this activity, it was reported that out of several thousand inquiries received, the center in question analyzed on average about 100 business cases each year during 1984 to 1998 based on the case database documents.

Based on the data collected in the course of the research, the Case Agency's territorial sweep encompassed the entire state. From the Case Agency's perspective,

there were instances where affiliated universities had successfully engaged in commercial venture formulation and launch.

There were also instances where the university consortia venture partner that was represented in the case study research did make resource investments. These investments were in various commercial and programmatic economic development partnership opportunities with other state-sponsored agencies charged with technology innovation management. An example of the unique form of the latter were various situations where the university participated in economic development opportunities in partnership with the Case Agency. In addition, the university also became involved with limited interested federal agency participation economic development opportunities. This university likewise had a history of engaging in entrepreneurial venture activities on its own. Therefore, the university in the research context had been active in consortia of interest for this research. However, the research focus only included cases of university, state agency, federal agency and industrial partnership.

In collaboration with the case study university's entrepreneurial center, the researcher established the avenues for access to key institutional representatives selected to participate in the research.

The research focused on the operations of the Case Agency done in connection with the rather unique form of partnership. The unique form of interest for the research were those university- industry and federal agency partnerships, in concert with the Case Agency, which supported the commercial development of infrastructure ventures deemed strategic to the subject state's future economic and commercial competitiveness.

Thus the choice of the specific situations to be research was informed by the limitations imposed due to access to the data as well as the type of consortia of interest which had been attempted. The Consortia became primarily regional in focus but inclusive of other individuals and institutions deployed through out the state in relationship to consortia.

The Choice of Embedded Units of Analyses

Creswell (1996) and Yin (1994) both point out that the research type which allows the use of all sources of evidence (e.g., surveys, archival data, guided discussions as well as non-universal experiment results) to support the analysis of data is the case study strategy. Referred to as a “confluence of evidence”, this approach supports contemporary explorations through a case study methodology. It also matches well the disparate types of field data that were available for the research.

Creswell (1996) and Yin (1994) further point out that when various contextually disconnected organization sources are involved in data generation, they may be considered “units of analyses” with potential external validity contribution to the extent that they are connect at the “meta level”. A so-called “meta level” connection could be clearly demonstrated at the level of the Case Agency. This was a fact that further served to support the use of the single case with embedded units.

The choice of embedded units of analyses became the design of choice when the following observations were made:

- **Four unique examples of university-federal agency-Case Agency and industry consortia existed and were accessible.** These were selected to be units of analysis because of these characteristics.

- **The Case Agency, the university and the modes of access to each example were collectively uniform across each of these units.** However, each was distinguishable in clearly discernable ways (e.g., they were based on different business models, differing kinds of technological innovations at their core, and in one case, involved different organizational assets at all four essential institutional levels³).

Therefore, the nature of the research questions themselves collectively supported the decision to select the case study as the research method to be used in the research (Potter 1996, Maxwell 1996, Creswell 1994 and Patton 1980) and the case study with embedded units of analysis as the key feature of the research design. In sum, the single case with embedded units of analysis was (1) appropriate, (2) manageable, and (3) capable of providing a research design compatible with the research purpose and questions.

Selecting the units of analysis for the Case Study

There were four units of analysis selected for this case study. The focus of the research was to examine both successful and failed attempts to realize new commercial enterprises through support of new ventures. Therefore, the units of analysis were selected to include those that:

- Had business models which were founded on the application of the innovative technology; alternately in:

³ That is at the university, federal and case agency-levels as well as at the level of the non financial sector industrial strategic partner electing to be involved in the consortia supported commercial venture's development.

- (a) The firm's production/distribution functions,
 - (b) Embedded in its product line; or,
 - (c) Captured (simultaneously) in both aspects of the business;
- Had resources that were provided by a combination of university, federal and state agencies in concert with private resource investments; and,
 - For those situations considered, the research attempted to clarify "what works"; and, what appears to be a significant contributor to the outcomes assessed.

The four units of analysis selected all were multi-sector infrastructure projects that were judged by the Case Agency to hold the promise of increasing the competitiveness of the Case Agency's service area firms. Summary descriptions of each of the units of analysis researched are provided in the appendix identified. All university nurtured, the units ranged in primary sector focus from space, commercial shipping commerce, and aerospace systems development infrastructure ventures.

Data Collection

The manner of the procedures followed for the collection of the case data is a primary component of the research design. Particular consideration is necessary because well thought out collection procedures and management practices support the study's reliability (Yin 1994).

Primarily through the device referred to as "the Study Protocol" (appendix 2), a uniformed procedure for collecting the case data employed by case study designs is assured. Minimally, the issue of data collection in case study research must address the following areas:

1. What data will be collected?
2. What are the sources of data?
3. What is the procedure by which it was collected?
4. How was the case database developed and stored?

Each of these areas will be addressed below.

Data Sources

The exploratory case study research strategy, adhered to during the course of the dissertation research, employed a “convergence of multiple sources of evidence” approach to the analysis component of the analysis (Yin 1994). A schematic of the approach is shown Figure 24.

As such, as an example, guided interviews were conducted for each of the four consortia studied. In addition to these sets of four interviews being conducted with representatives of each of the partner organizations⁴, additional interviews were secured on a selected basis.

Case Database Development

Each data source contributed to the case database. Figure 24 is a depiction of the multiple data sources contributing to the composite case database. However, interviews with representatives of consortia participants, as well as the Case Agency representatives, provided the foundation of the case database. In addition to five (5) key interviews with

⁴ Each of the four Consortium studied were sponsored to result in a commercial venture being successfully formed. For each of these as a result of the operational definition of Consortium assumed in the research, a minimum of four partner organizations or agencies representatives had to be interviewed – one from the university (typically the university attached champion), one knowledgeable representative from the sponsoring

representatives of the Case Agency, interviews were secured in association with each of the four consortia researched.

More specifically, the case database is comprised of the following:

- (1) Audiotapes of the semi-structured interviews held with senior management representatives of each of the partner institutions for each of the four consortia studied. These consortia served as units of analysis in the research.
- (2) Transcriptions of each of the audiotapes of the semi-structured interviews of consortia participants.
- (3) Interviewee comments following review of transcriptions. These were confidential transcriptions provided back to the interviewees to permit review and comment content for accuracy, adjustment, or clarification.
- (4) Unit of Analysis Summaries developed by the researcher for each unit-of-analysis. These summaries were developed from the semi-structured interviews.

federal agency, one representative from the case agency organization, and a representative from the industrial sector partner firm or commercial organization.

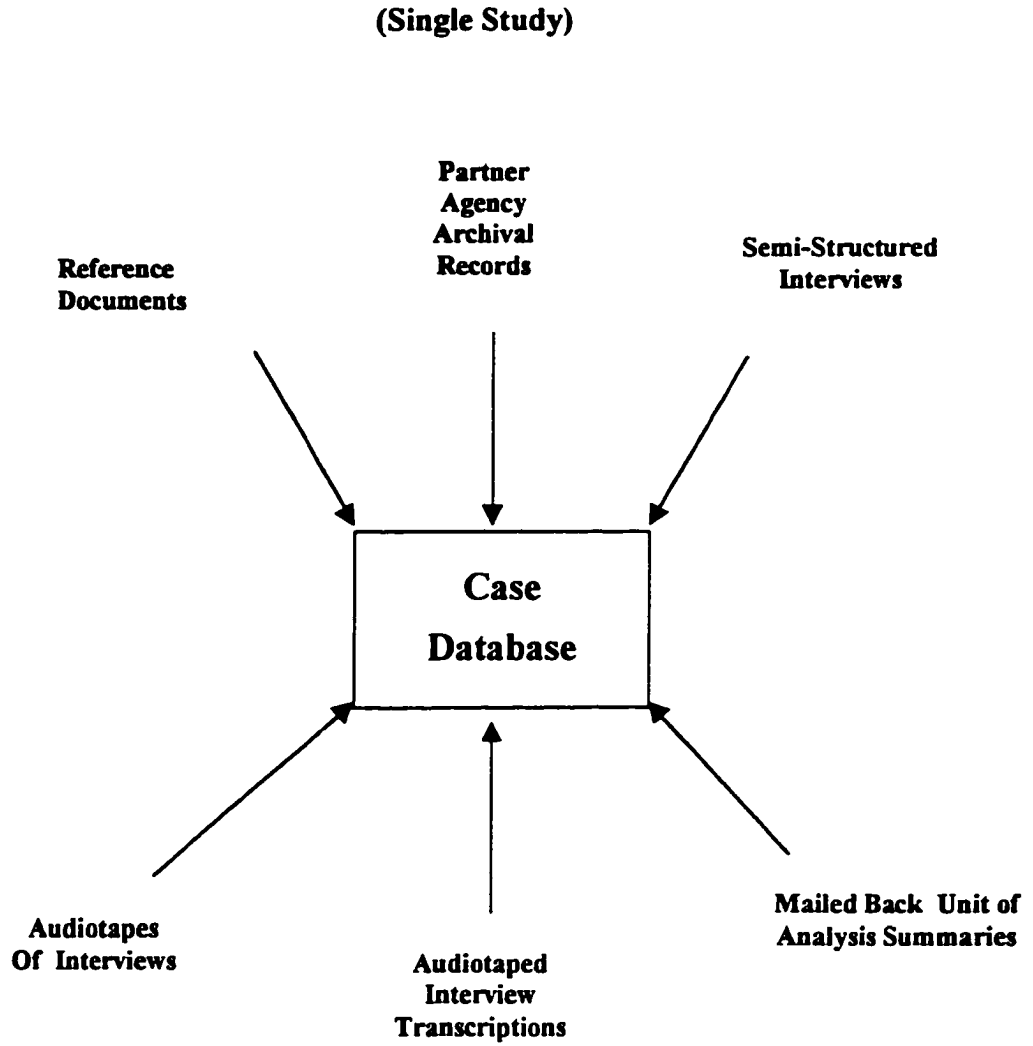


FIGURE 24. Convergence of Multiple Sources of Evidence
(adapted from Yin 1994, 93)

(5) Unit of Analysis Summaries comments. These were participant comments for unit of analysis summaries. This permitted each research participant to provide additional data in the form of: (a) hand written edited, (b) verbal overview comments (e.g., taped voicemail records in at least one instance) and/or (c) written summary comments. The review focused on the issues of the effectiveness in assuring institutional and individual anonymity; and, the extent to which the summary was viewed as accurately capturing (the respondent's view of) the pertinent consortium's development story and its emerging venture development and management challenges.

(6) In addition to these, the Case Agency summary was provided to each of the Case Agency senior management participants for their review of its accuracy and anonymity.

In addition to these data collected through the field interview process, consortia organization process and development documentation was also secured. These "Case Reference" documents included critical Case Agency and unit of analysis programmatic overview documents and operations and policy diagnostic documentation. Among these data were:

- (1) Reference industrial sector related analyses, selected feasibility studies performed in support of the case study's participating regional university entrepreneurial center (ECTR) venture evaluation activities conducted during academic years 1995-1996 and 1996-1997;
- (2) Various Case Agency regional center program description and summary documents;

- (3) Case Agency Technology Organization Sector Strategy Documents ;
- (4) Case Agency-sponsored consultant market assessment and program evaluation documents; and,
- (5) Other reference documents supplied by the research participants.

The schedule of targets for semi-structured interviews was base on the objectives:

- (1) Providing a perspective from each major participant in the consortia, and,
- (2) Including the level of Case Agency management selection. The following matrix was used to guide the interviewee selection.

Assistance in identification of participants was obtained from:

- (1) The case regional area Case Agency's regional university partner organization (i.e., the Entrepreneurial Center) director;
- (2) The case study participating regional university's research foundation assistant director; and,
- (3) The case study's participating regional university senior manager for research and academic affairs.

Relationship of Data Sources, Analysis Methods, and Research Questions

A detailed data collection and analysis guide is for the research is provided in the appendix (see appendix 1, the study protocol). It is developed based on various qualitative research data analysis techniques advanced by Patton (1990) and Miles and Huberman (1984) in particular.

Yin (1994) suggests that the choice of the appropriate sources of data, compatible methods of analysis, and research design may be more clearly seen when the matter of the level of the unit of analysis is considered. As shown by the Figure 24, given the fact

that the focus of the research was on understanding technology innovation management when state level agency consortia ventures are the management vehicle, the correct unit of analysis is organizational. Thus the sources of data that are appropriate when collected from the organization should regard its Organizational outcomes and/or functional area activities. Further individual representatives-as-data sources should be solicited to provide information on “how the organization works, or why it works”. In the case of the research, the case organization was formed when consortia were developed. These were comprised of various institution’s contribution of resources as partners to the ventures in question.

Thus given the case study with embedded unit of analysis design, it is implied that individuals representing each of the sub-organizational units (the partner organizations) and the Case Agency itself should be approached to serve as data sources for the Case Agency.

That is precisely what procedurally was done. Specifically, the following discussion provides a treatment of how the data were linked to the design and analysis.

The following were the institutions considered in association with each example of the innovative technology commercialization behavior under study. These are the recognized potentially significant contributors to the success or failure of the subject consortia. They also appeared to play potentially meaningful roles in the continued success of the consortia. This success has been the objective of the Case Agency’s programs of interventions pursued.

Although each of the institutions listed (i.e., the companies, the universities, financial institutions and governmental research and development agencies that support

them) could have been the primary sources of the evidence used in support of realizing the research objectives of the research, the principal mode was to consult five of them (i.e., the Case Agency's field division's senior management – (1) the regional offices' senior management and (2) the university affiliated business partner organization⁵, (3) the university economic development senior staff representative, (4) the university affiliated Consortium's Champion, (5) the federal agency's participating senior management representative, (6) the private sector partner sector senior management, (7) the Case Agency's industrial sector division senior management representative with the particular innovative technology's application oversight responsibility. Where practical and viable, the investment community institutional agency representative was consulted as well.

An example of the relationship between all of the relevant data sources, the method of analyses performed, the research questions, and the paradigm or theoretical construct explored is summarized in the matrix shown Table 10 (see attachment 1, the study protocol for a detailed treatment). In all cases, the data and associated analytical method to be employed to support the various forms of study validation strategies used are also identified in the matrix.

⁵ In the regional case, this was the university affiliated entrepreneurial center senior management.

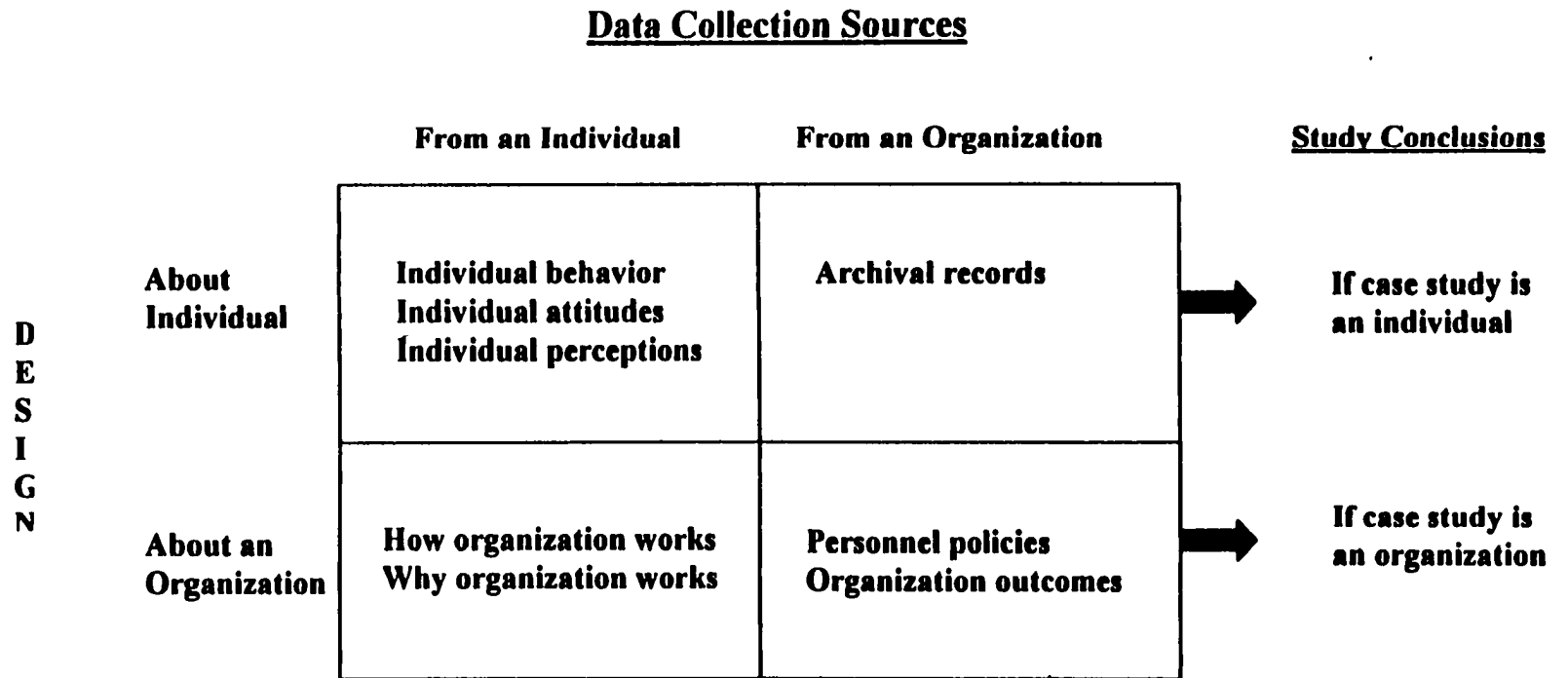


FIGURE 25. Design Versus Data Collection: Different Units of Analysis (adapted from Yin 1994, 72)

The Perspectives of Key Units of Analysis

The perspectives of key units of analysis for the field work included those of the following institutions:

1. **(Non-profit) Commercial Infrastructure Development Ventures** (through R & D and related innovative technology management functions).
2. **The Innovative New Venture:** that is, A Case Agency-supported/selected new innovative venture team -- or the actual entrepreneurial firm that has been selected to receive guidance and other kinds of resources intended to enhance its future commercial prospects and viability (e.g., existing or proposed venture whose plan has received a preliminary assessment of possessing a viable commercial business model).
3. **The Federal Government** --Federal Agency functional area representatives (e.g., economic liaison officers of DARPA, NASA, DOE, etc.) where responsibility for managing the provision of the federal level agency's support of the unit of analyses new venture resource allocation rested.
4. **The University**-- university economic development or Industry-University staff outreach centers. This includes senior university representatives who are responsible for recommending support for new innovative ventures to receive university financial and/or related resource support.
5. **The Case Agency Organization** (including headquarters, regional office and partner organization offices) -- Case Agency regional staff members who served in support of the subject new venture's evaluation with responsibility for assessing the business's requirements and directing its successful launch.

6. **The Industry -- Commercial/Industrial partner firm** (i.e., the firms providing staff for new product development resources, research project funding support, etc.) support those that were engaged in the innovative venture's successful launch and its continuing operation.
7. **The Financial Institutions --** For selected new innovative venture cases of "success", representative officers of financial institutions that typically provided some aspect of the new venture.

Of all of the entities identified above, those for which the university, the quasi-governmental state agency, and a target operating new venture industrial participant were viewed as the *minimum* collection of perspectives necessary to support the research findings. Supplemental evidence was collected from participating federal and relevant commercial financing and regional technology management support agencies as noted above.

Data Sources and Collection

The primary data for the case came from four sources:

- (a) Semi-structured interviews conducted with senior representatives of each major partner organization that participated in the consortium's commercial venture creation and subsequent development efforts;
- (b) Reference documents that:
 1. Summarized and described the Case Agency's operations and programmatic thrusts;

2. **Internal documents for each consortia researched that record each of the consortia's stages of development and critical challenges addressed in the course of their commercial development;**
 3. **Provided a record of the partner institution's unique involvement in the consortium's development and commercial advancement; as well as its rationale for participation.**
 4. **Reported any centralized records that contrast the relative selection criteria and performance of each of the four consortia considered;**
- (c) **Associated external market, industry or organizational assessments generated in the course of providing business model feasibility assessments performed under Case Agency sponsored research projects conducted through the case regional university's affiliated Entrepreneurial Center; and finally,**
- (d) **Documents that were the research interviewee's marked-up comments returned by the research participants in the course of the research for unit of analysis Summaries and the case study report.**

Secondary sources of data included: researcher ledgers; contact sheets, compiled references in the literature and through private sector service organizations (e.g., consulting firm reports pertinent to the subject) and Case Agency publicly available documents.

These secondary source documents, collected and used in the course of the research included:

- (1) **reference industrial sector related analyses, selected feasibility studies performed in support of the case study participating regional university's**

entrepreneurial center venture evaluation activities conducted during academic years 1995-1996 and 1996-1997;

- (2) Various Case Agency regional center program descriptive and summary documents,
- (3) Case Agency Technology Organization Sector Strategy Documents;
- (4) Case Agency sponsored consultant market assessment and program evaluation documents; and,
- (5) Other unit of analysis reference documents available such as (a) internal consortia five year strategic growth plans; or (b) the consortium's market development strategy documents.

Where possible of interviews were also conducted with recommended network commercial business partners provided by Case Agency staff. These were included so that their perspective and assessment of the new venture partnerships sponsored could be included. In addition, their perspective on the historical records housed by the Case Agency provided case validation as well as assure a more accurate understanding of the new venture support phenomenon under study.

Sources such as entrepreneurial center archived records, Case Agency system-wide procedural, policy, environmental and any of several management control documents (e.g., project or budget status documentation) were included in the case database constructed in the course of the research.

As noted elsewhere, any archived data was gathered in a way that it could be used to support analytical procedures that were capable of isolating "patterns-of-success" (or failure) that would subsequently prove useful for a "case load" of situations. These were

envisioned to be a case load of situations that were recognized -- nominally by two or more institutional representatives -- as fitting the profile of the primary unit of analysis considered. In any case, more conventional methods of clustering, theme identification, and pattern recognition were followed. These methods are is discussed in the data analysis section of this chapter.

In all cases, each participant was provided the opportunity to review unit of analyses summaries for accuracy, anonymity and perspective. Additionally, various financial and venture investment entities associated with commercial aspects of the consortia were used as data sources. These entities were those investment and other similarly institutions with the potential for being significantly impacted by the outcome for the consortium as it advanced through the various stages of its commercial formulation and subsequent development.

Supporting organizational and procedural documents, where available, were employed as sources of additional case study evidence. Each of these sources of evidence served to support the application of the embedded single case study design (e.g., see the Case Agency's program description and policy references).

Validity and Reliability

Due to the qualitative nature of case study as a research strategy, two primary issues regarding the soundness of the research invariably arise: (1) validity and reliability of the research, and (2) The integrity of the qualitative research results. In this section we discuss how the research design supported rigorous research with respect to validity and reliability concerns.

The issue of the research validity and reliability inherently attached to the research design are addressed in this section. The focus is on reliability and validity concerning both data and subsequent analysis of that data. Thus, the issues addressed below are those concerning data collection and treatment in order to support the case findings.

Development of the Case Study Research Design to Assure Data Validity and Reliability

To assure the validity and reliability of the data, three modes for validating the data as collected were instituted:

- All interviews were conducted employing a previously approved audiotape and guided by the theory based interview/discussion guide develop to support the research purpose and objectives.
- All interviews were audio taped and subsequently transcribed. These tapes provide the primary data source for research.
- The confidential transcriptions were provided back to the interviewee for that individual's review of the transcription's content as to its accuracy of fact and intent.
- Summaries for the specific consortium as a units-of-analysis (for which the interviewer's transcribed remarks formed a data element) were supplied back to the interviewee for that individual to make hand written comments maintaining institutional and individual anonymity. The review included assessment by participants concerning the extent to which the summary was viewed as accurately capturing (the respondent's view of) the pertinent consortium's development story and its emerging venture development and management challenges.

- The Case Agency summary was provided to each of the Case Agency senior management participants for their review for accuracy and interpretation.
- Due to the differing positions of participants (one partner organization agency executive⁶ agency representative that was university affiliated, two regional field office directors, two industrial sector executives and one cross functional industrial sector division executive), triangulation based on these differing role-based perspectives -- of the same organization -- was viewed as a sufficiently rigorous procedural measure to assure both the accuracy and validity of the Case Agency summary.

Similarly, the same arguments concerning rigor for the case summaries was consistently applied for the case database in general. In particular, the practice of providing the unit of analysis summary for review by each of the interviewees, served to enhance validity of the summaries.

Thus, following this procedure, each marked summary and transcription provided to the research participants served as a triangulation of data and interpretation and supported sound qualitative research methods through design. By being afforded the ability to cross check events in the development time horizon from the different perspectives recorded in the course of the interviews, validity through interviewee triangulation was afforded. Subsequently, verification of those timelines, roles played and critical consortium milestones with the use of collected reference materials – retrieved both from the public domain and/or supplied in connection with the interviews,

⁶ It should be noted that this individual enjoys extensive private sector experience and active participation in current venture capital and start up funding community.

institutional triangulation of data. This triangulation also afforded confidence in observed themes and patterns of development that were generated. These were procedures employed to enhance research soundness were recognized in the qualitative literature (Creswell (1996); Yin (1994; 1993); Miles and Huberman (1984); Patton 1990) as key to assuring of the data accuracy is achieved.

Data Analysis

Both methods of data and investigator triangulation of the results were used to assure reliability and internal validity. Both reliability and internal validity of the data were afforded through the practice of maintaining contact records with the selected sights. Those records served to archive the various modes of venture sponsorship observed and reported.

Thus, interviews with regional personnel regarding the nature and extent of each case's contact and/or other venture evaluation and sponsorship activities were recorded through the use of case ledgers, archived data sets, as well as any recorded descriptions of each case discussed. The detailed research protocol is attached (see appendix 1).

Analysis

The case study analytical procedure was applied to the data collected during the data collection phase of the research. Analysis produced the themes that emerged as a result of evaluating the case data through the perspective provided by the theoretical framework.

This is the essence of the confluence of evidence case analysis method advanced by Yin (1994) and demonstrated by Miles and Huberman (1984).

Figure 26 provides a schematic of the logic followed in the conduct of the analysis performed for the dissertation. The figure suggests that an effective overview of the methods whereby the analysis was performed as follows:

1. Alternately, for those observations that failed to support anticipated case database generated outcomes, a basis for further treatment of the unexplained themes that emerged from the case database was provided;
2. As a result of this theme and pattern development phase of the analysis, the case database served to suggest unrecognized patterns and themes to subject to further investigation.
3. These set of observations and recorded outcomes that constituted the case data supported themes and (given the existing level of understanding suggested by the pertinent literature) unreconciled patterns became the foundation for further discovery and perhaps emerging insights for forming advantaged consortia sponsored commercial venture management policies that could serve to address the research questions.
4. In the case of these irreconciled patterns and themes, the dissertation research questions were addressed in a way that supported the development of suggestions for improved Case Agency consortia management practices and potentially fruitful further Management of technology innovation research agendas. Agendas that may well prove to support the advancement in the theoretical framework that supports improved technology innovation management practices for industry, universities, federal and state level governments and quasi-governmental organizations in general.

Sample Analytical Frame

Table 9 is an example of the analytical summary that results from the process of data analysis.

Consider the last two rows of that table. The literature-based paradigm questions referred to in the figure are as follows:

Question 6: Given self-reported successes, how was the level of product-market segment development captured by the archived data of the target product-market faced by the proposed venture? Was it reported to have made a difference in the outcome?

Question 7: Where the entrepreneurs championing the new product, of the opinion that their proposed product or business model was uniquely the first of its kind – and thus innovative?

Based on Table 9, from the second column, the typical analysis proceeds with consulting the case database to ascertain whether, given the interviews of the various participants in the four units of analysis, that the answers to these two questions would emerge through: (1) interview comments, (2) the supporting documents that were assembled in connection with the units, or (3) the Case Agency as column three in the figure would suggest.

The next step in the analysis was to look for themes and patterns so that a logical chain of evidence would be developed. Thus, in this example, one commercial success (consortia D), one programmatic success (consortium A) and two unclear consortia outcomes (consortia C and B) were observable from the case database. In the case of the commercial success the data suggests that prior to official commercial operations,

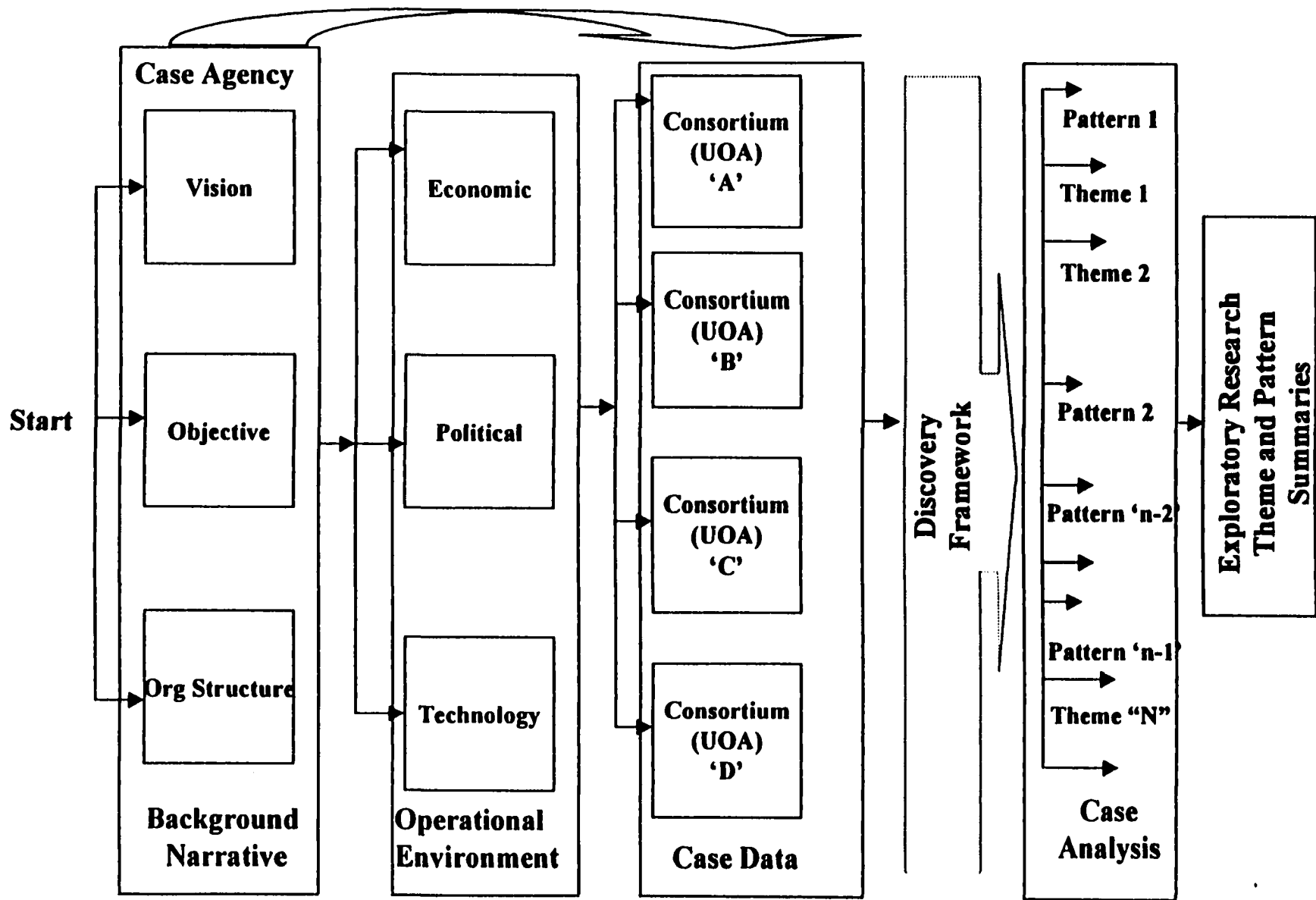


FIGURE 26. Logic of The Analysis

Consortia for Technological Innovation Management through New Ventures

Literature-based Paradigm Questions (by Question number)	Unit of Analysis Consulted	Source of Data	Type of Analysis Supported	Meta Research Questions(s) Addressed
4	6,4,7,8	D,S,D/S/C	<ul style="list-style-type: none"> • Logical chain of Evidence 	
4	6,5	D,D	<ul style="list-style-type: none"> • Clustering 	
5	2,3,5,7,8	D/S, D/S/C, D/S/C, D/S/C, D/S/C	<ul style="list-style-type: none"> • Logical Chain of Evidence 	
5	6,1,4	A, S/C	<ul style="list-style-type: none"> • Clustering 	
6,7	1,6,2,3	D/S/I, D/S/A, D/S/C, D/S/C	<ul style="list-style-type: none"> • Logical Chain of Evidence 	Q1
6,7	6,8,7	A,S/I/C, D/S/C	<ul style="list-style-type: none"> • Themes • Clustering • Chain of Evidence 	Q1

A - Archived Records
C - Contact Sheets
D - Interviews

S - Surveys
**I - Documents (Industry Reports, Feasibility Studies,
 Program Documents, etc.)**

Table 11. The Exploratory Study Primary Research Questions to Paradigm Extension Question Matrix

detailed consideration of the product markets targeted absolutely effected the ultimate business model that emerged in the operating venture. This occurred as a result of the commercial partners and state legislature demand for commercial standard analyses in this regard.

The same case database can be viewed to support the conclusion that considering all of the units of analyses, relative commercial success was absolutely tied to the extent to which this phenomenon occurred. Where it did not, the commercial projects flailed around without direction and experienced mission creep and relative failure as reported by participants.

The prior analysis, coupled with the case database led to the final column in the table, that of the meta questions: i.e., What worked?; and, How can consortia be managed better? The inductive building of the unit of analysis summaries and the case study continued. For this data analysis episode, given the experience of the Case Agency, the results suggested that the Case Agency should establish a formal process whereby potential university based consortia ventures get developed, requiring credible market and business model development assessments and assistance early on in the process prior to commitment of subsequent resources by the any of the partners. That practice was found to work. That pattern was observed. As regard the issue of improved management practices, these outcomes suggest that the state level agency must adopt procedures whereby this aspect of any potential commercial venture has to be provided. Therefore, in this fashion, inductive data analysis led to development of themes and patterns from the case database. The analysis was performed for the entire set of issues that the framework raised.

Validity of the Data Analysis

In case methods, external validity is secured in terms of the analytical generalizability. That is, to the extent that the convergence of evidence support conclusions advanced by the paradigms under investigation, the study results are said to support analytical generalization. To that end, triangulation of data and interviewee perspectives were the primary mechanisms relied upon to secure internal validity. This issue of internal validity was more explicitly addressed through adherence to the detailed description of the study protocol presented in the attachment found the appendix of this document.

Moreover, the case study design structure was deliberately built to address the validity of the case study. Discussed in Chapter III of the dissertation, Figure 27 provides a schematic representation of how the issues of internal and external validity were addressed through the structure of the research design.

Internal validity as supported by the use of a control group could not be assured by the virtue of the structure of the research. Similarly, it should be noted a feature of exploratory case study methodologies is to not require or be benefited by provision of a control feature. Context and systematic analysis of what is observed serve as the primary source of control for external validity. The following three points demonstrate the viability to provide “control” of the research context:

1. Each field office of the Case Agency is populated with different personnel, each of which having a different venture evaluation background, time in service (with the Case Agency) – was assumed in the dissertation research

project to serve as a credible surrogate for “experimenter training”/ bias ,
service region;

2. no data was included from offices not participating in the data collection procedures described; and,
3. determining the universe of Case Agency’s state wide ventures was deemed not a plausible procedure to follow for the field sources under study,

The exploratory research design employed inherently did not allow for a full range of tests of so-called internal validity. Alternately, with the exception of the matter of the “interaction” of selection and the fact that the Case Agency resources were expended on a set of specific ventures, external validity, in a traditional sense (Cambell and Stanley 1976) cannot be established. However, this does not preclude establishment of the “aims” of external validity through detailed description of the case context. Therefore, the goal of “transferability” (Lincoln and Guba 1994) was supported.

To the extent that the various forms of field data allow, the matter of internal validity was accommodated by an approach to the data analyses that included the following three forms of triangulation:

1. Data Triangulation
2. Paradigm perspectives on the dissertation field data set (or theoretical triangulation); and,
3. Analytical Methods triangulation.

Regardless, it should be recognized that the primary thrust of the research was to support the clarification of the issues so that subsequent research efforts could be better

framed: in this way support advancements in relevant technology innovation management theoretical constructs can be achieved.

As a rule, the various technology innovation management construct explorations and supporting outcomes were recorded primarily through a case evaluation procedure. This aspect of the research adhered to a procedure where both descriptive data -- in the form of interviews – was collected; and, selected industry analyses that had been performed were used for four unit settings within the case^{*}.

Summary

The dissertation research design adopted was a single case with four embedded units of analysis exploratory research study design.

The case database was constructed of multiple sources of evidence, which included audio tape recordings of key agent interviews (guided by literature grounded discussion guides), transcribed audiotape discussions, and reviewed summary documents of each unit of analyses that included the development and management “story of each”, a Case Agency summary document, a set of interviewee marked-up transcriptions and summaries, case and unit of analysis reference documents and selected consortia feasibility studies as they applied to each consortium.

The primary method for assuring research validity and reliability was the research design (i.e. the four embedded units of analysis forming an operational aspect of the Case Agency), the process of data verification (that is the reviews of the interview

^{*} Examples of these were the feasibility analyses, conducted on a one month basis, which served as a background study of the U.S. commercial modeling and simulation component of the information processing technology industry; or, the market assessment of the small to intermediate space payload launcher infrastructure market and industry).

transcriptions and summaries for accuracy), and the extensive use of triangulation in all of its forms based on the multiple perspectives developed through the data collection procedure (interviews and multiple sources of evidence), the multiple sources of evidence that case study designs afford, and the method of analysis that entailed theme development, pattern identification, and discovery of irreconcilable differences in literature assertions observed, through the case data.

Rigor Aspect	Case Study tactic	Phase of research in Which tactic Occurs	Research Case Study Design/Procedure Used
Construct validity	<ul style="list-style-type: none"> • Use multiple sources of evidence • Establish chain of evidence • Have key informants review draft case study report 	<ul style="list-style-type: none"> • Data Collection 	<ul style="list-style-type: none"> • Conduct Key Institutional partner interviews • Construct UOA summaries • Receive Draft Case Study report Mark ups and comments
Internal Validity	<ul style="list-style-type: none"> • Do Pattern Matching • Do Explanation Building • Do Time-series Analysis 	<ul style="list-style-type: none"> • Use replication logic in Multiple – case studies 	<ul style="list-style-type: none"> • Multiple embedded “Units of Analysis” case study design • Interviewee Review/Comments on UOA summaries
External validity	<ul style="list-style-type: none"> • Use replication logic in multiple-case studies 	<ul style="list-style-type: none"> • Research Design 	<ul style="list-style-type: none"> • Multiple embedded “Units of Analysis” case study design
Reliability	<ul style="list-style-type: none"> • Use case study • Protocol • Create case database 	<ul style="list-style-type: none"> • Data collection • Data collection 	<ul style="list-style-type: none"> • Protocol Followed • Case data Securely Stored

FIGURE 27. Case Study Tactics for Four Design Tests (adapted from Yin 1994, 33)

CHAPTER V

CASE STUDY

The purpose of the research was to develop and identify more effective approaches to the management of advanced technology innovation that are realized as a result of university, industry and governmental agency consortia support of new commercial ventures.

By supplying a summary of the evidence collected in the course of the conduct of the research, this document provides a definition of the research case.

For purposes of the research, an exploratory research strategy has been employed whereby the underlying dynamics and issues at work have been considered through the view of a specific situation. The resulting case data has been developed through the field research associated with the collection of specific outcomes witnessed in four (4) units of analysis investigated. These data, together with that collected in association with research of the overarching “Case Agency” constitute “the case” studied. Thus, the case study adheres to a field research procedure and research design that is characterized as a single case study with embedded units of analysis (Yin 1994) as provided in Figure 21 of the preceding chapter.

This chapter provides a description and discussion of each unit of analysis’ supported venture’s genesis, goals, objectives, and associated approaches to meeting those goals in fulfilling its stated mission. This discussion includes specific aspects of the contextual background relevant to detailed development of the case perspective.

Next we establish the environmental context within which the decisions concerning the various consortia were generated and for which each of the consortia matured.

To better understand the phenomenon of managing technological innovation, a specific example of a quasi-governmental organization was chosen as the unit of research focus. Referred to as the Case Agency, the organization selected was one whose pertinent operations and programmatic thrust were intended to make technology commercialization and business development investment decisions that favorably impacted regional (state wide) economic consequences.

Using the research agenda called for by the case study approach to discovery and exploration a research area of interest, the case study was constructed. These results reported are based on research of the Case Agency that was undertaken with the objective of exploring and thereby potentially discovering the key mechanisms and practices at work that seem to effect the advance of economic development through state-level programmatic interventions and other forms of routinized operations.

To better address that goal, four distinct situations (or units of analyses designated for anonymity as A, B, C and D units of analysis respectively) were researched. These units served to define the Case Agency and for the research. Figure 28, provides a conceptual depiction of the relationship of the units and the Case Agency superstructure. Viewed collectively, it is a conceptual representation of the case study organization (or alternately, the "Case Agency").

Chapter Organization

The case is developed through the discussion of the following specific areas of assessment: (1) the subject case study entity's organization, (2) its operational limits and

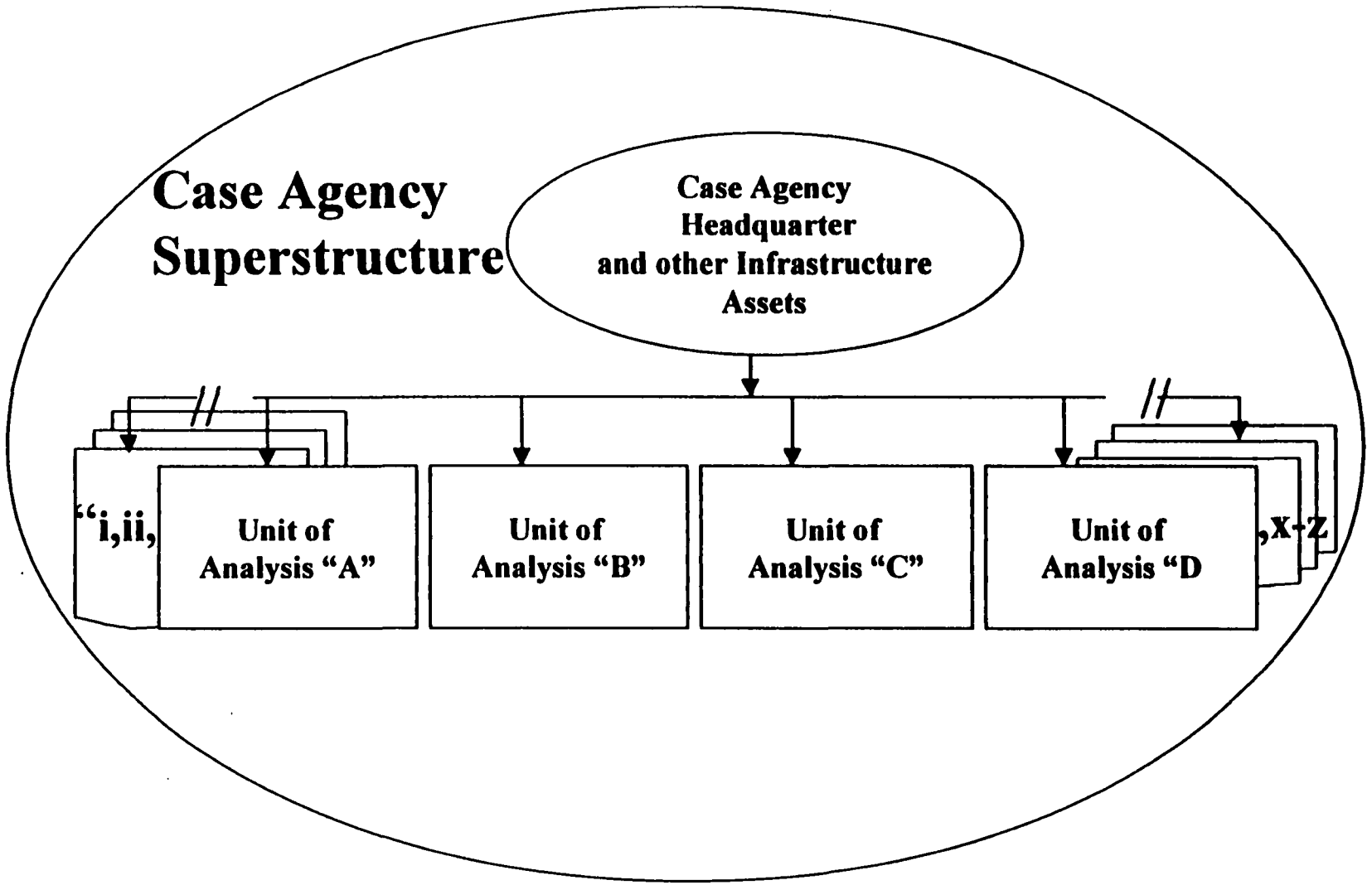


FIGURE 28. Case Agency Structure

range, (3) the political, economic, and pertinent organizational contextual background, and, (4) its procedures, products and services. With respect to any detailed specification of industrial sectors or product-market foci which were embraced by the developing consortia (units of analyses in this research) specific discussions are provided.

A plausible operational or intervention classification scheme, characteristic of generic approaches employed by developing consortia, is introduced to facilitate understanding. These approaches were deployed to realize routine output from the perspective of the case entity. These approaches, which provide some patterns in consortia development, are referred to as “modalities” for specific sets of policy based activities and sets of operations. These modalities emerged as consistencies across the four units of analysis reviewed for the case.

For purposes of this discussion, the term “Consortia” will refer to the de facto organization comprised of the set of agencies that elected to allocate resources to allow the viable operational creation—or launch—of the intended organization. For this research “consortia” is a designation given to the venture formed as a result of a set of resource allocations contributed by the following set of organizations:

- (a) federal agency sponsorship;
- (b) a university;
- (c) a state agency;
- (d) a state sponsored quasi-governmental agency with the specific objective of promoting economic development through support of technology innovation; and,
- (e) a partner commercial enterprise.

Figure 29, shown on the following page, graphically depicts the conception of consortia for the research.

Based on the field research interviews conducted in the course of investigating each of the four sets of venture partnerships reviewed, other euphemisms for the various organizational forms supported by the case units in the course of it fulfilling its mission have been used. The consortia have also been referred to as: “Collaboratives” or “Partnerships”. Regardless, in every situation upon which the research focused, the composition of the organizations participating and the desired favorable outcome of the defined units were the same: The creation of a commercially successful venture.

For purpose of discussing each of the specific ventures that are the subjects of research, they will be referred to henceforth as the units of analysis. They, together with the various field and headquarter staff and line assets and organizational units, will serve to collectively define the case organization. That case organization will be referred to as the Case Agency. The relationship of the units of analysis to the Case Agency – the agency that is the focus of the case study -- is graphically represented as the “Case Agency superstructure” in Figure 28.

Case Document Organization

Organizationally, this case study begins with a background narrative. This is divided into: (a) a statement of the goal and/or vision of the Case Agency; (b) the Case Agency’s stated objective; and, (c) a comprehensive description of its organizational structure, generic procedures or approaches – or tools and techniques -- used to fulfill its mission and vision in the course of reaching its programmatic objectives. A discussion of the economic, political and technological context out of which the quasi-governmental

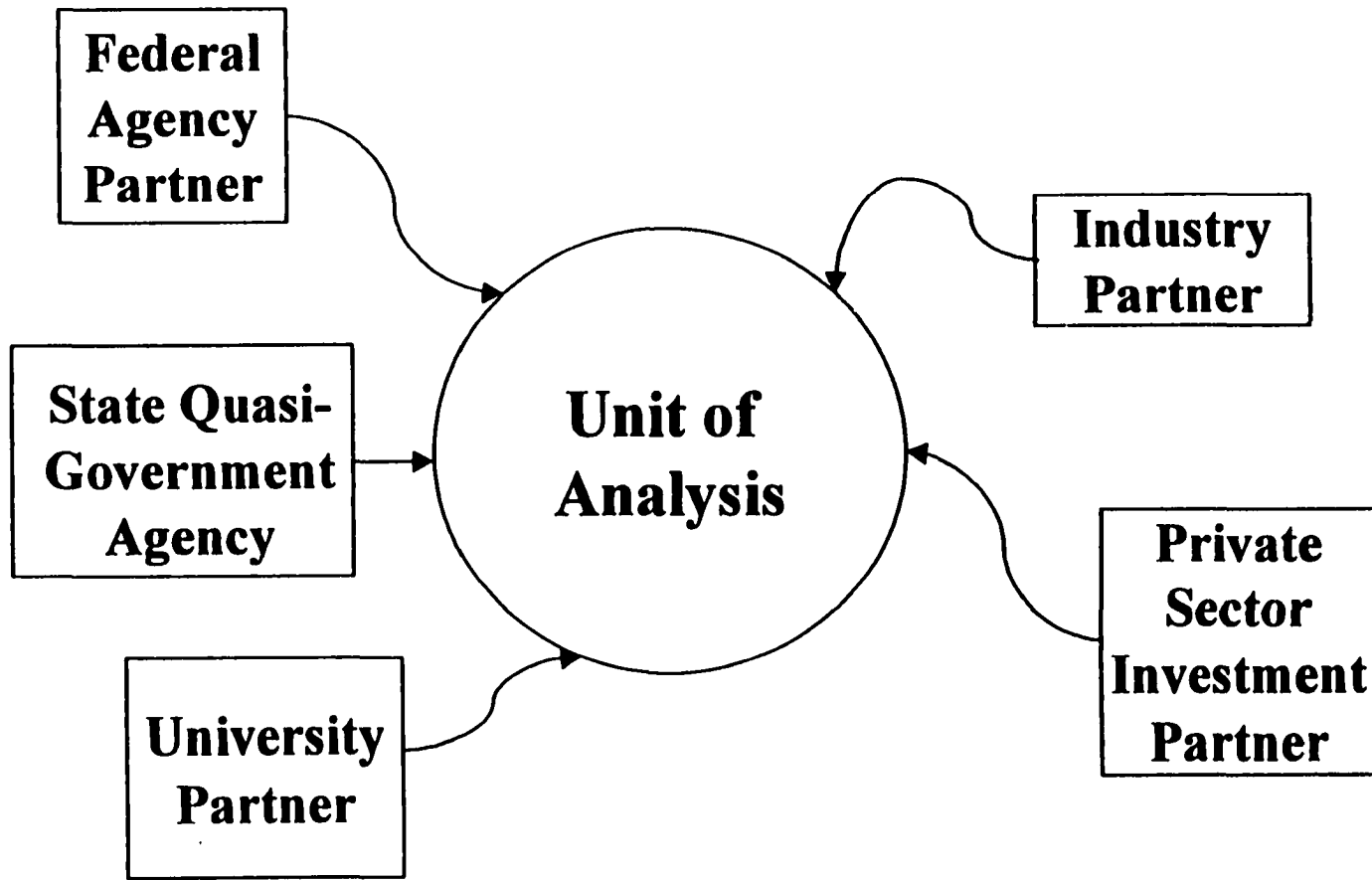


FIG 29. Typical Unit of Analysis Structure

agency was formed – and thus the environmental frame that guides the case unit’s collective operational focus – is provided. This constitutes the Operational Environment of the case unit.

To understand the case unit’s environmental boundaries, the detailed outcomes of the set of units of analyses researched are subsequently analyzed for themes and patterns of operation and effectiveness discovered in the course of examining the units of analysis. The unique set of unit-of-analyses interview data – and their associated research documentation – collectively constitute the case data. A treatment of these, given this case organization developmental context, and operationally constrained environment, provide a statement of the “Case Environment”. The limits of that environment effectively define “the case study environmental boundaries”.

The collective narratives of the consensus set of ‘stories’ for each of the Case Agency’s units-of-analyses produced both common and disparate themes. These themes, taken together with other forms of evidence collected in the course of the research are examined with respect to a theoretically based analytical framework. The result is a description and exploration of the Case Agency based on a framework for consortia, or new venture, development. Therefore, the framework is tempered by the experience of the actual consortium developments.

That integrated summary together with a consensus listing of the critical roles played by each of the institutional partners in the consortia, provides the basis for the technology innovation management themes discussion that concludes the case discussion. This organizational flow of the discussion is graphically depicted in Figure 30.

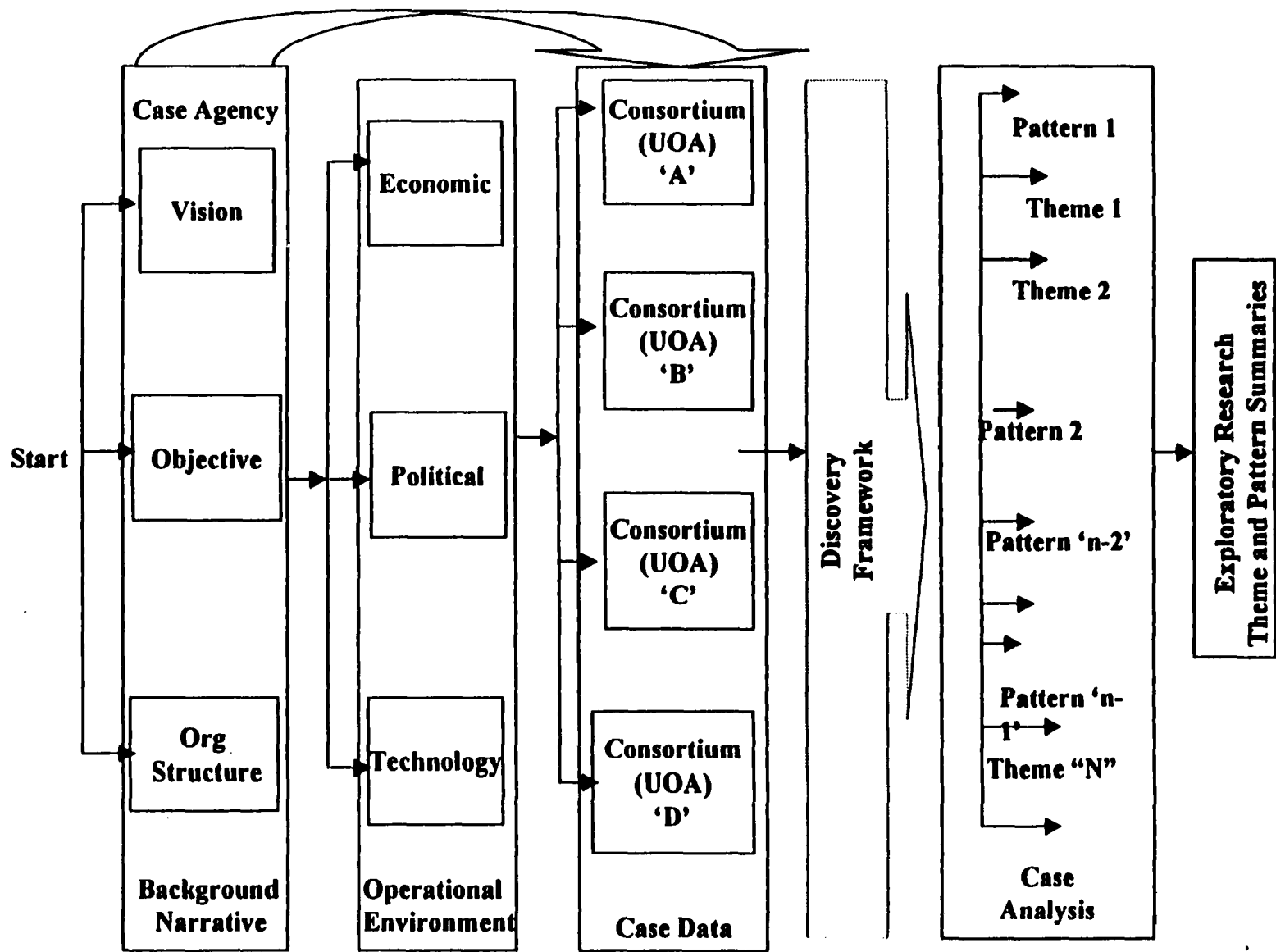


FIGURE 30. Flow of Case Study Chapter Organization

Background: The Case Organization's Development

According to research documents associated with the Case dated July 1997, the following is the Case Agency's stated goal (mission):

“ [The Quasi-governmental Case Agency's mission is that it] increases the [sponsoring state's] economic competitiveness and quality of life by advancing the development of [the state] as a technology state and by creating and retaining technology-based jobs and businesses.”

It's stated vision – as of July 1997-- was reported to be as follows:

“By the year 2000, [the Case Agency] will:

- Help [the state] achieve its long-term vision for emergence as a technology leader by championing and taking leadership when appropriate for the implementation of the recommendations of *[a recently formulated by client constituents and the organization's stakeholders strategic plan document]* by:
 - Convening technology leaders to discuss critical issues and becoming the “knowledge point” for science and technology issues;
 - Documenting workforce needs and assisting [the state's] companies and institutions of higher education in developing technology-based solutions;
 - Building [the state's] science and technology infrastructure for the 21st Century by creating the new generation of technology Development Centers and expanding [the agency's] Technology Awards program *[a specific form of technology development and research project cash grant]*;
 - Nurturing [the state's] entrepreneurial environment by doubling the capacity of business incubators and entrepreneurship centers and supporting a statewide technology transfer system; and
 - Deploying advance technology in manufacturing and accelerating the deployment of information technology broadly across [the state] by continued support of [the state's] *[specific program]* Partnership and related regional organizations.

- Assist in the creation, attraction, retention and conversion of 7,500 new jobs, 225 new companies, \$250 million worth of competitiveness, and achieve a score of 4.3 on 5.0 scale of customer satisfaction, according to the objective measures [*for a 1997-reference year*]. These numbers [*were to*] be achieved by a systematic review of all [*Case Agency*] products and services to ensure their effectiveness in delivering results.
- Expand [*the Case Agency's*] programs 10% by developing efficiencies and creating new revenue streams.
- Provide 20% of its programs and services electronically and dedicate 5% of its total budget to creating a knowledge-based culture within [*the Case Agency*]. All [*Case Agency*] employees will be required to develop and implement an approved self-directed learning plan."

Execution for the Case Agency was accomplished through designated employees acting as specific industry sector conferee facilitators. In addition, on a sector by sector basis the Case Agency assured success by: (1) the active contribution of constituent clients, and (2) lively participation of various key geographically dispersed private sector and impacted governmental agencies. This most recent strategic plan and specific associated implementation agenda built upon an earlier 3-year plan that had just expired at the time the new plan was adopted.

The Agency's Genesis

The Case Agency (which includes the organization referred to during the field research as a quasi-governmental agency, state agency case organization) will be referenced as the case organizational unit. The sponsoring state's legislative body created the Case Agency in 1984. It was launched with an initial mission that was to:

“enhance the [state’s] competitiveness by providing businesses with access to the state’s intellectual resources and to assist in the creation and retention of technology-based jobs and businesses.”

The stated general approach to realizing that mission was for the Case Agency to:

“[*Forge*] partnerships between businesses, government, and academia to create an environment in the [*state*] conducive to the creation and expansion of technology businesses.”

Environmental Boundaries

Case Agency External Environment

The general environmental context out of which the Case Agency, in its current form, germinated is provided by the following considerations: the target industries served, the governmental landscape, the pertinent university setting, and a treatment of the salient political realities faced.

The Target Industries: Product-Markets Served

With its comprehensive charter to support economic development for the state that seeded its formation and operations, the Case Agency is poised to address all technology based industry sectors of the economy as they manifest themselves throughout the state. Thus, its target industries are those that constitute the entire composition of the macro economy of the world and nation.

Having noted that, the organization of the product markets addressed in the course of the agency’s various activities run the gamut of select industrial sectors. In effect, the industrial sectors served form the state’s view of a credible model of the technology driven aspects of the state’s economy. This is clearly the case in that the sectors – by

implication – are assumed to constitute the key divisions of state’s economy as serviced by the agency.

The industrial sectors targeted in the course of the full articulation of its various programmatic thrust are those for which the state’s business community reached consensus and agreed would increasingly serve a vital roll in securing a prosperous economic future for the state. Five industrial sectors were thus defined to be “key” to that future. These five are:

- (a) Biotechnology and biomedical applications,
- (b) Electronics and advanced manufacturing;
- (c) Energy and environmental technology,
- (d) Information technology and telecommunications; and,
- (e) Aerospace and transportation technologies.

Collectively, these are designations of the target industrial sectors which make up the advanced technology aspect of the state economy. That view developed as a result of extensive and systematic consultation throughout the state with the business, legislative and potentially impacted state agencies. These elements have adopted the resulting five-sector model of the technologically driven aspects of the state’s economy as THE essential sectors that will determine the state’s economy in the future through effective technology innovation management. As a result of this view, the state agency’s initiatives that yield the consortia that are the focus of this research, typify the kinds of commercial ventures whose unique characteristics are that they are primarily targeted to provide new product and technology innovation enhancing infrastructure. The consortia in this manner have the effect of promoting the viability of this five-sector vision. This

serves to assure that the vision promise will be realized in a way that will ensure that its anticipated future potential will be realized.

No distinct product markets could be said to represent the constellation of product-markets that were the foci of the four units that collectively comprised the case unit's operational focus.

Governmental Landscape

There are several pertinent governmental agencies (federal, state, local, and quasi-governmental) that constitute the regulatory, sponsored research, and/or remaining sources of funds and/or potential sources of developmental assets. These collectively form the backdrop within which the consortia studies were launched and flourished.

Federal level government agencies included: The National Aeronautical and Space Administration, Department of Defense (specifically Departments of the Navy and Air Force, Defense Advance Research Procurement Agency), US Departments of Commerce, Energy, and Transportation, as well as selected U.S. Congressional committee staff and member offices.

Those federal agencies with greater than \$100 million in extramural Research and Development annual budgets, by mandate of the US Small Business Innovation Research (SBIR) or Public Law 102-567 of 1982 and Public Law 102-564 of 1992, must establish a SBIR program. Supplementing these is the title II aspect of this legislation.

The list of Agencies that participated and thus were potential federal partners is as follows:

SBIR Agencies

Department of Agriculture

Department of Commerce

Department of Defense

Department of Education

Department of Energy

Department of Health and Human Services

(Including the National Institutes of Health)

Department of Transportation

Environmental Protection Agency

National Aeronautics and Space Administration

National Science Foundation

Nuclear Regulatory Commission.

A complimentary Federal level venture supporting legislative thrust to this SBIR program was the Small Business Technology Transfer (STTR) Pilot Program. Referred to as the "Small Business Technology Transfer Act (STTR) Pilot Program", P.L. 102-564 amended Section 9 of The Small Business Research and Development Enhancement Act of 1992. These provisions are augmented by ones that contained a graduated agency spending authorization (for all agencies that had extramural budgets in excess of \$1 billion for fiscal years, 1994, 1995, and 1996 of 0.05, 0.1 percent, 0.15 percent of that budget respectively). The STTR agencies included those below:

STTR Agencies

U.S. Department of Defense

U.S. Department of Energy

U.S. Department of Health and Human Services

National Aeronautics and Space Administration

National Science Foundation

State and Regional Governmental Setting

On the state level, the economic development agencies of the state, particularly the executive branch responsible for promoting economic development, became the sponsoring agency for the quasi-governmental technology innovation management organization (or the Case Agency) that is the case focus. The pertinent state level agency organizational setting is largely defined by the Case Agency's structure. That organization is a private non-profit agency seeded and supported by state funds.

The Case Organizational Setting – State Governmental Setting

Having undergone a shift in sponsoring state agency affiliation at the state level, the Case Agency underwent a significant policy and programmatic resource deployment shift in the course of some (Consortium D and A in particular) during the case study research. Specifically, the state shifted funding and administrative oversight – as well as significant top management level turnover over the 10 year (1988 to 1998) timeframe with which this analysis concerned itself.

The shift was from the state's educational executive branch agency to that of with the executive branch's trade and commerce department with an economic development mission.

Fortunately, regardless of this development, the situation in at least three out of the four circumstances of the units of analyses researched, that although the primary year of initiation for the units of analyses upon which the research analyses concentrate occurred before the current set of policies and programs were manifest. However, major components of it remained significantly unaltered. Thus the major programs are ones that -- in the course of the research discussed herein, most initiatives, products and macro level organizational structures for the state are captured by the Case Agency and remained unchanged.

Thus, it can be said for example, that there are no significant regional agencies. This does not include the regional advisory groups -- e.g., the Chambers of Commerce or area so-called Technology Councils that provide coordination with to afford a focus on local issues. In all situations discussed, the Case Agency is "the governmental structure" that meaningfully contributes pertinent resources to the Consortia ventures of focus in a way that must be factored into the assessment of consortia outcomes as they are reported here.

Case Organizational Setting -- Its Services Distribution Organization

Organizationally, the Case Agency -- in addition to the president's office and his staff top management structure that includes Marketing and Community relations and Government affairs and liaison functions -- is broadly divided into three operational units. These are: a Finance and Administration directorate, a Technology Commercialization Directorate -- under which a field organization (or Regional Services Division) is managed, and a Technology Industry Development directorate. With the exception of the various respective regionally deployed staff offices and personnel, the

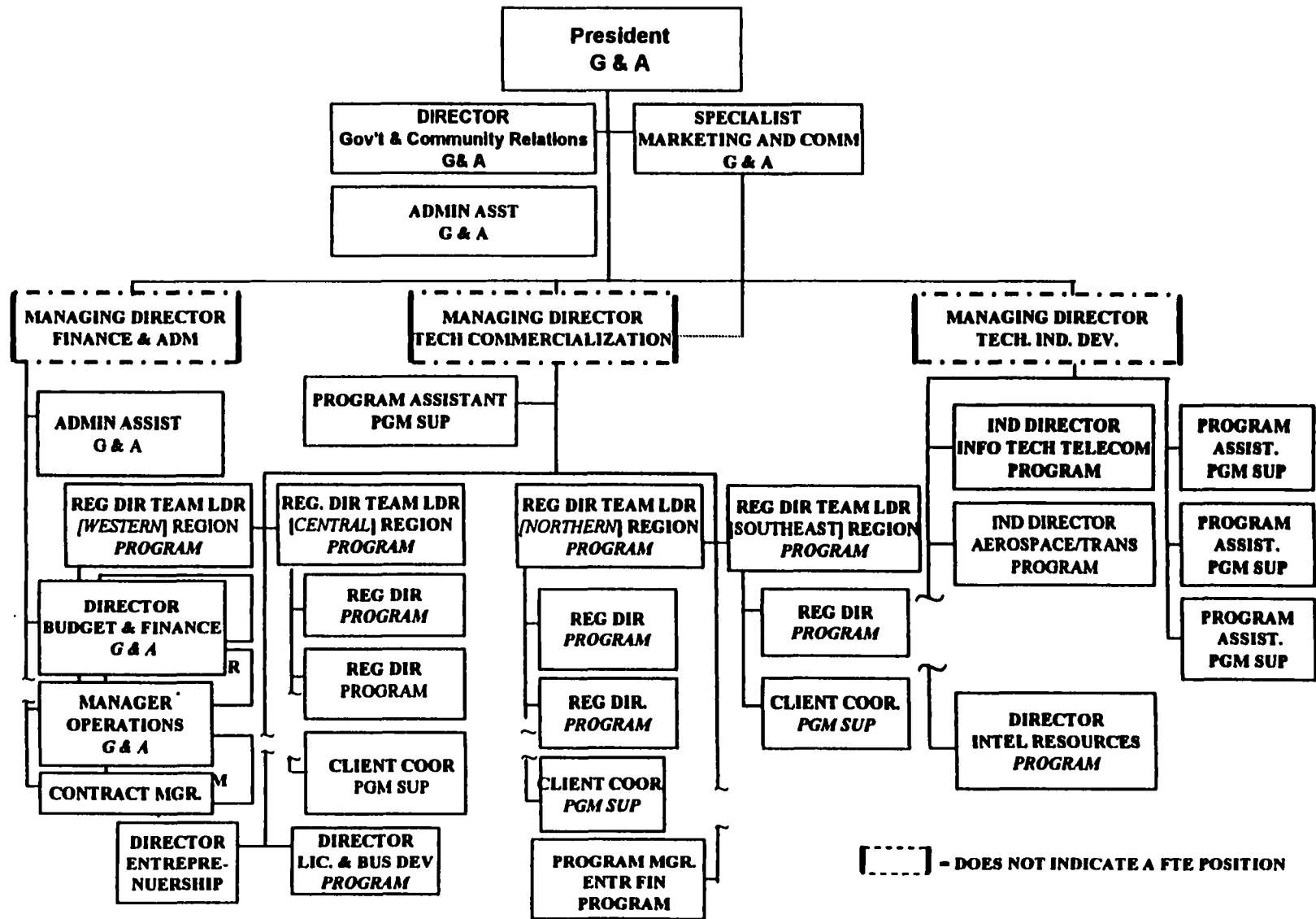


FIGURE 31. Case Agency Organizational Structure (Adapted from Field Reference Documents)

organization is predominately (in terms of absolute staff personnel numbers and other organizational resources) a central or headquarters (Strategic functions) divisional structure.

The Regional Organization

As noted in a Board Approved plan (1994) the Case Agency:

...[*was to have a*] major component ...[*that*] will be an emphasis on regional delivery of services. [the Case Agency] [*will*] reposition its regional offices throughout the state [*in a manner that was to*] provide businesses with one place to come to access [*the Case Agency's services*] The activities and goals set out ... will be accomplished within the organizations' current appropriation by a small staff of highly trained individuals with experience in technical specialties and business. The organization will be streamlined and flattened to bring more personnel into direct contact with [*the Case Agency's*] customers. [*The Case Agency*] will use partnerships to leverage this core expertise throughout the [*State*].

The Case Agency Partners

The [*Case Agency*] organizationally employs four generic classes of so-called partner organization components: entrepreneurship centers, federal agency R & D assets located in the state's regional and state funded research centers, and university research centers.

In number, the university partners play a disproportionately dominate role – being more than 20 in number and regionally distributed throughout the state's universities and colleges. These are complemented by a collection of entrepreneurship centers (greater than 6 state wide with 4 (four of those) supported directly by the Case Agency); manufacturing center's of excellence and training (at least 4 state wide); and these are complemented by 5 federal laboratory centers distributed throughout the state.

A “Flat” Organization

The staffing qualifications and compensation levels were reviewed by an independent private organization. As stated in field collected reference material: “During the 1996-1998 biennium, appropriations will need to be brought up to [the Case Agency’s current expenditure level that is presently supplemented from reserve funds.”

[The Case Agency assured accountability by requiring that] “ each program area will have a specific plan with milestones and budget responsibility as well as expectations based on results, not effort. Accountability will also be passed along to *[the organization’s]* partners who receive grants or contracts and they will be expected to report on results achieved versus commitments made. Outside, private sector expert assistance in performance measurement will be obtained to produce professional and demonstrable results based on client input.”

The source references continue to report that:

“ *[the Case Agency]* will avail itself of current information technology to make its help available on-line to greatly increase its ability to reach [the state’s] businesses. The appropriate use of information technology will improve the staff’s ability to serve the business community in an efficient and effective manner, as well as facilitate the collection and measurement of results.”

Case Agency Board Structure

In addition to a governor appointed board of directors for the subject quasi-governmental Case Agency to which the Case Agency president must report, a Technology Advisory committee was also established and appointed. With regard that Committee’s purpose and operations contribution in connection with its requirement to fulfill the organization’s goals and objectives the following was reported:

“...*[The Case Agency]* will form a Technical Advisory Committee made up of individuals with knowledge, skills or expertise in the specific needs of industry and technology. As part of the fabric of the [subject state’s] business support infrastructure, *[the Case Agency committed to work]* closely with other organization which reflect the thinking of the business community

including [*a list of governor appointed a task forces, Chamber of Commerce, Business Professional Associations and State industry representative lobby organizations*]” to assure that [*the quasi-governmental agency*] would continue to be closely linked with the business community and [*responsive*] to its needs.”

Based on the field data collection process, it was noted that this committee, subsequently, became all of the so-called Industry Sector Steering Committees for each of the 5 sectors of Case Agency focus.

Specific Programmatic Thrusts – Tools and Techniques

In addition to a the requisite senior management staff (e.g., President, Board of Directors, public and governmental relations, together with a full complement of so-called “functional area” Vice President-level senior managers), perhaps a unique characteristic of the agency is its service provision structure. In this regard, the agency is primarily divided into two related, culturally complimentary yet distinct divisions (or groups).

One group, the Technology Industry Development arm, is composed mainly of technology, industry and development professionals. These are staff scientists and engineers with a unique perspective and expertise in the area of technology and related business climate challenges faced by the specific industrial sectors for which they have direct responsibility.

The industry director corps plays a critical role in the structure. Such issues as those regarding the development of a constituent consensus among the commercial, academic and impacted federal agencies whose resource contributions are key, fall on the industry director corps to resolve. The industry director corps is responsible for facilitating and supporting the realization of the target industry’s strategic directions. In

this sense, the individual industrial directors are expected to effectively identify, articulate, and build consensus among critical elements of the industry. This consensus is necessary to ensure that the desired roles of the constituent firms served by the agency will be realized by the state's industry.

Associated with this charge, these industry directors are charged with promoting the clear collective sense of the set of industry infrastructure deficiencies -- or uniquely indigenous systematic impediments -- which must be overcome for their impacted client firms to more fully realize their potential for commercial success.

It is noted that all "major" economic development infrastructure projects which are targeted to promote fundamental industry sector growth are typically supported through this organizational and programmatic aspect of the Case Agency. Moreover, it is through this infrastructure enhancement approach that the Case Agency attempts to provide, for the various industrial sectors' addressed, long-term (or strategic) commercial viability.

The so-called "Regional Office System" is the other remaining major organizational aspect of the agency. Adopted in July 1995, the Regional Office System organization of the agency's operations is divided further into three component program and services parts.

Namely:

1. **Helping Companies acquire Technology** -- e.g., shepherd a client firm so that it might license over 400 technologies owned by the Case Agency, or with one of the state's universities -- including any number of university housed Technology

Development Center's or with a state-located participating federal laboratory, jointly perform technology research and development projects.

2. **Turning Technology into a Product** -- e.g., facilitate client firm university liaisons so that they develop product/process prototypes through state university partnering.
3. **Get Technology-Based Product to Market** -- e.g., with the aid of any of several entrepreneur centers help firms in the early stage bring new products to market by facilitating their reception of in-depth assistance from university or private sector volunteers. In certain appropriate instances, this assistance can also take the form of providing client firms directly with staff experts on federal sector funding, as well as direction for angels and venture capital private sources of funds.-----

The Case Agency performs its services to its client base in a manner that is organized around:

- (a) A regional geographically representative field staff for territorial coverage of potential commercial venture assessment and services distribution.
- (b) Centrally housed industry experts with responsibility for assessment.
- (c) Supporting functional area organizations (e.g., in publications, research facilities, etc.).
- (d) Other knowledge worker-associated office support systems maintenance.

Specific program developments are designed to assure future viability and competitiveness of the key industrial sectors specifically identified.

The agency attempts to realize its objectives and vision through the exercise of several specific programs and initiatives. The programs and initiatives include:

- (a) **Business Assistance** -- primarily a so-called “start-up” assistance, the specific resources associated with this focus are: the regionally distributed entrepreneurship centers; international marketing; Technology Entrepreneurship Series, and the State Technical Information Center.
- (b) **Technical Assistance** -- Assisting companies in developing new and/or enhancing exiting technology-based products, processes and services by appropriately availing firms of a list of resources which includes: industry directors as experts, federal laboratories, Intellectual Property Programs, Manufacturing Partnerships, a university administered Technology Applications Center; various technology development centers and the state’s distributed – primarily in universities -- Intellectual Resources.
- (c) **A (graduated) Technology Awards Programs** -- to spur investment in and development of technology innovation initiatives.

Mechanistically, this last set of awards range from a so-called “Innovation Award” (or a grant of up to 20,000.00 dollars for 6 months provided for projects expected to be commercialize within 12 months after the project is completed) to a Small Business Innovation Research Program (SBIR). The SBIR, with the addition of a Small Business Technology Transfer Pilot (STTR) program, is a federal agency awards program that benefits state companies in their effort to secure funds. That is, by having the Case Agency provide required proposal completing items such as:

- “Letters of Commitment“ and/or,
- Up to a \$15,000.00 Case Agency/initiating company match of funds allocation to a participating university for the companies’ projects, (these

are done in connection with Federally Funded Research Development Center (FFRDC).

Thus, the Case Agency further assists state companies in securing larger federally provided innovative research and development project funds that may have significant multi-year and multi-phase technology innovative management impacts.

In all situations, it is the overarching focus of the Case Agency representatives to leverage, as much as possible, any specific resource allocation in a way that will maximize the impact of that allocation in reaching its objectives.

The University Setting

The university partner in the four reference consortia considered in the research may be viewed as having resided with either a particular university's college of engineering and technology's dean's office; or, with a specific department head within that same university's college of science.

In all situations considered, it was through the respective academic dean's or department head offices to which discretionary funds were allocated that college faculty were allowed to serve in the initial liaison roll with the federal agency. The partner university support rendered was critical in all of these situations for the ventures' advancement and level of success.

While subsequent academic college's venture champions were attached to a sponsoring academic department of the university, significant support for the advancement of the venture also came from the universities independent research foundation in varying degrees.

Outcome of the Case – A Case Analysis

Case Analysis – Emerging Themes

The general approach to analyzing the case was to consider any of the commonalities and/or distinctive differences that emerged from a review of the facts and observations associated with the four consortia researched. These were used to group research outcomes into specific themes or patterns that emerged, given the theoretically based framework advanced for the topic.

The case analysis was concentrated on consideration of the data collected in the course of the research in a manner that afforded clarification of specific outcomes observed in selected case situations. The outcomes have been examined through the insight, and framework, drawn from the literature regarding new venture assessment.

Political Realities Faces

It is clear that the decision processes and organizational structure of governmental agencies engaged during the course of the consortium development were critically responsive to political control to varying degrees. Considering all cases, it would appear that a potential measure of venture maturity might well be the extent to which both federal and state legislature involvement and advocacy is successfully secured.

That is, relative advanced venture development – and therefore some evidence of advanced stages of commercial success – is associated with the advent of successful formulation of state and federal-level **Legislative** body advocacy. In the four units of analysis researched, this outcome was uniformly reported – or absent from their collective field data based report.

For the purpose of the case summary, a treatment of this requisite superstructure development will be foregone in favor of a mention only of the aspects of it that had some clear – and reported – bearing of the relative “successfulness” of outcomes under investigation. The following is a topical sketch of the theoretical framework against which these results were structured and analyzed.

Considerations of:

- **Industry Structure Dynamics -- Technology innovation management considerations** unique to specific forms of competition and market development which advantage inter organizational arrangements given proported characteristic industry developmental stages.
- **Industry Sector Dynamics Due to Market Specifics**
 - Target product-market generic modes of strategic competition
 - Strategy developments that alter sector Critical Success Factors (CSF's)
- **Organizational Structure and Process --** The issue of competitively advantaged proven innovative technology organizational structures and cross border team procedures.
- **Forms of Governance/Ownership --** Competitively advantage consortia management, power and incentive structures specific to the competitive and underlying critical technology applications whose innovations are being managed.
- **Organizational and Process Management Rules for Pre-Prototype Innovative Technology Collaborating Competitors**
 - Benchmark Roles for Quasi-Governmental Agencies Like the Case Agency
 - University Roles in Effective Consortia Development

- **Modifications to Venture Assessment and Investment Decision Making**

Procedures Unique considerations called for in situations where consortia play a vital role.

Thus, for example, both in the cases of both Consortia “A” and “D”, it was found necessary for the partnering university president’s office to directly intervene in pivotal state legislative committee deliberations. This theme of university-led state funding agency political advocacy emerged in both of these two situations . The advocacy was performed in a way that resulted in a coordinated effort to support the promoting the affected region’s political contingent at state – and latter federal – level budget allocation deliberations. These efforts eventually yielded a budgetary and bonding authority and line item for the consortia.

In addition, through relationships established with local elected officials by university senior management, sufficient political constituent pressure was developed and exerted to enhance the likelihood of desired outcomes.

Relevant Consortia Activities

University, industry, and federal agency consortia have been in increasing operation since 1984 – when federal legislation in effect permitted increased use of pre-prototype product and process research and development collaboration among potential domestic market competitors, their trade associations, interested government agency and leading university expertise.

As a result of these Research and Development legislative, policy, and research organizational practice developments, a significant experience base has developed regarding consortium construction, management and development. A basis for “best

practices” has been thus established — albeit NOT specific to all potential industrial sectors.

In the case of consortium researched here, it is clear that national level experience and business or operations models where to varying degrees considered to gain venture assessment and meaningful design references. Thus, in the case of consortium A and D – the two most mature emerging commercial infrastructure ventures researched – existing thinking, and the potential competitor organizations’ ‘business practices’ models served to suggest viable approaches venture launch and operations policy.

In the more formative remaining consortia, existing consortia marketing and/or commercial non-profit affiliated research institutional models were allowed to provide a reference frame for the preliminary infrastructure center venture idea feasibility and subsequent venture assessment.

In at least one of the units of analysis considered, a university– one, co located within the same state as the new venture – and had a more protracted history of success with consortia operations and development. In this specific situation, the reference consortium's business model, as used in a consortium development, was in part adopted due to the fact that the university enjoyed a significant national reputation, and had experienced developmental success in a related product market industrial sector.

In this case, the business model for which the specific corporate membership fee schedule, ultimately used by the researched consortium was one adopted by the university sponsored venture champion and had been patterned after a successful reference consortium – a scheme shown to have worked well. The reference organization

was a nationally regarded engineering educational university co- located within the same state as the emerging new venture consortium.

With this exception, no other trends in the general area of consortia venture development and management were identified. There were no patterns influencing the specific approach to any of the consortia's researched organization structures and associated operations policies.

The consensus view was that key personnel at the quasi-governmental agency (focused upon in this research) did indeed attempt to evaluate the state's strategic commercial sector potential for particular desired ancillary educational policy enactment. That was the universal approach adopted – that is, to the extent that the consortia research came under consideration at the headquarters level for venture assessment and resource allocation commitment.

Thus for example, each consortia initiative has been (and are currently being) routinely assessed for their likelihood of also being able to provide educational and technology research and advancement opportunities to partner universities and companies.

The scenarios for economic development considered in consortia evaluation can be demonstrated with an example. As an example of the economic development thinking, researchers considered the case of communications systems. The agency's analyst suggested that a sound programmatic thrust be pursued. This thrust would be one that attempted to isolate, define the research and development requirements, and enhance the state's university--level research and educational focus in some specific relevant physical subsystem developments.

For instance, a specific example regarding this concept was in the area of the typical communications satellite's transponder subsystem. This was a recognized area of expertise at a state institution of higher learning. As such, the competency captured there should have been leveraged as much as possible to garner commercial competitor advantages to any vendors that choose to reside in the state.

In connection with this quasi-governmental agency led effort, various other sectors were identified – for example sectors in transportation, aerospace, energy, etc. In all cases the idea was to leverage, as much as possible, the existing university and private sector “brainpower”, university available federal research facilities, and other such assets.

Moreover, initiatives were adopted to attempt to better organize a more credible industrial sector presence throughout the state. The idea in all cases was to garner – through the use of well-targeted project funding initiatives -- concerted efforts to provide a comparative competitive advantage for resident enterprises throughout the state in the industries in which they compete.

The Need for Structure Innovation in R & D

That the research and development function may require consideration of the characteristics of the product market and associated industrial structure architecture to which it is targeted has been widely suggested in the literature. Specifically, that aspect of the literature that may be considered to provide some insight on how to – with competitive advantage -- address corporate technology strategy formulation and implementation through university, industry and government agency partnerships. This area is coming under increased scrutiny. The same can be said for the management art that is corporate strategy formulation and operations in light of an ever increasing benefit

derived from establishing alliances and joint ventures (Quinn et al. 1996; Spekman et al. 1996, Chesborough et al. 1996).

Contemporary research on technology innovation development provides insights into advantaged ways to structure university led government and industry research and development partnerships. The core idea associated with gaining competitive advantage through university partnerships with industry and government is one that advances the notion of just what are appropriate -- and evolving -- roles for university technology research and development collaboration. The recommended forms are ones whereby such commercial venture partnerships are organized in ways that result in de facto adopting of standard organizational forms for the given target industry under consideration. Similarly, adoption of target industry organization collaborative procedures may inform relatively more viable ventures. Thus industry specific inter-company and innovator collaboration procedural and protocol standards for organizing such knowledge-worker team process or product research and development collaboration activities must be done in ways that demonstrate emerging competitive advantage and pay homage to industrial sector cultural norms and mores.

Consortium management experiences and research further suggests that the connection between effective consortia operations and governance (or organization and executive power projection) structures and procedures clearly are greatly influenced by norms and expectations of the commercial industry and associated product-market targeted. That the Case Agency is organized along the lines of specific strategic industrial sectors, suggests that -- at the level of tacit knowledge -- this ingredient to

effective program based intervention and technology investment success is well understood as key.

Nonetheless, the collective evidence developed, based on the field data, suggests that these have not been fundamental considerations regarding the selection of specific approaches to venture development, or program advancement. This theme seems to be substantially in evidence both in the case of venture assessment as well as with regard to operational policy development and/or organizational or programmatic design.

Development of Novel Aspects of Case Agency Consortia Development

With regard to the Case Agency, the consideration of novel aspects of consortia development must be viewed from the perspective of the Case Agency's various interactions and initiatives for each of the four units of analyses considered during the course of the research. Recalling the Case Agency's various programmatic initiatives summarized in previous sections of this case summary, these could range from initial appraisal of the potential commercial venture's viability, on one extreme; to a significant multi-year direct capital investment on the other.

Development of What was NOT Novel

Case Agency staff involvement typically entailed initial venture assessment and awareness on the part of the field organization or the less typical responsible industrial sector director personnel. What was not novel -- and thus common to all -- was the preliminary exposure to the potential venture idea on the part of the local regional director. The same may be said for a key Case Agency Partner Organization -- one that was also attached to the university that would eventually advocate and provide critical early stage sponsorship from university senior management resources.

Another common aspect of the four consortia was the strong technical college advocacy and early stage support of all four – almost as an article of program development faith. That, together with a concerted effort on the part of both the university’s economic development administrator and the Case Agency’s business evaluation partner – itself attached to the university, where early developmental stage features of all four units of analyses considered. As a fully funded Agency “partner”, the attached partner constituted a minimal Case Agency asset investment in all situations as well.

In all of the four situations researched, these two organizational assets (the regional office and the university attached but Case Agency funded entrepreneurship center) of the Case Agencies would become involved in assessment. Further, in two specific situations (B and C) these assets constituted initial and sole forms of commercial venture assessment and development guidance concerning resource allocations that those ventures would receive from the Case Agency during the period of consideration of this field research (in the form of staff hours expended).

It is certainly the case that these two Case Agency organizational components were engaged – albeit to varying degrees – in all of the four situations that were subjected to the field research protocols.

The discussion of the matter of “novelty” will be divided into a discussion of: (1) Case Agency novelty; and, (2) Agency-Consortium novelty.

By the former, we refer to unprecedented – for the Case Agency -- interventions that were apparently pursued in the course of performing its mission in any of the four

situations considered. In the latter, the issue is what interventions, although typical for the Case Agency, were unique to the four units of analysis considered.

Case Agency Novelty: Unit of Analyses-Specific Outcomes

By all accounts received in the course of the field research, of the four situations considered, without question THE Case Agency initiative with the most impact was the set of headquarters staff level driven interventions that resulted in UOA 'D' s migration from concept to its current level of commercial venture maturity. From its inception in early 1992, the advocacy role played by the industrial director level advocate served as a catalyst both at the university, industrial, federal, and state governmental levels.

Specifically, this form of Case Agency staff led advocacy served to perform the critical role of advocating -- and thus advancing -- the "idea" of developing a university-affiliated commercial infrastructure venture toward a university and subsequently local citizen and business community advocated one. Local university championship was nurtured through this initiative. Success in this regard unleashed sustainable advocacy of the venture, which ultimately resulted in the viable formation of the consortium venture as evidenced in its current form.

While this development and mode of consortium development was unique for the four considered -- based on field interviews, it was however not necessarily unique to the case agencies set of successful experiences realized elsewhere through out the state in question. (The globally recognized telecommunications research center's burgeoning commercial success was reported to have happened in a similar manner).

Independent of considerations of the specific target product-market, the source of idea advocacy, the level of involvement, and other perhaps critical considerations the

following are the unique features of the Case Agency's involvement in the units of analyses researched :

1. Unique to the advancement of Consortium A was the provision of the initial funds for commercial market and business venture assessment study of the consortium. These funds were provided from the intellectual properties investment aspect of the agency, instead of the more routine industrial sector aspect. This funding was advocated in a conventional procedural way – that is from the field operations staff advocacy at the headquarters level.
2. There was no precedent within the Case Agency for the extent and effectiveness of advocacy and venture development promotion that successfully catalyzed the start-up university based entrepreneurship that characterized Consortium D. In some measures the most successful of the four considered, the unique feature of the case agencies involvement was the pervasive nature of the effective Case Agency staff's direct involvement. It is the consensus of the field research evidence collected that that involvement resulted in the favorable outcome of consortium D's current viable commercial outcome (i.e., the early and consistent advocacy for its development and advancement provided at the university, with key federal agency operatives, eventual industrial partner interest development).
3. Noticeable in its absence is the dearth of direct involvement on the part of the Case Agency in consortia B and C's advancement. With the exception of the Case Agency's university attached venture assessment partner organization provided assets, the Case Agency has experienced the least capital investment

involvement in these two infrastructure projects. It is the case that for Consortium B, that the champion advance venture concept in its current form, has been judged commercial suspect. On-going efforts to address this complication are being effected.

4. Due to its embryonic state, Consortium C has been primarily “monitored” in its development. In that sense, of the four consortia considered in the course of this research, it has – as a novelty – received no direct attention. From the Case Agency’s perspective, this is not a novel outcome given the stage of the commercial venture’s idea maturation.

Novel Aspects of Consortia Development – Unique to the Case Agency

The avenues for private sector venture appraisal are being actively developed on the part of the Case Agency’s Technology Commercialization Division. As such, developing an early and accurate appraisal of proposed venture feasibility (from the perspective of representative commercial investors) is emerging as a perhaps unique feature of the Case Agencies operations. The practice of evaluating the entire set of potential candidate economic potential, through effective technology investment opportunities available on during any given budget cycle, is perhaps not unique. However, the combination of field (highly specialized by industry opportunity evaluation) and investment deliberating staff decision making procedures may well be unique. Moreover, the interface between private sector investment decision makers and those with similar positions in the Case Agency, is being nurtured to the extent that its impact is already being felt.

For example, in the case of consortium B, the matter of the absence of attachable assets clearly arose as a potentially deal killing feature of the business model as it was being advanced by the university championship team. It resulted in an stance of creative inter university corroboration being advocated to promote a more viable conception of the venture business models. Also perhaps novel – as it might be appropriate – is the practice of marshalling Case Agency wide staff competencies and skill in a way that is intended to promote staff to staff instruction and improved event specific provision of needed client services. Thus the best-commercial-venture-assessment talent has been allowed to provide staff level training on the tacit knowledge associated with the function.

Self Reported Critical Roles Played – General Observations

University tolerance to faculty level advanced entrepreneurship is vital. Regardless of the situation considered, first and foremost, it was discovered that THE critical role played in all of the units of analysis researched was the unbridled support of the zero stage development efforts provided at the college dean level for all Units of Analysis researched. Tolerance for the advancement *pro bono* advocacy (at some stage) on the part of the champion by upper management was also suggested to be key to consortia success.

As is the case with all commercial ventures the role of the champion was found to be key in all situations researched. Moreover, for those with a clear and eminent commercial aspect, it was reported that the commercial /industrial partners' input at the relatively early venture design and planning stage – as well as throughout the latter stages proved invaluable (as was found to be the case in Consortia A and D).

The key partner's participation turned on their being confident of the confluence of three relatively vital and significantly evident aspects being in hand:

- (1) Credible Consortium management (usually a judgement arrived at because the champion was professionally know and regarded by the sector partner,
- (2) The existence of a favorable appraisal of the implicit business model attached to the consortia operations – this outcome was usually assured through the commercial partner's staff participating in the consortia's operations model "ghost construction"; and,
- (3) The participating industrial partner being able to effectively justify the existence of, as well as realize immediate cost-effective benefits of, technical services through their participation in the venture, and risk mitigation through the active and official participation of the state in financial aspects of the venture.

Be that as it may, it should also be noted that in the case of two of those participating industrial partners, the role of the state was **ABSOLUTELY** key to their extended and complete commitment to the commercial advancement of the venture. Specifically, it was reported by industrial partners -- on more than one occasion -- that the development of state agency provided legal and financial commitments for the consortium venture were essential. That factor clearly resulted in their subsequent commitment to fully participate as a capital resource-allocating partner to the consortium based commercial venture. Most risk hedging commitments came in the form of the private sector partners entering into various forms of service contracts and/or corporate memberships (this result applied in Consortia A, and D's case)

Self Reported Critical Case Agency Consortia Specific Roles:

The following are the self reported critical roles played by the Case Agency in each consortium researched: (by Consortium as Identified):

Consortium A

The Case Agency provided the funds for the initial Business Consultant study of the market and venture feasibility. In addition to receiving the consortia's first form of private sector investment (from the consulting firm), the Case Agency sponsored study results were promising enough to extend the federal agency partners enthusiastic support of the university led venture. That outcome in turn resulted in the consortium team being able to secure an expanded level of support of the university senior management sufficient enough for it to budget for the hire of the venture's champion. That hiring of the venture champion together with other developments, was reported as critical to the venture's ultimate state of institutional success. Of perhaps special note, the federal agency, the regional office of the Case Agency, and the industrial partner were very clear on this development's criticality.

Consortium B

Again the vital role played by the Case Agency was to provide the funds for the initial feasibility analyses associated with the venture. With this result, an initial business model was developed. This 6 month feasibility and market assessment study served to release champion staff time and provide critical inputs that – together with the champions well developed skills and professional relationship with the federal agency's senior management, resulted in a critical consideration of asset transfer.

Another potentially critical role is currently being played at a later stage of the venture's development (e.g., the so-called third stage or market expansion phase). Here the potential for multi-year funding of the consortium facility as a state technology center for transportation infrastructure development is resulting in inter-university collaborations. These collaborations may result in significant improvements to the viability of the consortia.

Consortium C

The single form of Case Agency support provided to this most formative of the four (4) consortia researched, came in the form of the Case Agency's routinely provided entrepreneurship center staff and graduate student support for business model development and feasibility assessment. This situation has experienced the least amount of Case Agency support and programmatic concentration.

Consortium D

There is a uniquely – universally recognized -- level of Case Agency staff support and advocacy which characterizes this consortium. In addition to the initial feasibility analysis funding and subsequent business plan formulation report funding, without exception, the full measure of the Agencies political and regional as well as industrial sector staff support has been marshaled in connection with realizing the commercial market potential of consortia D. Over three Case Agency staff changes, that support has extended into the highest level of the agency. For example, the president of the Case Agency has a permanent seat on the consortium's board – as does the sponsoring university president. Moreover, the senior Case Agency staff have been very active in

brokering vested constituent state aerospace firm participation in the design, due diligence and private sector financing required to launch the commercial venture.

The Case Agency also played a vital role in securing state legislature approval of official state budget support for the venture.

This consortium has received the highest level of the Case Agency support provided of the four considered.

Thus, in sum, the developments that seem to have been critical to Consortium D's relative high level of commercial viability were the following:

- (a) The identification and dedication of the consortia's Champion;
- (b) An effective sequence of Quasi-governmental Agency's sector directors' advocacy and support for the Consortia's venture advance;
- (c) Effective formation of political advocacy -- both at the state and federal levels -- grounded in solid Local-level elected official advocacy.
- (d) In part as a direct result of item 'c' preceding, the creation, in April 1995 by an act of the legislature of the sponsoring state government, or an official (legally liable) Consortia organizational entity was viewed as absolutely key to Consortia D's commercial viability and development.
- (e) The meaningful allocation of in-kind resources as well as the approval of limited financial support on the part of the partner university during the pre-commercial launch of the Consortia for sustaining its management and operations expenses; and,
- (f) The meaningful -- and compatible -- federal agency program development policy initiatives that set the stage for the redefinition and creation of the

current form of the commercial space industrial sector – and thus this [i.e., *consortia D*] venture.

Self Reported Critical Roles Played - Consortium B

There is almost uniform adherence to the view that perhaps THE most critical role played was that done by the recognized champion – the former dean of engineering for the university partner. It was through that dean's set of personal contacts, professional history, and persistence, that the consortia moved from an “idea” to it's current state of organizational maturation and commercial gestation.

The enthusiastic initial support on the part of senior university management was recognized as key to the consortia. This management intervened for provision of the “pre-organizational” prototype investments. These investments were required to advance the consortia idea from concept to venture advocacy unit and eventually into an operating organizational enterprise.

The participation of the historical private sector partner seems to have been crucial at several junctures in Consortia B's development. The first commercial customer came through that vendor's networks. Meaningful planning and design inputs were received through this avenue as well.

Clearly, the initiating role of the federal legislative statute, and the associated congressional and national governmental executive branch initiatives precipitated fundamental rethinking of assets and how they should be managed. This resulted in the opportunity to acquire the asset being presented to the university and subsequent emergence of consortium B.

Self-Reported Critical Roles Played – Consortium C

There was almost uniform adherence to the view that perhaps THE most critical role played was that done by the recognized champion – chair of the academic department and existing research center for Consortia C. It was through that individual's set of personal contacts, professional history, and persistence, that the consortia move from an "idea" to it's current state of organizational maturation and commercial gestation.

The enthusiastic initial support on the part of senior university management was recognized as key to the venture. This support provided for provision of the "pre-organizational" prototype investments required to advance the consortia idea form concept to venture advocacy unit to an operating organizational enterprise.

It is at the level of securing a well organized set of historical private sector partner participants that Consortia C's development now turns. Their have been -- to date -- no commercial customers. Meaningful planning and design inputs are currently being pursued to develop these participants.

This consortium concept has not gotten to a level of concept maturity that has warranted higher levels of political and private sector support (e.g., state budget item consideration or venture capital or other financial institutional financing).

Self Reported Critical Roles Played by the team that Formed the Partnership— Consortium A

The effective advocacy and subsequent commitment of the various levels of university management – ranging from department to the president of the university -- to the development of the venture idea were key to the success witnessed in consortia 'A' to

date. In addition, although there is a lingering skepticism in some quarters with regard to the future commercial viability of the center, there seems to be a developing consensus that the current Executive Director is also a major contributor to the center's current level of success.

Case Analysis

The Framework for Assessing the Case Agency as a Partner in The Consortia

This section synthesizes results of interviews with representatives of each of the— at least -- four sector partners: (1) university, (2) federal agency, (3) state sponsored agency, and (4) key private-sector-enterprise participants for each of the four units of analysis researched. These results are organized to reflect a synthesis from interviews, documentation collected in association with the interview, and other documentation concerning the venture.

The discussion of the summarized results that follows is organized around any unique and/or characteristic responses collected across all four consortia for at minimum each of four key areas explored during this effort. These four areas are listed as the headings of the various sections and include: (1) Industry Dynamics Considerations in Consortia Venture support, (2) Target Markets and Consortia Venture Support, (3) Organizational Structure and Process, and (4) Modifications to New Venture Support Decision.

Industry Dynamics Considerations

Recalling that industrial dynamics refers to the characteristic of any given industry's stage of development, this section focuses on the extent to which the case data provides evidence that might be organized to suggest outcomes with pertinence in this

regard. That is, of interest is for example, whether the state or stage of a consortium's target product-market and associated industrial sectors where a factor given weight in the case agencies decision to participate in the venture. Whether the consideration was emphasized by the Case Agency as important or not by any aspect of the private-public partnership's commercial development effort is also a key consideration of this section.

The Rule Across the Embedded Units of Analysis

With the exceptions of:

- (a) The pre-state legislative approval for the official Consortia D and A's authorization— that is in the form of a set of market and venture assessment studies and analyses performed in support of the creation of the venture's business plan;
- (b) The main private sector partner's decision procedures for agreeing to participate in partnership with the consortia venture commercial planning and development; and,
- (c) Subsequent private sector financing of the Consortia's further development;

virtually no consideration was given to the matter of product/service positioning and model development based on the industrial dynamics faced by any of the proposed ventures associated with the consortia.

Markets—Target Markets and Consortia Venture Support

A shared view of a "product-markets" based assessment of the competitive dynamics and associated market potential for each of the four (4) consortia HAD NOT

been developed. This was especially the case for the least commercially advanced of the four – Consortium C.

In the situation of consortium C, because of the heavy degree of university capital asset exposure there was consideration up-front assessment by:

- The university,
- Its primary commercial venture assessment arm – the university attached Case Agency entrepreneurship center partner; and,
- The independent university research organization

Significant consideration has been given to clearly articulating its targets and business models.

Be that as it may, the universal observation is that product market considerations for infrastructure consortium with multiple target product market and associated industry sector impacts, fail to focus on this issue. As a result, a viable commercially credible evaluation of any of the Consortia business models' market potential did NOT inform the successful advocacy of the Consortia as it was discussed among the partner-university, or federal level officials whose support had been expressed.

In effect, there was a “gut feeling” that it was a commercially viable concept and essentially “a good thing” for academic and economic program development. However, there was not a model of the market or marketing and business development plan that served to support the assertion of commercial promise during the early stages of consortia development.

The Consortia's business plans were known to have been required in just one situation. By “business plans” what is referred to here are plans containing estimates of

the anticipated level of commercial activity in the case of consortium “D” or aerodynamic tests in the case of consortium “B” for any break even estimates, service pricing models, requisite launching frequencies, etc. — That requirement was reported as necessary in connection with the State finance committee deliberations for Consortium D, but not for any of the other Consortia – inclusive of the only other consortium that also succeeding in securing state agency support: Consortium “A”.

Prior to these stages, where they were required for proper business plans were not needed or prepared before that time for any of the consortia.

The Markets—Strategic Option-Competitor

Under this item, the central issue is was the matter of potential competitors and the formulation of business development and product-market plans to address them. Were these considered and made key to securing participating partners support and consortia participation? If so, how was that requirement projected by the Case Agency on each of the consortium that collectively anchored the Case Agency analysis?

The short answer is that in all cases this consideration was give attention. This was done at an initial Case Agency funded market assessment and business feasibility analysis conducted in all units of analyses that constitute the embedded units of the case study.

To the extent that there is a pattern to be gleaned in this regard it is this:

- Across all of the units, the one pattern that emerges is that as each of the consortium proceed to commercial launch, the level and depth of analyses in this regard is demanded to be more rigorous and less parametric.

- As was the case for the more or less “pure” infrastructure consortium ventures (e.g., consortia A and D), competitors were viewed to be “university” based or affiliated ventures – and not “commercial” research and development or training or production service providers;
- The Case Agency – through its regional offices, partners, access to various private sector market assessment service providers, and on line research facilities, etc. – is fairly rigorous in uniform exercise of addressing this aspect of any venture support effort in which it engages. This is especially true of the consortia research in the course of this case study.
- It was uniformly reported that insufficient commercially viable analysis and strategic formulation efforts were performed for the commercialization decision supporting infrastructure projects/ consortia sponsorship on the part of the Case Agency. To the extent that the partners address this deficiency, it is usually as a result of the demands of the private investment or alliance industrial sector partner of the consortium in question. It was there partners who were found to require competitive and commercially viable market assessments and business plans as a prerequisite to their internal decision to participate.
- Regardless of this last data, zero-, first-, and second-round venture decisions were found to NOT require or have developed such analyses in the course of arriving at their ultimate decision to extend their

participation in the advance the consortia venture. It is precisely these stages of financing that are done primarily by the university housed champion and /or that are advanced by the university economic development resources themselves.

The Markets—Strategic Development

All consortia partners had a rather inconsistent perspective of product distribution issues and the associated matter of business strategy development. To the extent consideration of the matter was advanced, the typical view centered on a perspective view of service product distribution to be via so-called “bellwether” market provision. The perspective is characterized as: “we’ll see what arrangements work well and model our subsequent market and business growth on those discoveries”.

In the case of Consortia A, B, and D, the apparent approach selected for its strategic market development was one in which a clearly defined an innovative business model would be arrived at through close developmental relationships with participating strategic customers or allies. The formative nature of consortia C precluded serious consideration of this matter. That venture had not sufficiently decided on what it’s business model would be. This was also the potential consortium with the least amount of Case Agency involvement.

On a state infrastructure level, the various facilities’ roles were consistently viewed as appropriately holding this market development focus. In each of these situations (Consortia A, C, or D), the core vision was for the “Center of Excellence” aspect of the consortia operations to serve as shared assets. Thus, for example, in the case of Consortium ‘A’ various advanced new product research and development

arrangements would be established with private sector member firms and university resources. Of these, those procedures for service provision or effective team corroboration shown to be mutually rewarding would be pursued subsequently. The perspective was similar for other consortia with applied technology research initiatives (in the case of consortium B and D).

Thus, the most commercially and technologically promising forms of corroboration would be ones that would serve as a basis for standards setting operations, and thus become a well spring (or incubator) for corporate and technical talent development.

These data suggest that the partners viewed as proper a strategic vision of the non-commercial services provision aspect of the consortia as: *being organized in a way that would support a product-market orientation in which technology for research and development testing services of products would accommodate any project associated user or industry standardized applications.*

The consensus orientation left as “unconsidered”, although necessary, further strategic focus on the matter of product’s distribution issues in the consortia’s design or operations. Although it was viewed as key in some of the interviewed opinions, it is clear that such product distribution concerns were given limited consideration in the course of arriving at a positive decision to support of any of the consortia’s current or immediate future commercial operations launch.

Organizational Structure and Process

The assumed appropriate culture for the consortia ventures -- among their various partner organizations (with the exception of the private sector partner in the case of

Consortium B, the federal agent in D and the center champions in A and C) seemed to be absolutely entrepreneurial.

In the case of consortia A and B, these cultural preferences were punctuated by the desire to establish limited strategic alliance based project teams. Thus, organizationally Consortium “D” benefited from the kind of collaboration strategic alliance-based service provision contracts and project team developments as was the planned case for Consortia B and A. Consortium C had not sufficiently formulated its business model to arrive at that design consideration.

Regardless of this uncertainty, given the predominately applied and developmental research nature of consortia A, D, and B, it was clear that effectively forming traditional R & D structures may not have been the appropriate collaborative organization form to adopt. The identification of strategically suitable R & D organizational forms for the major target product-markets to follow, ones which depended upon a given industry’s standard collaborative or subcontracted research and development practice, WAS NOT an explicit aspect of the vision of neither the champion nor any of the remaining partners.

Organizational Structures – Technology Innovation Management and R & D Strategy Implementation

The market and strategic development plans for commercial sector support by Consortia A, B and D are in their refinement stages. Hence, the primary objective remains to support modification of advanced commercially developmental services, through commercial contract performance of iterations and testing.

Defense service contracts are not specifically forbidden as a condition of the transfer of government facilities/assets. Thus, the current organizational structure of the Case Agency accommodates novel non-defense public sector applications as well as those emerging modifications called for in defense related initiatives. The consortia management is open to novel approaches that establish appropriate channels so that the consortia further secure competitive advantages in their emerging global markets. Under the research aspect of the concept, Consortium D may well serve to become a “wellspring” for commercial related products and services by providing a strategic asset for various commercial new product development organizations.

None of the various consortia were formulated with a mind toward assuring that they were culturally compatible with their respective industrial sector target product-market norms. That is, with the exception of but a limited set of venture support deliberations, the matter of the requisite corporate cultures was not considered. In none of the situations researched were commercial venture organizational behavioral design features -- together with their rules of functional area conduct -- were not selected in a way that assured established and emerging cultural norms of commercially competitive business cultures would become adapted as a result of consortia ventures’ planned developments. Therefore, it was observed that in none of the situations researched was it ever the case that corporate cultural aspects of the target launch product-markets’ were addressed through any of the consortia’s operations or strategic development plans or operations.

Cultural compatibility with target product-markets is a structural design constraint that was intended to be accommodated by each of the centers’ operational designs and

procedures. Significant commercial services provision in all cases expertise has been already factored into this aspect of the operation as well.

Forms of Governance/Ownership

With the advent of the official establishment of the state sponsored consortia authorizations (e.g., Consortia A and D), the organizational structure of consortia was not defined. Thus, it is clear that the intent of the structure was to support collaboration with commercial partners, or at least be open to developing an appreciation of how to facilitate collaboration.

With the exception of consortia B and C, the various remaining consortia all have a similar form of governance to the others with the following point of distinction:

- a) The partner state quasi government agency's president as the committee chair,
- b) The university president as a permanent board member, and
- c) Several prominent commercial sector and financial sector related corporate executives and technical experts – a significant portion of whom hail from the private sector.

Senior consortia management is of necessity very concerned with this governance issue. Until recently, in the one case where it applied (Consortium D) that consortium executive director was not allowed to expend any of the available capital resources. The implicit model in apparent use was that of business as usual but targeted to commercial markets. These markets were such that no one the on staff had any measurable experience in successfully addressing. That requisite experience was to be developed via strategic alliances formed in conjunction with private sector partnerships established.

In all consortia situations, comments made regarding collaboration suggests that any kind of team collaboration structure required by customers, would most likely represent no major challenge to the consortia management team. The consortia management looked forward to the advancement of their knowledge of the business that would be obtained through the required collaboration with both corporate allies as well as with faculty of engineering schools of the various universities located throughout the state.

In this regard the Consortium B are very much in the formative stages of its development. Therefore, its organization as well as any other team structure, will be executed in a way that will accommodated and supported by the center facilities, senior management, and the board of directors.

With respect to securing consortia venture development resources from its partners, explicit consideration was given as to whether the various consortia business models matched up well with the organizations and procedural norms which characterized the product-markets targeted (clearly with the exception of consortia C's situation, which does not apply).

A demand for continually redefining the business case for the consortia both at the university research organization, the state quasi-governmental agency, and various other private investor quarters which focused on the Consortia's viability has emerged. Thus, a focus on "fit" of organizational and procedural norms is a focus of Consortia management team.

Organizational and Process Management Rules

Both at the level of the state quasi governmental agency as well as the private sector partners of the various consortia – which include the various applicable venture development teams – all partners focused on adequacy of senior management’s concern for supporting technology innovation in relation to creation of an “innovating” corporate culture.

Focus on a creating a so-called “learning organization” occurred at the State level. However, this was not an explicit concern of the consortia or regional level partners. With the exception of Consortium C, the various business models of the consortia did not preclude their support of the notion that entrepreneurial teams and environments benefit from being isolated from the culture of the firm or firms that produce and distribute existing products. However, that was not an explicitly stated design constraint or objective for any of them. To the extent that the feature is supported, this outcome would be achieved primarily by providing an off-sight collaborative work site for the project team members.

In the case of consortia D, A and to some extent C, there was a vision that competitive advantages could be secured based on the ability to have results accessed remotely – given suitable advanced infrastructure installation. The matter of promoting effective innovation to support the creation of inter-organizational self-directed teams was NOT an explicit consideration for the consortia.

The following forms of partnership could be accommodated by the consortia operational configuration and policies:

- a) **Virtual Corporation⁷** (where pre-prototype services were contracted out by the industrial/commercial Consortia partners),
- b) **Alliance** (with limited coordination but composed of members driven to enhance their own relative positions),
- c) **Joint Ventures** (a separated legally distinct organization jointly invested in by the partners in terms of money, personnel (fixed temporary assignments), and/or other in kind investments), and
- d) **Variations on Corporation Governance** (autonomous divisions – e.g., a wholly owned subsidiary) or a unit contained “within” the corporation.

The specific set of organizational and operational infrastructure necessary to realize these options had not been reportedly worked out for each by the consortia. Moreover such considerations were not articulated save at various factions of the state quasi-governmental agency – e.g., at the regional, industrial sector and partner organizational level. Therefore, realization of flexibly leveraging these organizational form alternatives remains a hope because, to date, there were very few recorded projects underway or completed. Thus, there is insufficient data to provide further insight for these sets of issues.

⁷ “Virtual Corporations” as used here refers to the relatively flat new product development governance structures. They are considered to enjoy relative competitive advantages (e.g., in terms of product introduction speed and higher quality solutions effectiveness). Advantages are due to the fact that these corporations can leverage such underlying process technology innovations as those found in communications technology innovations (e.g., telephony’s email, video conference, and “groupware” networks) and their associated commercial cultural shifts (reduced loyalty to the firm with greater commitment to the technology). These developments support the ability to quickly assemble “r & d-to-new-product-launch” project workteams comprised of expertise which resides in various organizations. (Davidow 1992).

Consortia researched (again with the exception of C and B) all had relatively new start up centers. In the case of consortia D, it had just completed its second round of financing in venture capital terms, while consort A had done its third. The team interactions and work styles in these start up centers (both formal or informal), mirror the entrepreneurial , management by objectives (MBO), or protocol modes. These modes are characteristic of the target product market industry norms but due to the limited number cannot be assessed with respect to the consortia. Whether, for example, consortia A, B, or 'D' are alternately "flat"(clustered), star, or hierarchical structures interfacing with a compatible commercial partner's organizational cannot be addressed at this juncture.

Nevertheless, due to its formative nature and location, it appears probable that the consortia structure could be managed in a way that it would provide the innovative "reservations environment". Such environments are noted (Mintzberg 1986; Galbraith 1992) as being required to accommodate innovation in all organizations.

Quasi Governmental Agency Roles

There are clear cases of a vital role having to be played on the part of the quasi-governmental agency. In all cases, but especially in the Consortia D situation, the initial business venture model development advocacy and concept vision were essentially authored by this agency.

Staff changes, together with funding for concept feasibility development and subsequent assessment were keys to success only in the case of Consortia D. The other consortia (A, C and B) have not undergone that development.

In the case of consortium A & D both, clearly vital political support garnering roles continue to be played by the senior management of the agency. Moreover, in the case of consortia D, its president is the chair of the authority's board of directors.

It was noted by several respondents, that the state governor as well as the university president had to be developed into advocates of the Consortium D concept. Both have been brought to that position.

In short, the significance of the agency's role cannot be overstated.

University Role in Consortia

Interviewees felt very positive about the role the university partner played in all of the consortia's development. In addition to critical advocacy at the senior university management level, the engineering dean's level support resulted in early and meaningful faculty led research, political support, and some initial operating capital which were all provided by the partner university.

It was the university, through its sanctioned support of the independent research center organization, that contributed technical faculty and the organizational due diligence required to advance the idea to an initially staffed activity in all but the Consortium C situation.

The kind of support which was uniformly found to be associated with successful efforts to launch advanced technology new ventures through university affiliated consortia where -- in the case of Consortia A, B, and D's advancement "Direct operations expense investment". The expenses covered by this investment included a major line of resource (or budget item like) account coverage for the facility's interim operations. In addition to these, the quasi-governmental agency, in partnership with the university's

independent research organization, provided the necessary resources to operate. This effective arrangement was also responsible for having performed the business plan development for those consortia (i.e., A & D) which served as a critical reference in the course of securing state fiscal authority as well as critical commercial partner support.

Modifications to New Venture Support Decision

None of the Consortia ventures have developed a pipeline of products or established R & D processes that leverage the respective organizations at this time. It is too soon in their respective its developments to assess these outcomes.

Appropriate R & D Team Staff Personality profiles, Selection

Whether or not the personality of the various new venture team's or there champions, will generate schemes for the delegation of authority needed to realize organizational and operational objectives has not been established. What complications these relationship will produce in the way of the team "chemistries" is not known at this point in any of the ventures. However, reservations were expressed among interviewees regarding the appropriateness of several of current consortia teams' composition and orientation for realizing the established commercial objectives.

With respect to the educational objectives, similar reservations have been expressed in all cases, but particularly for Consortia D and B. It can be said that clear progress toward the various consortia goals of development have been registered. Nonetheless, there are clearly mixed assessments on the part of the interviewees concerning this aspect of the consortia development. However, the teams assembled were viewed as "strong links" in the advancement of the various ventures to their current levels of commercial success.

CHAPTER VI

CONCLUSIONS AND IMPLICATIONS

Recall that it was the primary purpose of this research to develop and identify more effective approaches to the management of advanced technology innovation that are realized as a result of university, industry and governmental agency consortia support of new commercial ventures using an exploratory case study method of inquiry.

To that end, our discussion of the outcomes of the research may well be served by a revisit to the concept that is central to the research objective – namely, the concept of “technology”.

“Technology” has been representatively referred to as follows:

“[*Technology*] Refers to both a collection of physical process that transform inputs into outputs and knowledge and skills that structure the activities involved in carrying out these transformations.” Kim (1997)

Additionally, the associated societal function of technology has been suggested as:

“technology innovation [*the concept that is at the core of the dissertation research*] involves novel combinations of art, science or craft employed in a way that creates goods or services society uses...” Quinn et al. (1997)

It has been noted that the practice of employing consortia organizations to manage technology research and development function is increasing in importance to industry and governments alike. Changes with respect to the processes whereby advanced

technology is researched, developed, and commercialized are being witnessed through changes in the unique roles of key institutions associated with technology innovation management. Universities, federal technology research and development assets, and state-level quasi-governmental organizations, have all experienced a shift in roles. In addition, there have been pervasive alterations in accepted models of commercial enterprise (Quinn et al. 1997; Nelson et al. 1994; and Mowery 1992).

The passage of federal legislation in 1984 permitted and encouraged pre--prototype corroboration among potential commercial competitors as well as the various research development and demonstration (RD&D) asset organizations routinely involved the process of technology innovation. This has resulted in a need to better understand how to invest in and manage corroborative efforts targeted to further advanced technology development through commercial venture design and process improvements. This desire has resulted in the need to better clarify and subsequently manage commercial venture development consortia (Aldrich et al. 1995).

The primary research focus was the exploration and discovery of practices of consortia venture evaluation and consortia sponsored venture management that were found to be effective in promoting the successful launch of commercial ventures. To accomplish that objective, the literature based assessment framework developed in conjunction with the dissertation research (Saunders 1997) was applied to the case database.

In the remarks that follow, interpretations, implications, and conclusion based upon the case study are articulated and amplified. It is important to note that the "research findings" exists as the case presented in the preceding chapter. However, this

chapter attempts to explore the case findings for further implications that “may” be speculated or suggested by the case.

Organization of Conclusions

The approach followed in presenting the research conclusions, was to provide an overview of the outcomes of the research. These outcomes are organized in a format that essentially conforms to each of the major dimensions identified, in the theoretical framework (see appendix 2) used to explore the case.

For each of these key areas considered by the framework, the results of the research and analysis have been summarized. The conclusions that have been developed from that process have been organized to address the following areas:

- Theoretical implications;
- Consortia management practice; and
- Consortia venture evaluation.

The conclusions presented below emerged from interpretation of the results of the framework application and associated analysis for the specific case.

As a matter of practical management concern, it is noted that only through the proper consideration of multiple facets of the new venture success dynamics can:

1. The commercially advantaged membership of consortia be defined;
2. Consortia Organizational and management structures be defined;
3. Appropriate programmatic thrust and project portfolio selection criteria be discerned; and,
4. Effective new technologically innovative venture selection-for-support decision criteria be discovered and advanced.

A critical interest of the dissertation research was for a body of knowledge to be developed (and be framed) in a way that would result in a greater understanding and likelihood of new venture success.

To achieve this, the research was based on a given state's efforts to garner commercial viability from its technology research, development and capabilities base. An implicit assumption of the research was that organizational and procedural insights would emerge as a result of a structured exploration into consortia development and management. Additionally, it was an associated intent to have research outcomes serve to suggest areas for a future research agenda. The research agenda envisioned would have the result of affording an advantaged basis for improving the management of underlying technology innovation phenomena for consortia.

Literature-Based Reflections on Consortia Paradigms:

The research focused on technology innovation management through consortia. As such, the kind of technology strategy development and management issues intended to be isolated were those that would serve to clarify subsequent theory and practice research agendas. The agendas at issue were those that might plausibly serve to advance the subset of the underlying corporate strategic management imperatives at work. To accomplish this later goal, the case research outcomes -- by design - provided insight into the various paradigms that seem to underlay processes that collectively yield technology innovation management. A thematic review of the specific paradigms provided in the chapter V -- the case analysis -- was developed in a way that the paradigms "identified" lines of inquiry for future field research. Based on case findings, the conclusions below are offered. However, development of the following reflections

must first be bounded. Due to the fact that a specific geographically and organizationally bounded research arena was accessed for the conduct of the research, the following discussions must be confined to the specific research setting. However, it is an instructive aspect of the “exploratory” nature of the research to examine the informing theory and literature in light of the case study.

A primary result of these explorations was discovery of areas of subsequent research that – given the case situation and outcomes—seemed to hold promise of for enhanced theoretical development.

Long Wave and Consortia Venture Success:

Schumpeter (1954) and latter scholars focusing on the subject (e.g., Utterback 1996; Porter 1985) suggested that entrepreneurship would be rewarded in either of two distinct cases:

- a) most likely when the four unique cycles coincided with the venture development; or,
- b) when the technology embedded in an entrepreneur’s venture application had the effect of “redefining” the existing definition or production process associated with “competitively advantaged” products and services.

Reflecting on these propositions, we might ask; Is that result what was found to be evident in the case study units of analyses?

The short answer is we don’t know. Of the four consortia projects addressed through research, all were initially advocated by “other than market forces”. Thus, in the case of consort D for example, a federal agency initiative coincided with university

advocacy to push the development of the consortia. Private industry was not an initial promoter of the venture.

In the case of consortium 'A', a federal agency's desire to develop a more cost and response advantaged private-public partnership technology research and development model resulted in the formation of a university-led consortium that has arrived at stage two of the funding picture. It is not clear to what extent the commercial venture aspect of the consortia will reach fruition. At the conclusion of the study, the venture appeared to be experiencing programmatic growth-based success. However, the cause of its growth was primarily due to software applications developed in association with research and development of military operational services expansion -- not the larger and significant commercial marketplace applications.

Considering the research results on the whole however, these results do provide some insights into the issue. It can be said, for example, that to the extent that the underlying technology maturation waves were coincident when the consortia ventures were launched, there is evidence in the case database support the assertion that Schumpeter's long wave notion was supported by these results.

Future Research

A review of the case study with respect to results suggest the following agenda for research:

1. A correlational or causal assessment of consortia venture success with a set of judgements concerning the stage of the consortia venture's core innovative technology's maturation. Research in this area may well prove a rewarding development to better understand the nature of non-traditional forms of consortia.

2. A statistical analysis of consortia ventures to examine success in relationship to stage of technology development. This coupled with considering the specific form of consortia could extend Alrich et al. (1995) results in ways that might improve the likelihood of consortia commercial venture evaluative accuracy and expected value.

Consortia Venture Evaluation Framework Implications

Based on the case results, little emerged in the way of any meaningful consortia venture evaluation selection or consortia management heuristics.

In practice, the evaluation of any given technology's stage of development in terms of its migration from basic research discovery to its application would seem to add very little improvement to the venture evaluation process. Here, what is being referred to is the idea that conventional view of the stages of technology development may well be identified readily if they are viewed as being embedded in either the business model processes (including such "non-product" functions such as manufacturing or the venture's distribution functions) or the product itself. Thus, for example, an application of distributed controls systems technology may follow a conventional staged path of development when viewed from the perspective that the basic research may have occurred under a contract research vendor; while the technological proof of technological commercialization might have occurred in a trade association laboratory and the final pre-commercial and applications research and development stages might have been performed by a highly integrated systems development firm that was the strategic partner of the new product's manufacturing firm as a by product of their joint venture agreement. In this case of this research, the conventional stage was adhered to. However, they just did not follow a sequence within one vendors purview that was identifiable as such.

It is noted however, that the sense of a technology's relative level of maturity is perhaps so intrinsically associated with the business and technology application environment as to be tacitly shared view. Although not explicitly articulated, the "shared view" may well be an artifact of the institutional roles of key investment decision makers (e.g., venture capitalist, development awards industrial directors, private sector partner evaluators, etc.).

In the event that there is a shared view of technology maturity that develops for practitioners, explicit consideration by them of Schumpeter's suggestion and the appropriateness of the confluence of the four cycles he postulated appears to hold little potential practical evaluative or consortia management value. However, the relatively early stage of technology innovation embraced by the four consortia studied in the course of the research may have been in phases of development where this level of consideration could not prove to be a decisive factor for venture success. The consortia considered were collectively, perhaps, not mature enough in their respective commercial venture development for the consideration to make a difference. This is an aspect of the framework that is a candidate for subsequent research and theoretical development.

Implications for the Research Questions

Recall that the questions were as follows:

Q1: What are the major sources of consortia support for innovative technology based new ventures that seem to work?

Q2: What approaches to managing the commercial viability of advance innovative technology-based new ventures through partnerships of industry, governmental agencies, and universities are effective?

Reflecting on the case study regarding the conclusions that address the issue of Schumpeter's paradigm, it does not appear to be a major area of consideration that "worked" or had a positive effect in terms of improving the prospects of venture success. However, it should be noted that none of the four ventures (referred to as the embedded units of analysis in the research) had passed the test of commercial viability for greater than a 5-year period of commercial operations.

Therefore, it may well be that this consideration is a venture evaluation and management nuance. Significance might only be realized as competition increases, product markets mature and become better defined and when the various versions of business models that characterize innovative markets enter into the phase of competitor consolidation and more restricted strategic options. However, the case study did not provide strong support for this influence. This conclusion suggests an element of subsequent theoretical development and perhaps confirmatory research.

Conclusions – Implications for the Industrial Structure Dynamic Framework Dimension

Schumpeter (1939) addressed the matter of the underlying timeline and event horizon that typifies any technology's migration from science to successful product or process innovative application. In this section we turn to the framework for analysis developed for application in the research. The primary focus is on that aspect of the framework that addresses the matter of the impact of market dynamics on consortia venture success.

As elucidated in chapter two, commercial product-markets can be viewed as being usefully evaluated by the phase of their development. The central idea advanced is

that greater venture success should be realized when the selected business models are ones well suited to exploit the phase of the target market's development as a product market. These business models include product manufacture, distribution concept, development and organizational structures and processes.

Theoretical Implications

Abernathy (1986), Utterback (1996) and Kim (1997) assert that commercial markets driven by innovative technology go through three basic characteristic phases reflecting the experimental nature of the unearthed new product-market: Fluid, Transitional, and Specific Patterns of product market behavior.

The issue here is that of the way that the dynamics of industry structure influence any venture's potential for realizing commercial success. As discussed in the literature, this was the stream exemplified by Porter (1985) and Utterback (1996). This aspect of the corporate strategy literature suggests that the industrial structure of faced by any commercial venture will determine the business development strategic options that hold the greatest promise for success (Hax et al. 1986; Porter 1985).

Technology innovation holds the promise of enhancing or better exploiting the critical factors for commercial success that are established by the incumbent with respect to competitors. Using the case study findings to reflect on this issue, we asked:

“Were industrial structure dynamics considered by the consortia partners in the specific consortium's phases of development?”

Prospects for Advancing Market Phase Research Theoretical Models

Given the case study outcomes, the themes developed and patterns observed suggests that the choice of business model predicated on the competitive industrial

structure faced by the venture was not altered by the unique and non-traditional case of consortia studied.

Consider the four consortia studied. From the perspective of the most mature level of any given consortium venture's relative level of commercial success and associated market presence to that of the least mature unit of analysis, there is a clear indication that as Utterback (1996) and Quinn (1997) suggest, greater prospects for success are generated when a venture's model is reconciled with the competitive dynamics and competitor strategic deployment faced. To the extent that strategic alliances with commercial firms (typically the consortia industry partners) were secured, the case clearly suggests that a greater level of success resulted.

These general results suggest, in the case of the research conducted, that the relevant theoretical paradigms concerning market phase were supported by the data recorded in the case database. There are several areas that additional research is suggested. These are:

1. Given the relative limited level of commercial history associated with each unit of analysis researched, a suggested research agenda would expand the units to include those that have a history of commercial success that is greater than the standard 5-year commercial operations period accepted to define "success".
2. As consideration of the specific product market is asserted in this aspect of the framework for analysis (e.g., Utterback 1996; Quinn et al. 1997; Aldrich et al. 1995; Mansfield 1995; Roberts 1989) to be a key consideration in the ultimate outcome of venture or enterprise success (and the associated characteristic

product/technology development cycle). A suggested research agenda in this regard would seek to confirm or refute these assertions. That would entail the conduct of a statistical analysis of various consortia enterprises to address the correlation that might be recorded for associating structure, business model, type of technology, specifics of product markets and consortia process, structure and success.

Implications for Consortia Management – Industrial Structure Dynamics

Of the four units of analysis, two (Consortia D and A) were considered as having the greatest potential for realizing commercial venture success. These two were characterized as having benefited from receiving significant business model strategy and operations concept inputs from their respective strategic private sector business partner. It was the private sector partner's input which significantly clarified the business model that was ultimately adapted those two ventures. Moreover, it was in association with the need to receive commercial funding that market dynamic considerations were imposed on the consortia venture business model, to the extent that it occurred at all.

It was noted in the case analysis presented in chapter V that in both cases that recorded relative commercial success, the seeds for the venture DID NOT originate within the university partner organization. That institution was rendered receptive to the idea and a champion was subsequently either developed from within its ranks or hired to fulfill the champion role as envisioned by the key non-university funding sources. Thus, for example, in the case of consortium A, it was a venture development committee comprised of industry experts, federal, university, and representatives of the Case Agency that made the champion hiring decision as a result of a national search. In contrast, in

the case of consortium D, the university housed champion that emerged displayed tenacity and management style that suited the federal agency, advocating Case Agency agent, and (silent) private sector partner.

In the two units of analysis that did not have direct and significant commercial industrial partner inputs, relative lack of success and vision was a characteristic result.

The implication for the management of consortia that can be drawn is that the vital nature of the product market consideration is supported by the results. However, it also became clear that such a focus was not an important aspect of securing university support for the venture or its champion. The case analysis results suggested that a mechanism might be developed and instituted whereby that deficiency would be addressed.

Several potentially beneficial concepts to address shortcoming emerges during the case study research. These potential “practice” modifications included:

1. Development of a formal organizational procedure for university venture development;
2. Develop a formal champion training course (for university professors and staff designated as champions) whereby their suitability to champion a venture could be assessed against commercial venture entrepreneur’s skill sets. Thus, venture development requirements would be taught in a structured fashion rather than “on the job”.
3. Develop a career track for faculty development that would reflect the vital nature of successful consortia to university mission attainment.

Although outside the scope of research, these areas are certainly worthy of further development for effective management of consortia of the type research here.

Implication for Consortia Venture Evaluation Frameworks

As the case results demonstrated, consortia as commercial ventures get evaluated along various lines of consideration. It depends on the objective that partner organizations have for participating in the venture. Although changing, the most divergent set of evaluation criteria encountered was that of the university. The university role in economic development is emerging from its traditional stance of supporting basic research and development primarily for the United States Defense Department's advanced technology needs (Chesborough et al. 1996; Aldrich et al. 1995; Mowery 1992; Teece 1987; Charpie et al. 1978).

In the case of this case study research, the university's educational program and business community relations development goals were key considerations. These considerations yielded initial senior level support for all of the four ventures considered – to the extent that it was secured at all in the early stages.

From the case study research it was evident that university support for a consortium that did not reflect commercial market realities. This impacted private sector support and produced challenges in developmental focus and relative commercial model advancement. When these requisite conditions were not in hand, the consortium encountered relative failure. That is, it was a clear result of the case research that for two of the four units of analysis considered, the consortium with unclear business models manifested major challenges in terms of the consortium being grounded in commercially viable business model development and market focus.

Reflective to this outcome, that the commercial partners chose not to participate significantly in the venture-- investing instead at levels of resource allocations which proved to be insignificant for the consortia ventures' developments as a result.

Implications – Developments in the University partner Framework for Evaluation

The immediately preceding observations suggest that the framework for university consortia evaluation must include commercially viable inputs for consortia business model development – early on. They further suggest that associated commercially credible venture management practices and policies must be provided through a combination of instruction and venture management practicum training. These results also imply that this kind of staff development effort must have the effect of teaching university staff, inclusive of faculty designated to champion a consortia venture, how to accomplish the university development goals.

As a minimum the research outcomes clearly identified the need to overcome an observed bias on the part of the university scientists and engineers concerning appreciation of the critical role such issues as:

- a) Credible market assessment; or,
- b) The role commercially competent market and business model development strategies play in realizing technology innovation success through commercial venture support operations.

This also extends to university technology and science colleges senior management personnel.

The case data suggested that such a program enhancement will require of its participants nominally years of practicum training. That is, this last implication has been

shown –in practical applications observed by the Case Agency field directors -- to involve a repetitive process that spans years of fastidious venture advocacy. This is a venture advocacy process that is characterized by requiring of the entrepreneur that he or she acquire a contemporary competitive industry requisite business savvy. This goal might be realized as the result of the designated individual having to learn functionally what is required to succeed. The subject training would be accomplished through providing professional training (for the champion designee) through the various stages of institutional rejections that typically define any businesses' launch realities. These realities are those characteristically associated with their respective target industrial sectors and competitive markets. These are, in effect, the commercially competitive markets that any consortia venture's products or services have implicitly targeted.

**Conclusions -- Federal Agency Evaluation Framework Modifications --
Modifications to Federal, Case Agency Assessment Procedures**

As was noted in all but one of the situations considered in the course of the case research, the role served by the federal agency was found to be vital to a successful consortia outcome.

From the perspective of the participating agency, the criterion for federal agency participation was typically to realize agency-restructuring objectives (e.g., the need to downsize). This was the case for all of the UOA's included in the study.

An additional goal for federal agencies was to improve the commercial vendor or contractor's provided systems research and development product cost/quality outlooks (the situation identified in both UOA "A" and "D" of the case study). Thus, for example, in one situation the participating federal agency's change in senior

administrative personnel, as well as the agency's relative lack of experience in effecting asset transfers to university-led commercial consortia, led to significant confusion about the consortium's permissible targets for product-markets and associated suitable competitive business development plans. This had the effect of imposing severe business development delays – and thus significant lost business development opportunities at a very critical phase of the venture's deployment.

The matter of specific market and strategic dynamics faced by the consortium under consideration received extensive assessment at the point where the ultimate investor interest- generating a venture business plan, was finalized. This outcome was witnessed in increased clarity for all of the consortia studied in the case. That is, those that recorded the highest degrees of commercial success, regardless of the target product-markets involved, benefited by having formulated significantly higher degrees of competitive and commercially credible venture assessment sophistication. Thus, for example, issues of the appropriate business model to adapt to maximize a favorable realization of the strategic intent of the “more successful” consortia venture, viz a viz its product-market competitors, were incorporated into the business launch strategy adopted. Issues such as these were also assessed in light of their associated industrial structures strategic options as well.

Conclusions – Case Agency Evaluation Framework Modifications

During this case study research, the Case Agency was in flux. The Case Agency has proceeded to transform its programs and operations into ones that are less centralized and more territorial in nature.

In addition, the Case Agency has converted itself from a traditional university intellectual property enhancing organization to one that assists in economic development through the effective management of university, industry, federal agency and other institutional partnerships. These are partnerships that have business and economic development objectives that collectively return a specific form of competitive advantage to the host state's business constituency.

In addition to this shift in mission and programmatic emphasis, as of the fall of 1996, extensive field staff training in the evaluation process has been instituted throughout the operations staff. The process whereby the Case Agency performs its evaluations has been described elsewhere in the case study (see chapter V).

As a result, there is little alteration to that procedure suggested by these research outcomes.

Conclusions—Implications for the Research Questions

With regard to the matter of consortia evaluation, the results of the case study suggest that it is key to have the champion responsible for the development of the business model development and venture support. The practice of devising a commercially credible plan for any given consortium's business development emerged as key to the development of successful consortia ventures. The role of the resulting commercial venture's top management was repeatedly found to be vital to success.

Similarly, the case analysis showed that there is a requirement for the business and market development models developed and implemented to reflect the unique competitive and strategic options in the specific product markets targeted by the venture. Here the case data suggest, that the role of the private sector partner in fashioning the

model is invaluable—spelling the difference between commercial success and programmatic developmental stall.

These outcomes recommend that, given an initial business plan development, a clear key to consortia venture success was shown to be securing a commercial sector partner's interest. That interest was most effectively developed as soon as possible in a way that it would contribute substantively to the development plan for the venture. It must be a plan that will address the competitive realities of the target product-markets both in terms of requisite production, distribution, product line development models and strategically required alliances or partnerships (in all of these various forms).

A second key resource whose presence must be secured is that of a talented and committed venture champion. Such champions might be either procured through an official search for the consortia's top executives; fostered through the private and commercial sector (e.g., through a well formulated management mentor-apprentice program); or, developed within the impacted partner universities.

This latter can be accomplished through the establishment of a routine training option for interested candidates. The field data suggest such developments have been shown to make the difference in venture success and failure.

Although the specifics of the human resource issues associated with the selection and placement of the correct kind of consortia top management is key, it will be addressed in subsequent sections of this chapter.

With regard to the second research question: "What works for success" with regard to consortia venture evaluation procedures, the case data suggest that evaluations of business and consortia venture plans must be done with a business perspective as

paramount in consideration. Both university scientists and engineers (inclusive of their respective college's top management) exhibited a bias against factoring such critical issues as the target product-market critical factors for success and the implications to the product or services production, distribution or product pipeline functional area designs and operational procedures. Where this bias was overcome, relative commercial promise for the venture was observed.

The contribution of the private sector was found as key to commercial success. This was apparent in both in the planning as well as the initial product introductory phases of the consortia venture's development.

Conclusions—Technology Innovation Management – Commercial R & D Strategy Implementation Organizational Structures

The research analysis framework developed in support of the research suggested that relative greater consortia success would be expected for those ventures that conformed to competitively advantaged organizations functional model. These models have been shown throughout various commercial enterprise endeavors to garner competitive advantage. These were structures and functional area operational processes that essentially reflected contemporary management practices and competitively advantage operations procedures. In this area, it is recognized from the corporate organizational behavioral literature (Mintzberg 1986; Galbraith 1982) that the determination of the correct organization structure is significantly affected by:

- a) The strategic development option selected by the sponsor organizations;

- b) The standards for critical functional area business conduct (e.g., the product research and development infrastructure and talent assembly), and innovation in process, organization; and,
- c) Any supporting unique requirements in these aspects.

Thus, structure in relation to process and product is critical.

This area of the analytical framework also requires that private sector preferred modes of innovative technology monitoring be accommodated by consortia's ventures. Moreover, in addition to these aspects, the framework asserts that successful innovation management requires that relative autonomy be established for the innovating teams (Mintzberg 1986). Therefore, any consortia venture must also address the nature of the industrial sector specific and unique product-market development features that favorably exploit contemporary forms of critical success factors (Quinn et al. 1997; Chesborough et al. 1996; Spekman et al. 1996).

As presented in chapter II, it is accepted that schemes of consortia governance (management structure, organization, etc.) also have a significant impact of the likelihood of success. This connection has been explored in the literature (Aldrich et al. 1995; Nelson et al. 1994) for consortia.

In the course of the research the conclusions that following were suggested for each of these governance aspects.

Implications for Technology Innovation Management and Commercial R & D Strategy Implementation – Organizational Structures Theoretical Models

Of the four units of analysis and the Case Agency, each consortia venture was targeted to provide support to the state's business constituents. This support was

intended in a way that would serve their individual constituent businesses' technology innovative management needs while providing university and federal assets focused on those needs.

The Case Agency, in its mission to support the creation of jobs, companies and competitiveness, pursues a policy of facilitating the state's business community building a consensus. With consensus, it then serves to lend support to a statewide technology development strategy by ascertaining the collective sense of the key required developments in technology innovation support infrastructure. The resulting set of initiatives that are supported, through awards and Case Agency staff contributions, are supported are those product and process research and development facilities which are provided to support technology development objectives.

Case Agency activities include serving as a facilitator for constituent business' participation in a set of three year (bottom up) Technology Sector Development plan strategy formulating exercises. Thus various approaches to commercial technology innovation management strategies are supported through the Case Agency's programmatic thrusts.

Implications for the Advancement of the Theory

Little insight into the Technology innovation management theory was provided through the field research. However, it should be noted that in the case of the two most commercially advanced infrastructure consortia ventures, the collaboration nature of the work was specifically accommodated. In this sense, both Hamilton's idea of technology monitoring strategies and technology innovation management tenants were supported by the case study.

Moreover, as was the case in consortia A, Mintzberg's (1986) organizational and cultural requirements for effective technology innovation management through the establishment of an organizationally isolating Ad hococracy or Galbraith (1982)'s "Reservation" where both given support in the case of the research.

However, it must be observed that insufficient evidence was assembled to provide support for Quinn's et al. (1997) assertion that relatively greater success should be recorded for ventures that match well the need for competitively advantaged and relatively flat and/or innovative inter-organizational research and development structures. Consideration of the aspect of consortia design requirements was not evidenced in any aspect of the research.

Thus, to the extent that any commercial successes were registered, it did not realize that outcome as the result of an explicit and comprehensive consideration of the organizational and collaborator's needs to benefit from a process of technology innovation management. No consideration was given to a procedure that would apply what was found to be "best practices" – either in the state or universally – or in any other way motivated by this aspect of the theory.

Implications for Consortia Management

Of the four units of analysis, two were judged as having the greatest potential prospects for protracted commercial success. Both of these had firm participation concepts that could accommodate the recommended organization design and procedures advanced by the literature. Be that as it may, the evidence failed to provide any support for the notions involved.

Therefore, the implications for consortia management of this deficiency is to correct it. That is, these results would suggest that by requiring a design consideration of the technology innovating organization's proven characteristics, consortia structures could be devised that would allow a better assessment of the relative merits of intentionally addressing the various inter-organizational requirements. Further, such considerations could also suggest procedural requirements that might be adapted on a project by project basis for assuring advantaged new product or process research and development project coordination. Based on such initiatives future consort development needs could be isolated and procedures for project specific coordination processes and authority hierarchies could be refined to the point of garnering clear strategic advantages to the case state.

Conclusions—Implications for Consortia Commercial Venture Evaluation Practices

The case study results show that the matter of bellwether organizational or procedural practices regarding technology innovation management were not considered or factored into any of the four units of analysis considered. Nor were these a matter of assessment within the case organization.

In the interest of optimizing the scarce and limited state-level commercial technology research and development resources, the Case Agency might first apply the consideration to future consortia-venture-business-model development efforts. Should it chose to do that, it could support subsequent research to assess the relative merits of routinely employing venture support assessment and evaluation approaches.

Conclusions—Implications for the Research Questions

With respect to the first research question, it was repeatedly found that little to essentially no consideration was given to this aspect of technology innovation management or a consortium's prospects for commercial viability (i.e., venture evaluation). Thus, additional research will have to be devised to explore this connection.

With respect to research question 2, the matter of what works in consortium venture management, suggests that there is not well defined research agenda to explore the potential contribution to consortia venture success that evaluation or consortia management can provide. It remains a viable future research objective.

Requisite Organizational and Process Management Rules

From the federal agency perspective, the implication for improved commercial consortia venture evaluation and selection is to consider the practical issues associated with federal assets transfer to university and/or private sector consortia partners. Such transfers must be done in a way that reflects a "best practices" knowledge base that captures the best results experienced throughout the federal system of such activities.

The development of such a continuously improving basis for federal asset transfer and investments to commercial enterprises should be accomplished through the use of known processes and structures proven through application. The process would also assure the maintenance of a team of experts in this regard. Thus, it is implied from the case results that a constructive consortia venture evaluation enhancement (for federal agencies) would be to establishment of a functional area that effectively performs "due diligence" in a way that all mission critical considerations are comprehensively known and addressed. For example, such venture defeating matters as the legal liability, human

resource development, transfer of mission critical operations knowledge and transfer are clear requirements in this regard.

The outcomes of the research suggests that these issues must be addressed in a way that will secure the success of any federal agency's programmatic development goals. Specifically, goals to be achieved through forms of privatization that each of the researched consortia pursued. The same is the case for any functional enhancement to the approach advocated in the course of the study.

The Key Conclusion:

In at least three of the four units of analysis considered, the federal agency partner had a profound impact on the launch of the venture.

Implications for the Research Questions:

We observe that:

From the perspective of the Case Agency, the implications for question 1 are:

1. Suggestion for increased sophistication, formalization, and continued development of its venture evaluation process,
2. A programmatic and criteria modification implication concerning efforts to better harness the intellectual resources represented by the various university faculty deployed state-wide; and
3. That the case agency serves its constituent organizations (e.g., university partners and commercial clients) well. Thus, there are programmatic expansion implications in terms of exchanging cross functional area outreach supports, that are key to progressing from promising venture business model to viable, tax generating business operation.

Summary:

This chapter developed conclusions and implications stemming from the research. The outcomes of the case study can be summarized in each of three primary areas of concern:

- The research results summary of the major overarching conclusions that can be drawn given the research;
- A suggested subsequent research directions and agenda; and,
- The practical management and entrepreneurial implications.

These are centered on insights that appear to have applicability for improved venture assessment, and consortia venture management.

To provide an overall view of the research outcomes, we summarize each of outcomes of the areas as follows: (1) The key case study results are shown in Figure 32; and, (2) The implications for improvement in the management practices of Consortia suggested by the research are presented in Figure 33.

- **In No Case were adequate Business Assessment or Consortia Evaluation Schemes Used.**
- **The dynamics of Commercial Venture Assessment were Supported by Results;**
- **The More Rigorously the Business Case was used to Develop Business Model (Private Sector Partner) the Greater the Prospects of Commercial Success the more each of the Commercial Competitive results Obtained**
- **Innovator's Networks Were Key to Commercial Consortia Success (In two or the Four Situations)**
- **University Must Install a Rigorous Formal Champion Development Structure and Process, Based on Relative Consortia Success.**

FIGURE 32. Major Conclusions

- **Develop Staff Development Infrastructure** – Champion/Faculty Provide Entrepreneurship Training/Awareness (as University Economic and Science Program Development infrastructure element);
- **Diffuse We/They Mentality** – Inter Departmental and Inter-University Through Senior Management Initiatives And Modified teaching tenure /consortium Administrative Career reward Structures;
- **Enhance Role of (Early) Conduct of Candidate Business Feasibility Assessments by Champions’** – increase focus of Market/Business Strategy Consortia Venture;
- **Enhance Research (treat as a pilot study):**
 - **Expand Case** -- Consider (other) State-Wide Units of Analyses (e.g., inclusion of the state’s technical university’s Wireless Telecommunications Center as a benchmark success story);
 - **Expand Perspective** (National or International Focus);
 - **Enhance Confluence of Evidence** (e.g. with data access perform a Neural Network Study for Forecasting/Evaluation Engine Development);
- **Focus Research on Effective Consortia Management Practices** (e.g., conduct confirmatory Statistical (Path analysis or Logic Model Study).

FIGURE 33. Suggested Consortia Management Practices Development Agenda

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APPENDICES

These appendices contain: (a) the set of supporting documents employed to guide the research in the course its conduct; and, (b) unit of analyses summaries for each of the four supporting pre-prototype commercial consortia ventures researched.

The supporting documents include (in order of their appearance): (1) the study protocol guide -- or outline of the procedures for the conduct of the research; (2) a treatise of the literature basis for the topics covered during "interviews" held with the research participants; and, (3) a sampling of the data collection devices employed during the conduct of the research. These included: (a) research "Contact Sheets" -- completed in association with securing the interviews; or, (b) supporting documents (for example, any of the reference documents secured for the research and used to construct the summary write ups). A sample of the participant follow-up and introductory letter is supplied as typically served to finalize the data collection interview schedules. Appendix 5 is a collection of copies of the final editions of the actual summary documents (data) constructed and provided to the study participant for each of the four units of analyses which served to constitute the "embedded units of analyses" referred to in the study design section of this document. They are immediately proceeded by a matrix that displays the specific institutional composition of each of the units. As promised -- and required by qualitative research methodology -- they were written to assure participant and institutional anonymity. Each summary document is introduced by a two paged topical outline. Summaries A, B, C and D are found on pages 330, 359, 397 and 441 respectively.

APPENDIX 1. STUDY PROTOCOL

Purpose

The purpose of this document is to lay out the specific procedures for collecting the data from the actual operational environment under study. The protocol for data collection described are designed to explicitly support the exploratory research strategy employed to realize the proposed dissertation project objectives..

As has been noted in prior sections, It is the focus of the proposed research to examine both successful and failed attempts to realize new commercial enterprises the through support of new ventures whose:

- Business models are founded on the application of the Innovative technology; alternately in:
 - a) The firm's production/distribution functions,
 - b) Embedded in its product line; or,
 - c) Captured (simultaneously) in both aspects of the business;
- Resources are provided by a combination of university, federal and state agencies in concert with private resource investments; and,
- For those situations considered, attempt to clarify what works and what appears to be a significant contributor

to the outcomes assessed, in a way that will allow further discovery of promising research directions and/or potential theoretical refinements of the underlying paradigms which help explain how the process of technology innovation may be more cost effectively managed. Of particular interest is gaining a clearer understanding any modifications to new venture investment decision rules which appear to provide an enhanced likelihood of

success through infrastructure investments which compound effectiveness of technology innovation management partnerships composed of public private resources specifically allocated for innovative advanced technology research, development and commercialization effectiveness.

Key Features of The Case Study Method Chosen

A single case with embedded multiple units of analysis study research model (Yin 1994) was chosen as most appropriate approach to the conduct of the research due to the following considerations:

- The need to better understand how state level agencies can provide for a competitively advantaged business environment is increasing in importance because such activity is being attempted more often and more universally; and,
- The organizational landscape that characterizes the various agencies which at any given period actively support programmatic thrusts whose goals are to support or be directly responsible for creating successful enterprises is not uniform from situation to situation, a constant aspect of any regional economic development effort is the local state organization charged with the economic development oversight function;

Although labeled differently in various regional governmental jurisdictions, the advent of a general increase in the number of public sector organizations -- at the state and regional level -- charged with the responsibility of insuring its indigenous regional economy will grow and become increasingly economically viable is broadly recognized. By adopting specific programs designed to create an business environment that enjoys compelling competitive advantages through the development and exploitation of innovative technology, these (typically) state agencies attempt to establish a more

effective and comprehensive approach to managing their diverse advanced technology research, development and commercialization resources for their regional businesses.

The General Approach to Data Gathering

There are two primary procedures whereby these data will be collected.

These are:

- (1) using archived records of firms/enterprises that received state resources for the management of innovative technology; and ,
- (2) Conducting selected Case Agency center-referred other units of analyses data collection activities (e.g., senior management guided discussion in depth interviews, mailback or faxback surveys, summary contact discussions or conversations, and documents reviews)

As a matter of overall procedure, both of these qualitative field research data collection procedures can be characterized by the fact that they will uniformly begin with referral discussions held the subject region of the regional university for the Case entrepreneurial center(s) Director, and based on these branch out to contacts identified and secured with various representatives of the regional and headquarters field organization senior management designated staff. In addition, critical programmatic overview documents and operations and policy diagnostic documentation will be secured initially in this way as well.

Appendix 5 is a version of the sample research participation letter that will be sent in confirmation of telephone appointments. They will "follow-up" these conversations in a way that secures either a survey forwarding address or an on- site interview appointment -- or approval to participate in both.

The Case Agency regional offices and affiliate organizations (e.g., the regional university for the case technical assistance center or the regional case agency offices' director staff discussions will be conducted so that both the centrally archived data variable definition and value definitions can be performed in a two person discussion team (composed of the dissertation principal investigator, and the regional university for the Case's Entrepreneurial Center Director).

Initial guided discussions with representative organizations of each of the units of analysis listed below will be performed in this manner as well (see attachment 3 for a sample of a discussion guide). That is, the representatives of these non- the Case Agency regional offices, also defined as key units of analysis, will be generated as a result of the process followed for clarifying and defining the variables and their values based on the archived data program generated form management and individual regional office performance reports periodically collected from these various state-wide the Case Agency regional center managers and centrally warehoused and maintained at the Case Agency headquarters offices.

Documentation that is anticipated to be used include: (1) reference industrial sector related analyses, selected feasibility studies performed in support of the regional university for the Case entrepreneurship venture research and assistance venture evaluation activities conducted during academic years 1995-1996 and 1996-1997; (2) Various Case Agency regional center program description and summary documents, (3) the Case Agency technology organization sector strategy documents ; (4) the Case Agency sponsored consultant market assessment and program evaluation documents; and, (5) other unit of analysis senior reference documents.

This latter category of interview will be conducted in association with the Case Agency staff recommended network of commercial business partners so that their perspective and deferring assessment of the new venture partnerships sponsored can be garnered. In addition, their perspective on the historical records housed by the Case Agency will provide significant research methodological validation as well as assure a more accurate understanding of the new venture support phenomenon under study. Sources such as entrepreneurial center archived records, the Case Agency system-wide procedural, policy, environmental and any of several management control documents (e.g., project or budget status documentation) will be used in the course of the research. As noted elsewhere, archived data (e.g., any neural network identified successful situations , or patterns of success) will be gathered and used to support an analytical procedure that is capable of subsequently further isolating “patterns-of-success” (or failure) for a “case load” of situations that are recognized -- nominally by two or more institutional representatives -- as fitting the profile of primary unit of analysis considered: namely, the supported enterprise of interest (i.e., the innovative new venture considered).

In this section we address the question of exactly how the data will be collected and compiled during the course of the proposed research?

Determination of persons to Be Interviewed and Other Sources of Information

The list of persons to be interviewed will be determined by following a research procedure that uniformly begins with consortia organization referral discussions held with: (1) the specific region of interest addressed by the regional university for the Case entrepreneurial center’s director, (2) The regional university for the case research foundation director and (3) with the regional university for the case vice president for

research and academic affairs. Based on these branch out to contacts identified and secured with various representatives of the regional and headquarters field organization senior management designated staff. In addition, critical programmatic overview documents and operations and policy diagnostic documentation will be secured from these sources initially as well.

Reference points-of-contact for the units of analysis defined below will be identified and through these discussions. Where available introductions will be secured.

As regards the archived data for the neural network, variable definition and non-university and the Case Agency unit of analyses points-of-contacts will be determined

What do we need to observe?

The following are the units of analyses associated with each example of the innovative technology commercialization behavior under study. These are the recognized potentially significant contributors to the success or failure of the subject commercial enterprise launches. They also appear to play meaningful roles in the continued success has been objective of the program of interventions pursued.

Each of these units of analyses (i.e., the companies, the universities, financial institutions and governmental research and development agencies that support them) will be the primary sources of the evidence that is planned to be used in support of realizing the research objectives of the proposed dissertation research. The relationship between the data sources, the method of analyses performed, the research questions, and the paradigm or theoretical construct explored is summarized in the attached matrix. In all cases, the data and association analytical method to be employed to support the various forms of study validation strategies used are identified on the second line of this matrix.

The Perspectives of Key Units of Analysis

The perspectives of key units of analysis for the field work will include those of the following institutions:

1. **(Non-profit) Commercial Infrastructure Development Ventures** (through R & D and related innovative technology management functions). Examples include: case state's modeling and simulation center, its center for space infrastructure advancement, the regional university for the Case aeronautical test facility's project, electron beam accelerator facilities, etc.
2. **The Innovative New Venture:** that is , A the Case Agency-supported/selected new innovative venture team -- or the actual entrepreneurial firm that has been selected to receive guidance and other kinds of resources intended to enhance its future commercial prospects and viability (e.g., existing or proposed venture whose plan has received a preliminary assessment of possessing a viable (profitable or new wealth generating) commercial business model .
3. **The Federal Government** --Federal agency functional area representatives (e.g., economic liaison officers of DARPA, NASA, DOE, etc.) where responsible for managing the provision of the federal level agency's support of the unit of analyses new venture resource needs .
4. **Trade or Industry Consortia** (e.g., National or multinational technology commercialization Research and Development;
5. **The University**-- University Economic Development or industry-university staff outreach centers (the Case Agency supported university housed technology assistance center) or the regional university for the case's research foundation (the

regional university for the Case research management organization)) are examples. or senior university representatives who are responsible for recommending the selection on the part of the participating university business development functions, support of a new innovative venture which has received university financial and/or related resource support;

6. **The Case Agency Organization (including its headquarters, regional office and partner organization Offices)** – the Case Agency regional staff member who has served as the champion of the subject new venture’s support evaluation with responsibility for assessing the business’s innovative venture requirements and directing its successful launch.
7. **The Industry** – Commercial/Industrial Partner firm (i.e., the firms providing staff for new product development resources, research project funding support , etc.) support offices engaged in the innovative venture’s successful launch and continuing operations.
8. **The Financial Institutions** -- For selected new innovative venture cases of “success”, representative officers of financial institution that typically provided [all] some aspect of the stages of new venture financing (e.g., zero, first, second, third and fourth stage new venture financing). Examples include: venture capital firms, banks (investment and commercial), or governmental financing agencies (SBIC’s, SBA regional offices -- e.g., for loans, etc.)
9. **Nongovernmental Regional Business Development Agencies** Quasi governmental new venture support agencies with a stake (i.e., donated selected resources in support

of the new ventures success (Regional chambers of commerce, any task forces for certain specific infrastructure advancement)

10. **Regional and Local Governmental Units** -- Participating aspects of the regional /local governmental agencies whose support of the new venture was significant. (e.g., Donated easeways, land or materiel, favorable tax treatments, etc. (e.g., city -- or regional councils of governments -- economic development office representatives)

Of all of the above considered, those for which University , state agency, and a target operating new venture industrial participant will be viewed as the *minimum* collection of perspectives that must be solicited and analyzed to support the research findings. Supplemental evidence will be collected from participating federal and relevant commercial financing and regional technology management support agencies as noted above.

Organization of This Protocol

I. Procedures -- **How can we get at those observations?**

A. Initial Scheduling of Field Visit

Review of Preliminary Information

Verification of Access Procedures

Special Documents

C. Training the Case Study Team

In these cases, the first guided discussion will be jointly conducted in a similar fashion to that performed for archive data variable clarification and collection (that is, conducted by interview teams comprised of both this projects researcher and the regional university for the any of the case university attached entrepreneurs assistance center director).

Purpose of Training

Topics for Training

The Study Database

Figure 1

Figure 2

Case Study Protocol and Questions

A. Definition of the Consortia

Topics

Summary of Questions for Section A

B. Centralization and Decentralization

Topics

Summary of Questions for Section B

C. Instructional and Administrative Applications

Topics

Summary Questions for Section C

D. Applications Related

Topics

Summary of Questions for Section D

E. Special Education and Regular Education

Topics

Summary of Questions for Section E

F. Planning for Implementation

Topics

Summary of Questions for Section F

III. Analysis Plan and Case Study Reports

A. Individual Case Studies

Descriptive Information

Explanatory Information

Outline of Individual Case Study Reports

B. Cross-Embedded Unit of Analyses Analysis

Descriptive Information

Explanatory Information]

Cross-Embedded Units of Analyses Report

Reference Case Study Protocol

Consortia for Technological Innovation Management through New Ventures

Literature-based Paradigm Questions (by Question number)	Unit of Analysis Consulted	Source of Data	Type of Analysis Supported	Meta Research Questions(s) Addressed
1	6 (1,3,5,7)	I	<ul style="list-style-type: none"> • Theme Development • Pattern Matching 	Q1
1	1,3,5,7	D/S/C, D/S/C, D/S/C, D/S/C	<ul style="list-style-type: none"> • Clustering • Chain of Evidence 	Q1
2	6	D	<ul style="list-style-type: none"> • Pattern Matching • Chain of Evidence 	Q2
2	1,3,5,7	S/C/D	<ul style="list-style-type: none"> • Clustering 	Q2
3	6,5,3,8,4	D,D,S/C,D/C	<ul style="list-style-type: none"> • Logical Chain of Evidence 	Q1
3	2,1,7,8,6	D,D,S/C,D/C	<ul style="list-style-type: none"> • Clustering 	Q1

A - Archived Records
C - Contact Sheets
D - Interviews

S - Surveys
I - Documents (Industry Reports, Feasibility Studies, Program Documents, etc.)

Table 10. The Exploratory Study Primary Research Questions to Paradigm Extension Question Matrix

Consortia for Technological Innovation Management through New Ventures

Literature-based Paradigm Questions (by Question number)	Unit of Analysis Consulted	Source of Data	Type of Analysis Supported	Meta Research Questions(s) Addressed
4	6,4,7,8	D,S,D/S/C	<ul style="list-style-type: none"> • Logical chain of Evidence 	
4	6,5	D,D	<ul style="list-style-type: none"> • Clustering 	
5	2,3,5,7,8	D/S, D/S/C, D/S/C, D/S/C, D/S/C	<ul style="list-style-type: none"> • Logical Chain of Evidence 	
5	6,1,4	A, S/C	<ul style="list-style-type: none"> • Clustering 	
6,7	1,6,2,3	D/S/I, D/S/A, D/S/C, D/S/C	<ul style="list-style-type: none"> • Logical Chain of Evidence 	Q1
6,7	6,8,7	A,S/I/C, D/S/C	<ul style="list-style-type: none"> • Themes • Clustering • Chain of Evidence 	Q1

A - Archived Records
C - Contact Sheets
D - Interviews

S - Surveys
**I - Documents (Industry Reports, Feasibility Studies,
Program Documents, etc.)**

Table 11. The Exploratory Study Primary Research Questions to Paradigm Extension Question Matrix

Consortia for Technological Innovation Management through New Ventures

Literature-based Paradigm Questions (by Question number)	Unit of Analysis Consulted	Source of Data	Type of Analysis Supported	Meta Research Questions(s) Addressed
8-11	6,2,8,7	D/S/I, D/S, D/S, D/S, D/S	<ul style="list-style-type: none"> • Counting • Clustering/Themes 	Q1,Q2
8-11	5,4,3,6,10,11	D/S,S/C, S/C, A, S/C,S/C	<ul style="list-style-type: none"> • Counting • Pattern Matching 	Q2
12	2,6,3,7,1	D/S, D/S/I/A, D/S, D/S, D/S	<ul style="list-style-type: none"> • Pattern Matching • Chain of Evidence 	Q2
12	5,3,4,1	D/S, C/S,I, D/S	<ul style="list-style-type: none"> • Clustering • Themes 	Q2
13-15	5,6,2,4,7	D/S, D/I/A, D/S/I, S/I	<ul style="list-style-type: none"> • Chain of Evidence • Pattern Matching 	Q2
13-15	1,8,3	D/S, D/S,S/C	<ul style="list-style-type: none"> • Clustering • Themes • Pattern Matching 	Q2

A - Archived Records
C - Contact Sheets
D - Interviews

S - Surveys
I - Documents (Industry Reports, Feasibility Studies, Program Documents, etc.)

Table 12. The Exploratory Study Primary Research Questions to Paradigm Extension Question Matrix .

Consortia for Technological Innovation Management through New Ventures

Literature-based Paradigm Questions (by Question number)	Unit of Analysis Consulted	Source of Data	Type of Analysis Supported	Meta Research Questions(s) Addressed
16-19	1,2,5,6,7,8	D/S, D/S,D/S/C, A, D/S/C, S/C	<ul style="list-style-type: none"> • Theme • Clustering • Pattern, • Chain of Evidence 	Q2, Q1
16-19	4,6,7	S/D, S/D, S/D/C	<ul style="list-style-type: none"> • Pattern Matching • Chain of Evidence • Themes • Clustering 	Q2
20-28	1,2,5,6,7,8	D/S, D/S/A/I, S/I, D/S, S/C/I, D/S/I, D/S/I	<ul style="list-style-type: none"> • Chain of Evidence • Themes/Clustering 	Q2
20-28	4,6,7	D/S/I, S/I, A/S/I, D/S, S/C/I	<ul style="list-style-type: none"> • Chain of Evidence • Themes • Clustering 	
29-35		A/D/I, D/S, D/S, D/I, D/S, D/S/I	<ul style="list-style-type: none"> • Chain of Evidence • Themes/Clustering 	Q2
29-35		S/C/I, C/S/I, S/I, A/S	<ul style="list-style-type: none"> • Themes • Pattern Matching • Chain of Evidence 	Q2

A - Archived Records
C - Contact Sheets
D - Interviews

S - Surveys
I - Documents (Industry Reports, Feasibility Studies, Program Documents, etc.)

Table 13. The Exploratory Study Primary Research Questions to Paradigm Extension Question Matrix

Consortia for Technological Innovation Management through New Ventures

Literature-based Paradigm Questions (by Question number)	Unit of Analysis Consulted	Source of Data	Type of Analysis Supported	Meta Research Questions(s) Addressed
36-38	1,2,3,5,6,8,7	D/S, S/D, D/S/I,D/S,A/D/S,D/S/C, D/S/I	<ul style="list-style-type: none"> • Theme • Chain of Evidence 	Q1,Q2
36-38	6,5,1,2,8,7,9,10	A/D/S, D/S/I, D/S, D/S, S/D, D/S/C, D/S/I	<ul style="list-style-type: none"> • Clustering • Chain of Evidence 	Q2, Q3

A - Archived Records
C - Contact Sheets
D - Interviews

S - Surveys
I - Documents (Industry Reports, Feasibility Studies, Program Documents, etc.)

Key Concepts/Definitions

- **Infrastructure Consortia Team Senior Management – General and Administrative Top Management and Inter Partnership Organizational Partnership Liaison**
- **New Venture Champion – typically the Consortium Organization’s Chief Executive Officer (exceptions include: (a) Technical Director, and (b) University and Case Agency Senior Executive Advocate**
- **Principal Regional Venture Evaluator or Resource Broker**
- **Case Agency Field Organization versus Case Agency Headquarters Staff**

Table 14. The Exploratory Study Primary Research Questions to Paradigm Extension Question Matrix

APPENDIX 2. LITERATURE-BASED THEORY/PARADIGMS

Literature-based Theory/Paradigms to be Explored by the Dissertation Research

Case Study

Explorations Premise:

Only with proper consideration of multiple facets of the dynamics at work that collectively assure new venture success, can:

- (1) The commercially advantaged membership of consortia be defined.
- (2) Consortia Organizational and management structures be defined
- (3) Appropriate programmatic thrust and project portfolio selection criteria be discerned; and,
- (4) Effective New Technologically Innovative Venture selection-for-support decision criteria be discovered and advanced;

It is the premise of the dissertation research that with the results of the proposed investigation of the state's efforts to garner commercial viability from its technology research, development and capabilities base, a body of knowledge will be amassed (and framed) in a way that will result in a greater likelihood of new venture success. Further, it is an implicit assumption of the research that this outcome will obtain due to the investigation's discoveries affording an advantaged basis for improved management of the underlying technology innovation phenomena and universal corporate strategic management imperatives at work.

The research into the various paradigms that seem to underlay processes that collectively yield technology innovation management is treated in this section. The specific paradigms reviewed are examined in a way that identifies lines of inquiry for the field research. Quite specifically, out of research each area treated, detailed questions

tailored to allow paradigm confirmation, exploration, issue identification and development are suggested. This procedure was employed to develop the set of interview and discussion guides found elsewhere in the appendix. Operational definitions of the variables, as well as variable values used to permit the dissertation database to train and test the neural network are based on the treatment of these paradigms presented as well.

The literature suggests that the following are key to realizing both objectives:

Innovation's Dynamics:

Underlying Processes followed by Innovation:

Schumpeter's Theory.

- Two modes of commercial innovation: evolutionary -- technology innovation at the Macro Level, opportunity for process innovation arrives with recapitalization of production infrastructure. That happens -- for existing structures -- cyclically. There are four cycles: 3 year, 7 year, 11 to 15 year cycle and a long wave or long term underlying basic technology innovation cycle 40 to 80 years.
- Entrepreneurship: Revolutionary -- third party (or outside player) innovation Advantaged product or process penetrates existing markets redefining them. Suppliers, and/or fundamentally sector (e.g., gas vs. electricity for lighting) as a result of inventory replacement, product enhancement cycle, capital depreciation 7 year business cycle.

Exploratory Research's Paradigm or Theoretical Discovery Implications of Schumpeter:

If a new venture fits either of these dynamics, relatively greater success will come to those which are introduced during the confluence of these cycles, or capture long wave technology R & D based developments which redefine their target product markets.

Protocol Question (s):

1. Is this what is found or suggested to be the case in the Case Agency's state?
2. Do commercial ventures supported by Consortia fail which have improper timing in this regard.
3. Do R & D projects sponsored by the consortia succeed (or satisfy clients) when there focus is on well suited product or service for the fundamental phase of the technologies development (e.g., the sponsored venture has as its main product: the performance of research services contracts for the conduct of basic research, applied research or developmental , product/process licensing services contracts for new venture technology's developmental and initial introduction phase); or,
4. Do ventures supported (e.g., in terms of its equity investment, license agreement, or staff resource commitment to the new venture) by consortia succeed when their staff engages in product enhancement (feature development via improved control or interface subsystem contract research) development research for ventures launched during the market- introduction, growth, maturity, or decline phases of the product-market.

Appropriate Contributions given Market Phases: Abernathy and Utterback's Theory

The Product Market

Abernathy, Utterback or Kim assert that commercial markets driven by innovative technology go through three basic characteristic phases reflecting the experimental nature of the unearthed new product-market: Fluid, Transitional, and Specific Patterns of product market behavior as described in the literature section.

Exploratory Research's Paradigm or theoretical Discovery Implications of Abernathy/Utterback

This theoretical focus suggests that Consortia venture support success will be better assured to the extent that their venture participation reflects knowledge or credible judgment of what phase of the product-market the candidate technology innovation-based new venture falls within, and, whether its associated underlying business model is well suited for the competitive market conditions it faces at its period of launch. Here we refer to commercially competitive "market conditions" faced by the new venture's products on a tactical level -- as captured by such issues as its target markets "4 P's", and/or, on a strategic one-- e.g., its place in the product- market alliance affiliation landscape it has chosen to enter).

Thus, should the evaluated Consortia sponsored venture face a product-market that is characterized as in Fluid pattern, the theory suggests that each of the characteristic listed in table 1 page 37 would apply. Thus the organizational interface that would be most appropriate should be one staffed with researchers and management staff that are quintessentially entrepreneurial in personality, operating in a relatively informal

organizational context, producing product at a small scale, using general-purpose equipment required to allow frequent major product changes, and in developmental partnership with principal customers who are primarily interested in the delivered product's team's ability to provide for a required functional product performance.

When the venture is judged with justification as being in a Transitional product-market phase, new ventures alliances sponsored in partnership commercial partners who enjoy a significant market share become more critical. Products must be targeted to contain features that address the market's preferences for specific forms of application of the innovative technology. The sponsored new venture's production/manufacturing and distribution strategies should be assessed as to whether they address the need to be based on process and other related functional area (e.g., distribution channel operations) innovations. As regards the organizational structure and process management mechanisms planned for the Consortia sponsored venture, the Utterback theory suggests that partnership arrangements and corporate cultures that are executed through formal project and task groups will be advantaged over other optional approaches to these issues. Competing approaches to technology standardization (either in terms of product or process standards) impose some risk and suggest Consortia should invest in ventures that cover the multiple standards (demanding that it be allowed to invoke contract vehicles which support a "harvest" investment exit strategy as the market matures and move away from the particular venture supported).

Thirdly, the remaining pattern called for by the "Utterback school-of-thought" construct is the so-called Specific pattern. It suggests that Consortia sponsored new ventures launches will enjoy greater success if when judged to be in this phase, projects

are more formal and routinized. That they support alliances for the conduct of on-going basic research serving as outsourced r & d capacity of major commercial concerns (e.g., in the Hampton Roads area, an example would be the regional university for the Case 's college of engineering engaged with an area shipbuilding company in simulation for Computer Integrated Manufacturing (CIM) support where reduced process costs for hull design is the long term contract objective). Project plant support or proposed should be large-scale, highly specific to particular products, with a major cost reduction objective. The new venture should have the objectives of increasing process efficiencies through R & D.

Protocol Question (s):

For self reported or supporting analysis identified "successes"

(Questions that establish -- by judgment -- the candidate venture's product-market phase of development)

(Phase defined by target Product's Technological Generation)

5. Given the product/process innovation that is at the core of the new venture whose launch or expansion is to be sponsored by consortia, what is the potential partner evaluator's view of the technological generation of product or service? First, second generation, other? (explain if necessary)
6. If at all, how is the level of product-market segment development captured by the archived data? of the target product-market faced by the proposed venture?
7. Where the entrepreneurs championing the new product of the opinion that there proposed product or business model was uniquely the first of its kind -- and thus innovative?

(Phase defined by Number of Recognized Competitors)

8. How many competitors produce a substitute product? How was an estimate generated? What size firm – estimated annual sales, or number of employees – were viewed as the nearest competitor?

(Phase as defined by New Venture's market distribution Strategy)

9. Was a key aspect of the strategy for market growth of the new venture envisioned to be licensing the innovation or gaining significant market acceptance of the new product by introducing it through a joint venture with an established commercial firm holding significant related market share in key segments targeted by the firm/Consortia team? (If yes, a Transitional or Specific phase is assumed)
10. Was the disproportionate investment received from the industrial partner whose position in the target product-market significant? (Yes, a tacit investment in the new products channel and thus a validation of the specific or transitional period)

(Phase defined by Existence of Product/Process Standardization)

11. Is there an industry standard of product performance that must be met for the new product. (if yes, Transitional or Specific phase is assumed)

(Appropriate strategies/expectations for Organizational Structures and Process)

12. What style of organizational structure and attendant culture best characterizes the manner in which research and development is organized in the target product-market? (entrepreneurial fluid –e.g., a “skunk works” Fluid phase, management by objective with sunset strategic alliance-based project teams (transitional) , institutionalized R & D structure and control procedures (Specific)

Technology Innovation Management and Commercial R & D Strategy

Implementation Organizational Structures

(together with compatible operational policies) for Competitive Strategic Management and Process Improvement.

Structure

- **Quinn:**

Quinn's compilation of various R & D organizational structures would suggest that relatively greater success in "innovative-technology-management-through-R & D-generated" venture support on the part of Consortia would come from adopting those new venture's whose planned market distribution channel's are well suited to match or feed into what are product-market specific (and known) optimally advantaged organizational structures for commercial R & D. Ones that, in fact, tend to characterize the industry under consideration. These structures capture or reflect:

- a) Existing or emerging industry standard dynamics of product and process lifecycles (i.e., the log log lifecycles chart); and,
- b) Industry defining modes of corroboration (e.g., those dictated by channel management dynamics – as examples, Williamson's transaction economics scheme, or the "networks literature" in marketing regarding R & D channel management through so-called "tacit" dominant-subordinate channel member capital investments);

Forms of Governance/Ownership (Types of Partnerships)

- c) Appropriate degrees of functional outsourcing as addressed in Chesbrough and Teece (1996) modification of Williamson along the "Virtual-Integrated

corporation continuum or, the governance issues represented by “ tacit technology investments” dimension (Low uncertainty and asset specificity vs. High Uncertainty and Asset Specificity

Protocol Question(s)

13. Is the sponsored new venture’s organization structure well suited facilitate corroboration with commercial partners?
14. How is the intended product-market’s new products development structure accommodated by the organization, operations policies or product/services delivery mechanisms employed by the new venture business model?
15. Do successful consortia projects anticipate the need to match up well with the organization and procedural norms which characterize the target product market of the championed technological innovation? If so, how is that idea addressed during evaluation or captured by specific project support decisions?

Requisite Organizational and Process Management Rules

for Commercial Technology Innovation Management through the Unit of Analyses defined Consortia (Galbraith 1982; Mintzberg 1989)

This literature suggests that the process of supporting technology innovation is tied to the degree to which an “innovating” corporate culture is created. That it is associated with a so-called learning organization has been well established (Senge 1990; Drucker 1989; Chesbrough 1996; etc.] . Entrepreneurial teams and environments benefit from being isolated from the culture that produces and distributes existing products. These are often self directed teams. Reference in the literature as “Adhocracies” (Mintzberg 1989), or “reservations” (Galbraith 1982), The choice of appropriate vehicle

for innovation management is driven by the relative volatility of the product-markets shelf life, (higher levels of rapid innovation / turn over suggests more outsourcing ; and, whether the requirements for innovation entail whole systemic level innovations (those including more than just the product but its support and user systems) or are relatively product specific—innovations apply to products that are in effect components of systemic solutions where standards are well established for critical supporting technologies. The higher the risk to large capital stock, the greater the incentives to innovate internally (or to establish well functioning alliances). The range of centralization imposing organizations (as a function of risk) are virtual company, alliance, joint venture, corporation with autonomous divisions, and integrated corporation.

The issue for consortia decision enhancement is the extent to which these considerations are captured by the new venture sponsorship associated with successful ventures.

Protocol Questions:

16. Is the innovation of the new venture one that requires large scale modifications to the systems that it will benefit? (Is it a process innovation technology)
17. What form of partnership was adopted by the Consortia?
 - a) Virtual Corporation (where pre-prototype services were contracted out by the industrial/commercial Consortia partners),
 - b) Alliance (where limited coordination but composed of members are driven to enhance their own relative positions)

- c) Joint Ventures (a separated legal distinct organization jointly invested in by the partners in terms of money, personnel (fixed temporary assignments), and/or other in kind investments) and
- d) Variations on Corporation Governance (autonomous divisions – e.g., a wholly owned subsidiary) or a unit contained “within” the corporation.)

18. Does the organization and/or the new venture’s team interactions and work styles (both formal or informal manner), mirror the entrepreneurial , management by objectives (MBO), or protocol modes as characterizes the target product market industry norms? For example, is it a “flat” (clustered), star, or hierarchical structure interfacing with a compatible commercial partner’s organizational structure?
19. Is it a kind of acceptable form of adhocracy (or reservation) organizational culture (as shown by a market leaders’ precedent)? Here, staff communications practices can serve as a surrogate for evidence in this regard (e.g., frequent informal electronic communications, proximity conversations, impromptu meetings, etc.)

Davidow’s (Chesborough et al, etc.) “Virtual Corporation” or Relatively Flat New Product Development Governance Structures: Interfacing

Davidow (and the Marketing literature’s work on strategic alliances) and Hamilton’s modes of technology strategy scanning (e.g., monitoring through memberships, consortia sponsored pre-prototype r & d projects participation , demonstration or technology transfer market entry joint ventures, etc.) work , suggest that relative competitive advantages (e.g., in terms of product introduction speed and higher quality solutions effectiveness) can be realized by taking advantage of communications technology innovations (e.g., telephony’s email, video conference, and

“groupware” networks) and commercial cultural shifts (reduced loyalty to the firm with greater commitment to the technology). These developments support the ability to quickly assemble “r & d-to-new-product-launch” project workteams comprised of expertise which resides in various organizations. This notion suggests that the relative likelihood of experiencing new venture success for consortia will come from those new ventures which can be shown to appropriately take advantage of this innovative approach to R & D process management.

Quasi Governmental Agency Appropriate Roles:

Universities in Consortia

As reported in the previous literature chapter of this proposal, university associated consortia -- consortia per se (i.e., commercial variants on pre-prototype research associations) have only been a recent development in the U. S., brought on by contemporary legislative initiatives. Considerations of the advantaged roles for universities and/ or government agencies in association with garnering any national or regional commercial competitive advantages and viability for the business community served has been given recent focus (Aldrich et al 1995, Mansfield 1995, Mowery 1992, or Teece 1987). The theoretical prognosis of this stream of research suggests that appropriate roles for universities fall into the following primary areas:

- a) supporting basic research of the supporting science leading to a phenomenon level of understanding of the fundamental science at work in a recognized application area ;
- b) by concentrating academic program development in areas that support the regional commercially advantaged business community extending its competitive

edge through providing a well spring of appropriately trained science, engineering and trade skilled future employees; and,

- c) at the contract project level, providing non tenure rewarding applied research support to area business that could not otherwise afford have any turn key level research performed.

Out of the first two areas for university and federal agency supported consortia, innovation is supported indirectly. Ideas are germinated in the professional corroboration that accompanies such training and scientific investigative activities. Out of the third, the best role a university can play is to let the persistent request of the business community is serves help clarify areas of academic concentration that will in the long term return an area global or comparative downstream advantage (Porter 1986). Thus the following specific research questions are suggested.

Exploratory Protocol Questions

- 20. What form of asset contribution was made by the university in a successful new venture sponsored by a consortia? (technology was licensed/patented?, faculty led basic research team perform contract supporting research?
- 21. What kind of support was found to be associated with successful efforts to launch advanced technology new ventures through university affiliated consortia . Here candidate answers are as follows:
 - a) Direct capital investment -- to included leased research facilities)?,
 - b) Sunset technology license lending,?
 - c) Non-profit center R & D infrastructure contracts?

- d) **Contracted on-loan faculty and staff? Preliminary venture/innovative technology business development or evaluation support?,**
- e) **Other? Explain**

Management/Structural Requirements

Management and structural requirements of Advantaged Commercial And/or Non Commercial Partnerships/Joint Ventures may be best captured by the alliance issues raised by Spekman et al. (1996) (questions from Spekman's stuff)

Commercial Joint ventures "work" -- according to this line of research -- to the extent that:

- a) **The partners have well stated objectives at the outset of the venture;**
- b) **that realistic shared expectations regarding the core competency contribution of each partner are held by all parties (e.g., distribution and marketing "know-how" on one hand; with advantage product design, and/or product production requirements and access to capacity for it with regard to the target market;**
- c) **The joint venture's leadership takes the necessary steps required to effectively create an organizational environment-- which of necessity must be distinct -- develops a corporate culture that effectively synthesizes the of antecedent partner organizations while allowing the new venture's staff esprit de corps to thrive; and,**
- d) **Clear exit strategies on the part of the sponsoring partners are articulated with venture participation "sunsets" for all parent organizations. These arrangement must be captured in the associated staff compensation packages developed for the new venture employees. These compensation packages**

must support both the entrepreneurial and security needs of the new venture's employees and leadership.

It is the nuances to these conclusions that are called for public-private partnership joint ventures. That is, the primary research issue here is how must these tenets of joint venture management be modified when the different case of consortia whose sponsoring partnerships are composed of federal, university, state economic development through technology innovation management organizations together with a set of industrial/commercial partners all sponsoring the new venture. An opportunity to contribute answers to this is afforded by the proposed research.

Protocol Questions:

22. For the consortia situations found to be judged "successful", was setting a well defined sunset of joint venture operations viewed as a key to its eventual success? If so, for any given sector of the economy addressed, what were the typical duration of the success corroboration?
23. As with strictly private sector ventures, did consortia sponsored variants support the idea that highly placed senior management level championship on the part of the dominant partner organizations, was a key aspect of realizing success?
24. Was there a clearly delineated exit strategy for each of the sponsoring partners? If so, What was the general concept of the disengagement? What were the Terms and Conditions (T & C's) of the each sponsoring partner that satisfied each? What were generally applicable mechanisms for compensation of the new venture that conformed to realizing the venture's performance objectives?

25. How should the findings with regard to the rules of thumb for effective joint venture based new venture success be modified by consideration of the industrial sector practices of the target product market(s)?
26. What are the restrictions to joint venture development imposed by the unique nature of the private public partnership formed by government-university-state development agency-industry consortia?
27. In retrospect, are there any common themes in terms of rules for organizational, unique joint venture new product commercialization team management or communications requirements or with regard to project selection criteria identified by the case material reviewed (e.g., either through the neural network analysis or key player field interviews or documentation review) that when observed will tend to better assure success?
28. What , if any are the advantaged legal and financial vehicles recorded that appear to better allow requisite staff rotations and autonomy to secure new venture's success?
29. What are the program policy level recommendations regarding program administrative procedures to follow appear supportable by the research that tend to assure joint venture new venture success ?

Modifications to New Venture Support Decision

It is a central premise of the proposed research, that a beneficial by product for a principal units of analysis of the case study (i.e., the Case Agency and its consortia member federal agencies, universities and commercial partners), is the development of a resulting framework which captures the potential assessment enhancements to be used for evaluating new ventures supported through GUI consortia. These consortia, comprised

as they are of state- federal agency- university and commercial partnerships, represent a relatively unique composition of investment resources, managerial and success reward allocation challenges.

Although as noted in the literature section of document, widely accepted –and relatively straightforward--frameworks for new commercial new venture assessment exist, discovering any modifications to those criteria and practices that might improve the likelihood of the emerging form of new commercial venture launch support is a clear research objective. The venture evaluation and subsequent allocation constraints imposed by a consortia comprised of universities, targeted government technology innovation management and development agencies(state and local) and interested elements of commercial enterprise, have not been advanced.

The exploratory research also affords an opportunity to identify promising directions in the key areas of venture assessment framework improvements which -- when applied -- may result in a more cost-effective aggregate process for the research, development and commercialization of innovative technology. A process that –it is hoped – when properly executed, will visit upon the adopting regional business and technology communities, competitive and technological advantages.

The remaining protocol questions will be those that arise from the interest in discovering these differences.

Consortia: Licensing, Equity positions, and Joint Ventures: Selecting Partnerships for New Venture's the advance Technological Innovation Management

As Figure 11 of chapter II shows, the central architecture of new venture assessment falls into either of four component analytical/ assessment area:

- a) **Evaluating the sufficiency of the human factors of the potential new venture (the appropriateness of the collective skill sets assembled in the venture, its management team, organizational design and management procedures) – those components identified in the Founders;**
- b) **Evaluating the Opportunity in terms of its commercial and economic viability and associated financial promise – The Opportunity;**
- c) **Assessing the extent of agreement that exists between the adequacy of the business model, the talents of the personnel aligned to seize it, the design of the proposed operations in terms of its structure and management process and the demands of the opportunity under consideration – The Fit versus Assessment of Gaps; and,**
- d) **The ability to secure and gain access to the required resources that the entrepreneurial team lacks – Necessary Resources.**

While the primary unit of analysis for the research (namely, the Case Agency statewide and area offices) provides assistance in all aspects of this evaluation architecture, its primary role is to perform the “Fit” function. That is the focus unit of analysis main function is to manage the process in a way that best matches entrepreneurs with resources needed to transform a promising business concept into a tax contributing viable enterprise.

It is as a result of this charge that the primary focus of the research Consortia come into being. It is the discovery of how the criteria and conventional architecture used in commercial venture support – although well defined for commercial enterprise evaluations – might be modified to suggest directions of future research that hold the promise of rendering more effective economic, academic and business development

programs and practices. Practices which are by design geared to effectively manage the process of innovation for any given technology in a way that optimizes complementary area competitive success factor improvement.

Theme integration and Consortia sponsored New Venture Evaluation

Schemes: Modifying public-private venture evaluation criteria:

As discussed in the literature section, both Chesborough (1996), Teece (1987) and Hamilton (1986) suggest that Consortia as a means of optimizing the innovation process are limited by the confluence of market dynamics, technology innovation process mechanics, and legal organizational constraints. (Hamilton's (1986) Table 2 shown in chapter II suggests that commercial enterprise practices regarding competitively advantaged policies followed in their technology management. Under this framework, Consortia sponsorship of new ventures are limited to the last three forms of alliance (i.e., licensing, equity participation, or joint ventures) as their appropriate roles for direct support of new ventures.

The fusion of the constructs suggest thus far would appear to be as follows:

The decision to participate in a is arrive at after the New Venture Assessment proceeds along the following logical framework:

To address the technology development school of thought as exemplified by Utterback (1996) (1) Any venture must first be placed in the continuum of its stage of development (basic research - commercialization continuum); (2) It should consider the stage of the potential application's market application; The type of product market must next be considered; next a clear sense of whether the nature of the product process application supports its appropriate-ability or no appropriate-ability; That will define the

evaluation criteria and modifications to the conventional commercial new ventures assessment criteria and architecture captured by Timmons (1985).

The protocol questions that follow are those which will either verify or clarify the applicability of this logical frame.

Protocol Questions

30. What was the duration of the Case Agency involvement in the venture? (definition of consortia form)

31. What forms of investing were did the Case Agency engage in during the course of its involvement with the venture? (identify the type of consortia investment made)

What part of the target industrial channel was the business/venture concept targeted exploit? For example, possible responses might be as follows:

- a) The “pre-prototype-to-commercialization” region of the technology’s innovation process;
- b) “Prototype-to-commercialized” product line (with the Case Agency payout);
- c) “Technical systems demonstration-to-market” accepted product line (i.e., in all cases the Case Agency “harvested” its investment per contract); or, “Commercial demonstration-to-market” accepted product line; or
- d) the Case Agency facilitated the acquisition of venture with established strategically significant product market participant.

33. How relatively easy was product or process innovation to appropriate? (Teece (1987) asserts that success can be forgone if a specific logic has not been followed in the way the new ventures product line/business was launched?)

34. Into What functional area contracts (Porter, 1985) did the venture enter? (to allow exploration of Teece's concepts of requirements for new venture success must provide a description or typing of the unit of analysis venture)?

The following are samples

- a) **Were the contracts entered into consistent with Teece's notions of strategic vulnerability ? (for example to be a success in the cases where they were judged to "be successful").**
- b) **Where so-called specialized assets were required for a venture's success, was it the judgment of representatives of the various institutions involved in the consortia's efforts to support the venture true that its "divisibility" provide a recognized difference in the cases of success or failure ? (e.g., the distribution channel's special manufacturing assets).**
- c) **Was venture acquired by the firm owning so-called complementary assets? (possible responses: Yes, that action was part of the business model – it was an intended outcome)**
- d) **How should Consortia ventures protect for the potential downside (explore the validity of Teece's notions of appropriate avenues for strategic alliance support of innovative technology based firms)?**

35. Did venture develop a pipeline of products (or establish R & D process leveraging the organization?)

36. Was the target market (s) used to define R & D project system performance objectives (i.e., contact Appropriate R & D team staff personality profiles, selection?)

potential issue for the research investors that of these conclusions that are not implications

Appropriate R & D team staff personality profiles, selection

Results of a prototype development neural network development project (Saunders et al. 1996) suggest that a key aspect of the venture support assessment procedure that has received perhaps insufficient focus is that of the appropriateness of the team psychology of the proposed new venture's leadership. Goleman (1995) suggests that the matching the collective emotional intelligence of the innovating venture's management team is critical to moving from the stage of recognizing a potentially viable innovative business venture to the realization of that potential though successful commercial launch and protracted operation.

An associated conceptual basis for this area of exploration is the idea of innovating team (the firm AND its external venture support organizations which include aspects of consortia management and/or alliance partner's on loan staff) must enjoy the proper chemistry (or blend) of personalities and/or interpersonal styles to assure success. Preliminary results isolated in the prototype development project suggest that it is this trait which is THE key aspect of the venture assessment and support process. It almost single-handedly spells the difference realizing an innovative venture's "success" or failure.

An associated concept is that referred to as the "reasonableness test". That is, is management reasonable enough to take decisions that will improve the likelihood of the consortia sponsored venture reaching its commercialization of innovative technology

based venture's objectives. Exploring the vital aspects of this issue is the intent of the following set of research questions.

Protocol Questions

37. Given the roles played by the ventures management, How where the requisite new venture management functions address by the team. For example, did the teams financial management get performed by a manager whose skill level and financial performance expectations address industry standards?
38. Did the new venture's champions personality allow the kind of delegation of authority needed to realize the organizational and operational objectives called for by the new venture's business plan?
39. Is it your opinion that the composition of the team assembled promote or frustrate the success of the venture? Yes, Please describe in what

way _____

No, Please suggest where the fault lay (e.g., too many "Indians" not enough "chiefs" or the reverse) _____

In all cases, appropriately modified variations to each of these research questions will be generally developed for the selected sample units of analyses involved in the case study effort. Thus the management of the successful supported venture will be asked

suitably modified variations to these research questions. Similarly, representatives of key financial institutions involved will be either provided with a questionnaire or administered a guided discussion on the matter to gain that perspective. Both situations identified either through a neural network application (Saunders et al 1996) or by research participant consensus (i.e., > 50% of the key institutions involved in the innovative venture's launch and operations have knowledgeable representatives who share the assessment of the subject venture's success -- or failure) as successful or a failure, will be subjected to sufficiently varied field data collection procedures to allow triangulation for research validity. Although, as indicated in the methodological section, the primary source for these data will be directed discussions, this source of evidence will be buttressed by voluntary questionnaire responses, and /or phone interviews.

In the chapters that follow the one in which this appendix is referenced, we address the overall research concept invoked to select the research strategy and study protocol followed during the conduct of the proposed research. With the expanded research questions provided in the here in mind, what follows the reference chapter is the research concept and specific strategy followed which designed to provide for their answers and guide the conduct the proposed exploratory research.

APPENDIX 3. DATA COLLECTION INSTRUMENTS

Sample contact Summary Sheet

Contact Date: _____

Contact Time: _____

Contact Name: _____

Title/Position Held:

(Programmatic

Responsibilities) _____

Meeting Circumstance:

Main Issues:

Contact Suggested hypotheses, speculations, or guesses on Areas of Additional

Theoretical Development/Exploration _____

Contact Person Recommended:

Sample Guided Discussion Script:**State or Fed Agency Representative**

Thank you for agreeing to do this. Your assistance is invaluable. As we indicated during our telephone conversation and written correspondence, the objective of the research is to understand the practitioner's view of "what works" and doesn't well enough to suggest improvement to *[Case Agenda]* operations intended to support entrepreneurial success.

As an experienced executive whose charge is to help businesses grow from dream to successful operating reality, your insights are invaluable. We're interested in your opinion of "What Works". That is, we would like to know your perspective on the "realities" faced in providing support to the entrepreneurs of the commonwealth in their efforts to successfully start or expand new ventures which also advance the state-of-the-commercial-technology art for any given advanced technology is the understanding we seek. Of particular interest is learning more about the dynamics of a successful launch accomplished through partnerships comprised of government agencies (both Federal and State), universities (faculty, facilities, as well as direct investments including those made "in-kind") and critical aspects of the private sector.

To realize this intermediate objective, we would appreciate your describing in general what it is your office does. For example, we would appreciate a general description of the process (and procedures) this office follows in the course of performing its operations targeted to assist identify promising new venture's based on exploiting an innovative technology either in the way its products are manufactured distributed, or that

capture the advances in the technology through having it effectively embedded in the product.

QUESTIONS TO PLACE ARCHIVED RECORDS IN OPERATIONS CONTEXT (I.E., IN TERMS OF THE ACTIVITIES FLOW FOR THE OFFICE). COLLECT ANY DESCRIPTIVE MATERIALS AVAILABLE.

Q1 As a take off point, lets get a "picture" of what the center does.

Would you please describe your program that is designed to provide the support to entrepreneurs? Perhaps a useful way to do that is to describe the flow of potential deals you consider annually? For example, How they come to your attention? How they get processed given that? What nominal percentage of the overall deal flow receive some form of Center support? Please describe the various modes (or avenues of support the center provides?) (COLLECT ANY HARDCOPY DESCRIPTIONS AVAILABLE)

Q 2 Does the center enter into any venture performance based contracts (e.g., those that return some payout with success or with objectives being met), If so, would please discuss the “generic variations on this theme”?

Q 3 What other mechanisms does this office employ to advance new venture’s assessed to feasibly become successful commercial operations?

- PROVIDES AN OUTLINE FOR BUSINESS PLAN DEVELOPMENT
- BROKERS ENTREPRENEUR TO NEEDED FUNCTIONAL AREA AVAILABLE SERVICES (BANKER/LENDING INSTITUTION DIRECTOR, INTRODUCTIONS WITH KEY ASSET PROVIDERS)

Q4 How are critical local business development resources leveraged by the Center? How are business development consulting services networked or brokered? How are deals “shopped” to the investment/financial sector -- banks, VC’s, corporations with strategic interest in the business model’s product, etc.?

Q5 In what ways has the center supported the formation of new venture infrastructure that will enhance its ability to assure comprehensive new venture development services to promising innovative ventures – a local Small Business Investment Corporation (SBIC) support been involved in the successful new venture developments?

Q 6 Is there a Model that you use for Evaluating the commercial Potential of a New Venture? If so would you please describe it for us? _____

Q7 How do you treat potential new ventures with business models that are based on exploiting advanced technology (either in its product or service's manufacture, distribution/marketing or embedded in the product itself] *differently* for all of the potential deals you annually consider ?

Q8 What are the typical stages of business development that which characterize the ventures you get involve in ?

Q9 How do you define a successful support new venture launch in this office? For example would you define a supported new venture a success if:

A. IT RECEIVES PLANNED PRIVATE SECTOR FUNDING (E.G., VC, ANGEL, COMMERCIAL BANK FUNDING)?

B ITS IN EXISTENCE FOR TWO YEARS AFTER INITIALLY OPENING ITS "DOORS" FOR BUSINESS?

C. MEETS (OR EXCEEDS ITS) BUSINESS MODEL'S FINANCIAL AND/OR

MARKET PERFORMANCE TARGETS

D. OTHER? EXPLAIN _____

Q10 Is there a particular industrial sector for which this center enjoys a unique qualification to evaluate? If not, what would you judge to be the typical annualized breakdown of the types of new business ventures you evaluate or support? _____

Q11 Has this center been involved in the commercial launch of any ventures which were sponsored by academic or business development departments? If so, would you please list the ventures that come to mind? _____

Q12 Has this center been involved in the commercial launch of any ventures which required investments from area universities? If so, would you please list the ventures that come to mind? _____

Commercial Advanced Technology Research and Development Consortia may be thought of as technology research and development organizations whose resources have been assembled through the investment in materiel, manpower and capitol of partnerships made up of universities, federal agencies, sponsoring commercial firms and a championing entrepreneurial organization.

Q 13 Has your agency been involved in any of these? If so, would you please list those that come to mind for us?

Q14 Have you experienced any of these forms of consortia involvement that you would judge to have been successful? If so, please describe it (or them) and give what you definition of success was for each case addressed?

Q15 In your opinion, how have these new venture launch support activities differed from the norm, in terms of:

- a. their requiring a different venture evaluation frame of reference for assessing the idea's business potential and subsequently managing the do diligence development process,
- b. demands on your center's resources, and incremental increase (decrease) in new venture project management complexity; or,
- c. The manner of providing assistance in "Shopping" the deal? or having compatible awareness of and access to the networks of critical financial and human capital resources required to "make it happen"?

Q16 Given your past experiences, What "lessons learned" regarding Consortia deal development and successful launch come to mind? What -- to you -- where the critical success factors involved in the successes?

Q16a We are interested in recognizing the different roles played in the successes. Who – e.g., on the entrepreneur side – would you suggest we interview that was involved in the deal who might give us their perspective on these matters.

Name: _____

Address/Phone Number: _____

University Deal Advocate: _____

Phone Number Address: _____

The Key Federal Player(s) Name: _____

Phone Number Address: _____

Financial Institutional Deal Advocate: _____

Phone/Number Address: _____

Q16 b What was missing (or should have been addressed) in the “failures” that would have resulted in a different outcome?

Q17 Do you keep any records of the various new venture engagements you assess and assist annually? If so, what are the key variables for which data is recorded? And, How are they operationally defined.

(SHOW THE CASE STUDY REGIONAL UNIVERSITY ASSESSMENT LIST AS A
PROMPT AFTER INITIAL LISTING HAS BEEN DISCUSSED/COLLECTED)

Q18 How are they archived?

Q19 May we have access to them? Collect these data files on disk where possible?

APPENDIX 4. SAMPLE LETTER OF INTRODUCTION OF INTERVIEWER

Appendix 4

Sample Letter of Introduction of Interviewer

[*Case Study Regional University*]

Department of Engineering Management

[*City, State Zip Code*]

[*Date*]

[*Recipient Name*]

[*Address*]

[*City, State/Province Zip/Postal Code*]

Dear Dr./Ms./Mr. :

I am a Ph. D. candidate in the Engineering Management program at [*the case study regional university*]. Currently, I am conducting my dissertation research. I am employing a qualitative research methodology in connection with this dissertation research under the supervision of [faculty advisor, Ph.D.] in association with the [*Case Agency Organization*].

The research attempts to find out what are the key considerations, evaluation procedures and rules your organization uses in the course of its process of deciding to participate in partnerships of new commercial ventures. Further, the specific focus of the research is on clarifying the practitioners view of the unique requirements regarding this activity that are associated with those new commercial ventures that began as promising innovative research and development projects. As the focus is on this rather unique aspect of the new venture investment community of the [*case study state*], we would

greatly benefit from your participation. We would like to interview you about this issue. The interview will take about 45 minutes and will, be with your consent, tape recorded. You will be allowed a review of the summary notes generated from the interview and the interview will be kept confidential.

Your participation will be compensated in part by your receiving a summary of the dissertation project's finding once it is completed.

I will call you in a few days to arrange for the interview at a convenient time.

Thank you in advance for your participation.

Very truly yours,

Ralph B. Saunders, II

APPENDIX 5. SUMMARY RESEARCH RESULTS FOR UNITS OF ANALYSES

TABLE OF CONSORTIA COMPOSITION

SUMMARY	PAGE
A	330
B	358
C	397
D	441

Consortium	University	Federal Agency	Quasi-State Governmental Agency	Commercial Venture Finance Liaison	Industrial Partner
A	Regional University	DOD	CASE AGENCY	Case Agency Partner	Global Aerospace Company
D	Regional University	NASA	CASE AGENCY	Case Agency Partner	Global Aerospace Company
B	Regional University	NASA	CASE AGENCY	Case Agency Partner	International Laboratory Services Firm
C	Regional University	DOC	CASE AGENCY	Case Agency Partner	Regional Venture Capitalist

FIGURE 34. Units of Analyses Directory for the Case Study

**SUMMARY OF RESEARCH RESULTS FOR UNIT OF ANALYSIS
CONSORTIUM 'A'
CONTENTS**

Introduction

Summary Organization

Background: Unit of Analysis -"A"

'A's External Environment

The Target Industry

Governmental Landscape

The University Setting

Political Realities Faced

Relevant Consortia Activities

Consortia A's Story

Overview of "A" s Development

The Need for Structure Innovation in R & D

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Introduction – Document Purpose

This document provides an account of critical aspects in the development of Consortia 'A'. This review process provides feedback to ensure the accuracy of the preliminary results. And interpretations drawn from interview and other research data.

For purposes of this discussion, “consortia” will refer to the de facto organization comprised the set of agencies which elected to allocate resources to allow the viable operational creation -- or launch -- of the intended organization. For this research “consortia” is designation by the participation of the following set of agencies: (a) Federal agency sponsorship, (b) a state university, (c) state agency, (d) a quasi-governmental agency with the specific objective of promoting economic development through support of technology innovation, and (e) a commercial enterprise.

Based on the field interviews reviewed, other euphemisms for this organizational form which may have been used in reference to the consortia are: “Collaborative”, or “Partnership”. Regardless, in every case, the composition of the organizations participating and the desired favorable outcome of the thus defined units are the same: the creation of commercially successful venture.

For purposes of discussing the specific venture that is the subject of this document, that unit of analysis will be referred to throughout as Unit of Analysis “A.”

Document Organization:

This document begins with a background narrative. This is divided into a statement of (a) the goal and/or vision of the unit, and (b) the stated objective and/or approach of the unit. Next, a brief discussion of the economic, political, and technological context out of which the unit venture grew is provided. Given that

developmental context a narrative of the consensus “story” of Consortia ‘A’s’ set of events which led to its current state of commercial development is constructed.

Following this story, an integrated summary of the collective comments provided by multiple individuals through the interview process is presented. This discussion is followed by one which identifies the unique and unanticipated or atypical features which characterize the development of consortia “A” either as a start-up or viable not-for-profit commercial venture.

The integrated summary is followed by a consensus listing of the critical roles played by each of the institutional partners in the consortia. Finally, technology innovation management themes, which emerged during the investigation, are discussed.

Background: Unit of Analysis -“A”

According to research documents associated with “A”, the following is its stated goal (Vision):

...“A” will be a leading center for the development of computer modeling and simulation applications through a consortium of academia, government, and industry led by [*the sponsoring university*] and [*located in a specific region of the state*] ...” italics and alphabet reference added to assure anonymity...

The specific objectives (or mission) of “A” are:

- ... Economic Development;
- Research: conceive, develop, and promote modeling and simulation technology – focus on applications.
- Education - Develop and deliver specialized training
- Short courses
- University credit courses,
- Graduate program (s)
- Technical Expertise – Source for Industry & Government

Thus, the specific projects envisioned to be executed were those which had the effect of lending critical support to developing an institutionalized procedure. This

procedure would, in a competitively timely and cost effective manner, generate commercially viable computer-based models and simulations that would provide benefits to two primary target applications area. The first major application area was in the development of advanced defense applications. These applications increasingly employ advanced technology that springs from the highly dynamic and competitive commercial computer applications software sector. The second applications area involved the development of novel commercial applications based on state of the art military and defense systems training , modeling, and simulation applications.

In particular, what is being referenced here are those applications whose development was facilitated by the consortia. These resulted in a well articulated stream of competitively advantaged new product introductions of commercial products and services. Thus, for example, this category is exemplified by the set of products and services that arguably came about as a direct result of the regional firms' (referred to as member firms) participation in the consortia projects.

A key to making this consortia concept work was harnessing, through partnership with industry and government scientists and engineering expertise, the higher educational technological talents resident in the university engineering and science education systems of the host state.

This outcome was desired for two primary reasons:

- (1) It was recognized on the part of all partners that there was a need to develop statewide technological talent in the functional areas identified as deficient but critical to future success of each of the consortia partners; and,

(2) The need to expeditiously realize a protracted technological advantage. This would be achieved through the application of resident university faculty and graduate student technical talent and research facilities.

In the sections that follow we present the consensus view of : (1) The external environment out of which the venture was formed and within which it was designed to function; and (2) a summary treatment of the supportable observations that the field research suggests.

'A's External Environment

The general environmental context out of which Consortia "A" germinated is provided by the following consideration of the target industry, the governmental landscape, the pertinent university setting and a treatment of the salient Political realities faced.

The Target Industry: Product-Markets Served

This discussion provides a description for the so-called "industrial sector" that will be primarily impacted by the product-markets addressed by any application or technological innovations spawned by in consortia 'A's operations. "Product-markets" are considered to be the rather unique market segment defined by a specific application of the product's use and that may be characterized by exhibiting relatively homogeneous product price point sensitivities on the part of purchase decision makers.

A major characteristic of the technology of focus for consortia A was that it cross-cut many US Department of Commerce so-called Standard Industrial Codes (SIC). The venture's core techniques formed the essence of any potential product and associated services (which grew out of successful development) were heavily depended on computer

science and attendant information systems. Therefore, perhaps the most appropriate description of the target market would be the information technology sector. Thus, the sector is more specifically targeted to SIC's 7372 - so-called prepackaged software, and SIC 7371, so-called Computer Programming Services.

Research conducted earlier [e.g., DOC, "US Industrial Outlook"- 1994] suggested that the information technology sector was at least a \$ 54 billion aggregated hardware/software market in FY 1992 with \$23.3 Billion of that captured by the packaged software product-market segment. The major segments for the packaged software market may be depicted as follows:

- (1) Application tools (e.g., Data access, Data Management; Data Manipulation, Program Design, and Development Software) ;
- (2) Application Solutions (e.g. programs that do set business functions);
Systems Software;
- (3) Artificial Intelligence Development Tools – including Neural Networks –
for mainframes, workstations, and personal computers;
- (4) Artificial Intelligence Applications for Natural language Processing
DOC, Neural Networks; and,
- (5) Fuzzy Logic, etc.

The listing of SIC codes that capture this market (including Hardware, Software, and Integrated Systems are : 3571, 3572, 3575, and 3577; 7371 and 7372 , and 7373 respectively).

Governmental Landscape

There are several pertinent Governmental agencies (federal, state, local, and, quasi-governmental) which constitute the regulatory, sponsored research, and/or remaining sources of funds and/or potential sources of developmental assets that collectively frame the backdrop against within which the consortia studies were launched and flourished. Federal level government agencies included: The Department of Defense, Department of Commerce (specific emphasis should be placed on National Institute of Standards and Technology, and the National Science Foundation).

On the state level the economic development agencies of the state, particularly the budget authorization finance committee, appear to be the primary contributors to the success of the consortia's venture. Secondary support was garnered through a state subsidized technology innovation research foundation whose mission is to support economic development through a combination of matching funds and grants. This state support is designed to provide effective leverage of new product and technology research and development resources deployed throughout the state. Regional representation of this the quasi governmental agency organization which is the focus of the research served a vital roll in marshaling the concerted "voice" of a local political contingent. This collective local "voice" had a positive impact on securing the critical state level funding for consortia "A".

The consortia avoided a major set of legal and administrative difficulties due to the fact that an established local community college system setting was available to provide the requisite offices need by the venture.

The University Setting

The university partner in consortia "A"'s development may be viewed as having resided with the college of engineering and technology's dean's office. It was through this academic dean's offices that discretionary funds were allocated to allow college faculty to serve in the initial liaison roll with the federal agency. This was critical in university support for the venture.

While the subsequent academic college's venture champion was attached to the computer sciences department of a university engineering college, significant support for the advancement of the venture also came from the university president's office. The university president's office in question had economic development related venture support discretionary funds which it could greatly influence. These funds were made available through an independent academic research funding arm of the university's operations. This vehicle for venture support was invoked in the course of the consortia A's development and launch and was crucial in providing funding for pursuit of the venture.

For the venture in question, no set formal or official process had been established whereby official university support of promising economic development partnerships could be created. However, as of 1995, several such activities have been evaluated and are currently being provided for through this resource.

To the extent that a typical pattern of securing support has been identified, it adheres to the following sequence: Faculty champions a technological research based advanced application venture concept until it reaches a level of refinement that generates Dean level interest and backing. Typically, resources in kind are invested at this point.

That is no direct funds are allocated for the project. However, faculty time is approved along with suitable facility assess to take the venture concept to a level that suggests a feasibility analysis is warranted. At this point the university may lend its support to assisting in securing more comprehensive university attached business assessment resources or in locating sufficient state and other resources to finance such an assessment.

With continued promise being demonstrated at this point, senior management at the university will attempt to secure escalating levels of economic development support (in the form of state or federal agency grants writing support). With enough justification, the president's level may actually allocate a fixed amount of money greater that \$250,000 to seed the launch of a consortia.

Notwithstanding this typical pattern, a key ingredient is the dedicated sacrifice of the principal investigator to continue to expend significant personal resources to move the idea from idea to facility to stand alone venture. Thus, faculty as champion is typical and critical in early development of the venture.

In the case of this particular venture, the champion was procured through a national search procedure.

Political Realities Faced

It is clear that the decision process and structure of governmental agencies are responsive to political control. For the purpose of this summary, a treatment of this governmental superstructure will be foregone in favor of a mention only of the aspects of it that had some clear – and reported -- bearing on the consortia which is the subject of investigation.

In the case of Consortia “A” , it was found necessary for the partnering university president’s office to directly intervene in the state legislative committee level deliberations. This action eventually yielded a budgetary line item for the consortia. Moreover, through university senior management relationships established with local elected officials, sufficient political constituent pressure was developed and exerted to enhance the likelihood of that desired support for the Consortia.

Relevant Consortia Activities

University, industry, federal agency consortia have been in increasing operation since 1984 – when federal legislation in effect permitted increased use. As a result, a significant experience base has developed regarding their construction, management and development. A basis for “best practices” has thus been established through experience over time.

In the case of Consortia A, it is clear that a model for formulating the specific corporate membership fee schedule for the venture was patterned after a successful design found in operation elsewhere. In particular, the membership model developed by another university engineering entity located within the state was used as a model for that function in Consortia A’s case. The source institution whose model was used in consortia A’s development, enjoyed a significant national reputation, and had a more protracted history of success with consortia operations and development.

With this exception, any other specific trends in the general area of consortia venture development and management were not suitably visible to hold the potential for influencing the specific approach to Consortia A’s structure and operations policies.

Consortia A's Story

This section provides an overview of the sequence of events that chronicle venture A's development. The following sequence is based on discussions held with each of the key representatives of all of the participating agencies which comprise consortia A.

The themes discussed are those suggested by the historical sequence of events associated with the venture's development, as well as any additional themes –that were suggested as key and perhaps unique.

Overview of the "A" s Development

Due to a developing view on the part of a research and development arm of a major department of defense agency -- at the policy level, a new Joint Force training and evaluation organization was called to be formed in an region of the state with a strong tradition in housing significant military assets. A clearly contributing emerging dynamic was the increasingly obvious need to improve the effectiveness of the set of public and private resources dedicated to plan and develop an integrated multi-force war fighting capability.

To realize the goal of minimizing the cost of such operations, while also assuring an improved cost effectiveness of any standard operating procedures adopted, the leadership of the sponsoring agency wanted to create, evaluate, and otherwise suggest improvements to the management of its Defense Department assets. This goal was to be reached as a by product of any transformations in the approach adopted to improve cost effectiveness. Thus this was to be done in a way that would expeditiously fulfill the

agency's training and evaluation mission while also significantly improving the operational environment of the asset.

The Need for innovation in R & D Organizational Structure

Top management of a defense agency was charged with assuring the operation's success. Under their guidance, the agency sought to devise a vehicle for systems development. This vehicle would drastically alter the modes by which improvements to existing operations, needs assessment, planning, and field command forces training would be accomplished.

Exploratory conversations were held between senior management within the federal agency, representatives of local state economic development agencies, and a major regional university's senior and engineering education management. These conversations were conducted in an effort to assess and further develop the potential venture partners shared understanding of the appeal of the venture. In addition, it was a goal of the widely disseminated regional conversations to make clear the fundamental appeal, to each potential regional venture partner, that such a partnership would hold for the local engineering educational university, the local business community, and the initial advocating federal agency.

The object of these discussions -- on the part of the sponsoring federal agency partner's senior management -- was to develop a venue whereby a mutually advantaged trilateral corroboration (between industry, university and governmental agencies) could be secured. The initial focus was on clearly articulating and soliciting support the enhancement of the region's technical talent and developmental environment.

In effect, the envisioned corroboration was to promote the following 4 distinct outcomes:

1. Secure advanced core technology development through university-based research and system development in partnership with industry and ,where applicable, the development of state sponsored advantaged commercial technology research and development;
2. Significantly reduce the cost of key systems development components and supplies of scare resources. This was viewed as also including the idea of expanding the requisite, locally available technical talent needed to support the activity. These talents and resources were recognized as key to realization of the associated products and systems development and their subsequent distribution;
3. Enhance technologically advanced federal system developments in such a way that would also support explosive growth of commercially attractive spin off products -- ones which would embed the subject technological innovation in commercial applications; and,
4. Through facilitating this product market commercialization on a regional level secure transfer to the marketplace of any advanced defense agency sponsored training and simulation technologies to the commercial sector.

Based on the agency's offer, engineering faculty from a local university did a residency at the federal agency facilities for a summer. Based on this experience, two things developed.

First, it was discovered that a strong potential existed for a rewarding collaboration in several areas which were of particular interest to the university's senior management. These interests would assist with concerns about future competitiveness of the university. Specific university interests included: (a) the opportunity to meaningfully enhance the university's engineering and computer science pedagogy; (b) generate expanded opportunities for student professional training and development -- with significant career value added; and, (c) development of intellectually rewarding [to the participating faculty] engineering and computer science research projects. The potential benefit to the university in terms of improving program offerings, and thereby expanding its prospects of attracting high caliber faculty and student populations was recognized as well. These factors served as a central justification for its continued support.

Key university faculty members (including that institution's college level management) became committed to exploring the development of an advanced technology development center. This center would facilitate university, federal agency, and industrial sector corroboration on a technical level while also allowing advancing technologies with commercial potential to be supported.

To develop interest and support in the local business community, a series of concept meetings were held with local professional and economic development organizations. These meetings included representatives of both the private sector as well as the state and region's economic development agencies. A team composed of university faculty and federal agency staff assumed responsibility for orchestrating the meetings.

Two primary factors contributed to provision of sufficient funds and allocation university faculty and staff resources. First, interest in the area economic development

impact of the idea. Second, a clear commitment on the part of the university's senior management to advance the concept to a point where at least its commercial feasibility could be sufficiently evaluated. This evaluation was from both a non profit and for profit organization orientation. Thus, support was secured in a way that afforded a market study and subsequent business plan development for the venture.

The results of this initial study proved sufficiently promising to justify a meaningful allocation, on the part of the university, to commit to contributing meaningfully to the development of the facility and institution. That secured commitment extended to include support for a center budget that also served to justify a national search for an executive director. This director would serve as center development advocate, venture champion, and senior administrative officer.

This last development resulted in the hire of a center director in a October 1996 timeframe. As an early priority, the director moved to secure state funding and support for the target facility in a way that would assure: (a) a meaningful commercial vendor, as well as (b) extensive target commercial sector user organizations to join in partnership. These partners where to participate in the development of commercially available applications that, when modified, would apply advanced defense system technology for various uses with meaningful commercial potential.

A mid term (3 to 5 year) operations budget was approved at the state legislature. This was a result of the participation of senior university government relations assets, local political advocacy, and partnership with a sufficiently committed major fortune 100 multinational company vendor grants.. This assured seed funding which served as an anchor for further expansion and secured longer term applications. In addition, this

provided opportunity for technology research contracts as well as university federal agency staff corroboration program developments.

Current business development activities are centered on: (1) extending the avenues for support of regional business development, (2) enhancing private sector partner- state university faculty team led project applications and technology advancements, and extending the center's ability to instrumentally broker the resources needed to effectively promote the commercial spin-off of proven pre prototypes. These spin-offs for new businesses or new products are intended to enhance competitiveness of regional area businesses.

These events cover a 3 to 4 year period beginning in the spring of 1994.

Novel Aspects of Consortia 'A's Development

The following appear to be the primary "novel" aspects of 'A's "successful" development. They are listed in apparent order of contribution to success.

- (1) Contrary to convention, the University sponsored center advocacy came from a faculty member that would ultimately NEITHER be the Champion nor be the lead entrepreneur of the venture.
- (2) The Bulk of the budget and seed capital for the first round --or zero stage funding-- came from an engineering "college" at the discretion -- or at least without objection of that college's management (i.e., at the Dean level).
- (3) The advocating federal agency was the primary initiator of the idea. Therefore external trends played and continue to play a critical roll in producing a successful outcome. For example, in this case the call for government restructuring was external and played a critical role.

- (4) The combination of state institutionalization (via securing an annual budget) and installing industry respected senior management, precipitated the participation of the fortune 100 commercial partner. That in turn assured expanded state participation as well as, through collegial networking on the private sector side, expanded federal agency support.

All and all, the insightful advocacy role of the federal agents were key in the advancement of the concept.

Several developments allowed meaningful support to be secured. First, the fact that the agencies involved were able to develop a clear vision for the desired roll of the center. Second, subsequent to that development, they were able to adopt an effective and aggressive set of community outreach initiatives that served to articulate that vision. These developments collectively permitted a meaningful and effective advocacy to be initiated. This advocacy was at the state level on the part of the local university and targeted to the state legislative and governmental agency-level for technology innovation driven economic development. This advocacy would prove to be critical to securing the level of viability that the consortia currently enjoys.

The advocacy, together with the federal agencies continued commitment to provide “in-kind” resource support, was critical to moving the “idea” to its current state of fruition. It is now a concept that enjoys regional local level tax payer funded support in the form of a committed annual budget.

Self Reported Critical Roles Played

The effective advocacy and subsequent commitment of the various levels of university management – ranging from department to the president of the university – to the development of the venture idea were key to the success witnessed in consortia ‘A’. In addition, although there is a lingering skepticism in some quarters with regard to the future commercial viability of the center, there seems to be a developing consensus that the current Executive Director is also a major contributor to the center’s current level of success.

The Framework for Assessing ‘A’ as a Consortia

This section synthesizes results of interviews with representatives of each of the four sector partners – (1) university, (2) federal agency, (3) state sponsored agency, and (4) key private sector enterprise participant. The results are organized to reflect a synthesis from interviews, documentation collected in association with the interview, and other documentation concerning the venture.

The discussion of the summarized results that follows is organized around response to four key areas explored for during this effort. These areas are listed as the headings of the various sections and include: (1) Industry Dynamics Considerations in Consortia Venture support, (2) Target Markets and Consortia Venture Support, (3) Organizational Structure and Process, and (4) Modifications to New Venture Support Decision.

Industry Dynamics Considerations in Consortia Venture Support

The following are the answers inferred or explicitly provided by the collective responses of the venture partners associated with Consortia 'A':

1. The forms of support provided by the partners in Consortia A were not motivated to leverage underlying maturity of the industry patterns in the industrial sector (information technology) most closely aligned with the venture. The venture was not primarily concerned with patterns which could be conceived in terms of the trends in technology and business systems innovation unfolding in the industrial sectors that would be targeted by the venture. In addition, considerations of these industrial and technological dynamics were not evaluated or considered in garnering partner support for Consortia "A. To the extent industry maturity and patterns might have been considered, such considerations were not explicitly evaluated or used to further galvanize partner support.
2. At no time in any of the venture investing decision making frameworks applied, as a general rule, was there a need to characterize the Consortia concept in a way that made clear how it harnessed the underlying business and technology cycles attached to their target industrial sectors.

Consideration of the technology cycles of the target industry sector simply were not applied. Consortia "A" has only been in operational existence for less than a year. Nonetheless, thus far the venture has grown dramatically from an initial \$500,000 budget to a recent greater than \$12 million dollar multi-year contract. Several industrial sponsors and member companies have been secured as well. In that since, the concept is felt to be working and viable.

It is too soon to tell or verify whether or not Consortia A sponsored R & D succeed (or at least satisfy clients) when their focus is on well suited product or services which are in concert with the fundamental phases of the technologies development? ⁸

However, It was noted that -- thus far -- the partners are satisfied with the progress of the center. Official state sponsorship has resulted in the sponsoring university no longer having to carry the ventures start-up. Students and faculty are being employed and new systems development and training programs are being developed. That has been a clear result demonstrating the "current" level of venture success.

The primary commercial member relationships have been to participate initially with a grant and then subsequently enter into specific formations around initiatives. These formulations include arrangements of university faculty and student, federal agency technical expert, sponsoring private sector firm new product, or product-market application teams.

Collaboration across university or corporate cultures, a clear goal of the venture, has not been experienced or worked out. That kind of collaboration, although a consistently held "vision" and objective of the participating Federal agency senior management, remains a distant and as of yet unrealized objective.

The primary work of Consortia "A" is targeted toward enhancements of commercially available products to address Defense Department needs and/or modification of applications for emerging commercially available products. As such,

⁸ For example, given this consideration, it could be argued that the sponsored venture should have as its main product: the performance of **research services contracts** for the conduct of basic research, applied research or developmental research R & D phases.

most of the product-markets under consideration for the commercial industrial sectors targeted, would appear to be growth and product market definition for product enhancements.

The Markets – Target Markets

The organizational and managerial composition of Consortia 'A' is arranged as a traditional structure. As such it is primarily positioned to support the condition of a rapidly evolving market. The structure supports a view of the product-market⁹ in which the major future product-markets are being: (1) actively discovered by the various competitors and, (2) the most effective ways to compete to maximize wealth generation are being developed. Given this emerging nature of product-market's served:

- (a) entering into various forms of partnerships with little conscious regard for appropriate organizational structure for either case -- standard or innovative research process; and/or,
- (b) entering into a "new product development" contract arrangement similarly determine structure

Both appear to be the appropriate venture development policy stance to assume on the part of the consortia partners.

Alternately it should **provide product/process licensing services contracts** for the new venture technology's developmental and initial introduction phase);

⁹ Here a "product-market" is conceived to be the rather unique segment of a market defined by a distinct and meaningful set of uses to which a product is put. It is a segmentation that lends itself to providers formulating distinct strategies for effecting the products, price, position, promotion and place which affects the buyers' purchase decisions

Identified by various partners as “successes”¹⁰, the business model assumed for Consortia “A” was viewed as ‘appropriate’ to effectively address the market environment being faced by Consortia A.

The consortia “A” s products are “by definition” primarily second generation -- or higher advanced technology -- embedded technology products. They were therefore considered to be evolutionary innovation products by their very nature. To the extent that any first generation or break through product-markets will develop, that will happen as a “happy” by-product, and not as an intended outcome for the Consortia projects.

The Markets -- Strategic Development

Initial feasibility analyses attempted to address the question of "what was the level of product-market segment for the target industrial sectors by the proposed venture?". Based on the interviews it was reported, nonetheless, that this consideration WAS NOT and IS NOT a concern of any of the partner organizations with the exception of a partner charged with assessing the commercial strategic options the Consortia might possibly pursue.

The entrepreneurs, in the form of the Consortia partner organizations championing the new product, were NOT of the opinion that their proposed product or business model was uniquely the first of its kind -- and thus innovative. National Examples, as well as more advanced examples that existed elsewhere in the state, served to provide models for senior management and technical project team building. These

¹⁰ As regards the matter of success: It is definitely too soon to observe a recognizable commercial success. At this point “success” is measured more by the physical plant and client base expansion of the Center in terms of revenue growth and staff additions and increased membership (numbers and the diversity of the primary industrial sectors addressed by those member private sector firms).

models provided a base upon which the venture could fashion operations and economic models.

The Markets – Consortia A's Strategic Options - Competitors

How many competitors produce a substitute product and the venture support issues of how to identify these competitors generated the basis for this consideration. It was noted that only a few such centers existed worldwide and none regionally. Thus consideration of this matter was not rigorously pursued. Nonetheless, this sense of the competitive landscape served to justify the sponsorship of the Consortia A at the state, university, and federal levels. A primary private sector partner was more interested in two objectives. First, assuring access to critical federal market intelligence. Second, developing intellectual talent at a local university that served as the university partner for the consortia. This was recognized as the case because the firm's community relations and academic relations policy afforded occasion to similarly participate in such "partnerships" nationally. Therefore, for this partner, this particular consortia was not especially unique to prior experiences.

The Markets –Strategic Options - Distribution

In this case, all of the Consortia partners had a consistent perspective of product distribution. This perspective viewed product distribution to be via licensing and joint venturing with existing businesses. This would suggest that the partners viewed as proper a strategic vision of the consortia as: *being organized in a way that would support at most a product-market orientation in which products would accommodate any project associated user or industry standardized applications.* The consensus orientation left as "unconsidered" and unnecessary any further strategic focus on any further product's

distribution issues in the consortia's design or operations. Product distribution concerns did not weigh in the positive decision to support of the Consortia's launch.

The primary target market was assumed to be the federal agency in the consortia. The predominant view (i.e., that across all participants but the federal agency) was for the primary target market to be the federal agent. That market is very much services by the next largest commercial contributor and partner. This further suggests that a transitional target product market, shifting from the federal agent to the commercial sector, was assumed by default by the partners and Consortia senior management.

A defacto standard of software systems operating environments is assumed to exist. It is primarily commercially defined. The product market developments envisioned for the UOA under consideration here, were perceived to be similarly focused. Thus a transitional market dynamic was once again being assumed by the center. Among Partners and senior management, however, there was no explicit stated understanding or interest in this subject area. It therefore had little -- to not any -- bearing on the decision to invest in the center's development or subsequent operations and strategy formulation.

Organizational Structures and Process

The assumed appropriate culture for the Consortia Venture -- among its partners organizations (particularly the private sector and center champion) seemed to be absolutely entrepreneurial. This culture was punctuated with the desire for establishing limited strategic alliance based project teams. Thus, organizationally Consortia "A" was receptive to both a "Skunk Works" kind of collaboration or a sunset kind of strategic alliance-based project team. Regardless of this uncertainty, it was clear that effectively forming traditional R & D structures, which depended upon a given industry's standard

collaborative or subcontracted research and development practice, was not an explicit aspect of the vision of neither the champion nor any of the remaining partners.

Organizational Structures – Technology Innovation Management and R & D Strategy Implementation

The market and strategic development plans for commercial sector support by Consortia 'A' are still in their formative stages. The primary objective remains to support the commercially available modification of advanced commercial available products in modeling and simulation. Thus, the current organizational structure accommodates novel defense and other public sector applications. A secondary objective was the desire to establish appropriate channels so that Consortia "A" would eventually become a "wellspring" commercial strategic asset for various commercial new product development organizations.

Center project team efforts were NOT formulated with a mind toward assuring that the vital business culture of the target product markets were addressed through its operations or strategic development. Cultural compatibility with target product markets did not serve as structural design constraints to be accommodated in the center's design.

Forms of Governance/Ownership

The Consortia organizational structure was well suited to facilitate collaboration with commercial partners, or at least open to developing an appreciation of how to facilitate collaboration. Senior management, though strong and willful, –was open to adopting, on a project by project basis, any kind of team collaboration structure required by customer. As the center is very much in the formative stages of its development,

organization as well as any other team structure is stated policy to be accommodated and supported by the center facilities, senior management, and the board of directors.

The intended product-market's new products development structure is to be accommodated by the organization, operations policies or product/services delivery mechanisms employed by the new venture business model .

No explicit consideration was given, as to whether consortia 'A's projects needed to be matched up well with the organization and procedural norms that characterized the target product-market of the sponsored technological innovation projects generated under the auspices of the Consortia. This was an issue which was not raised in the course of any discussions held. Nevertheless, all partners viewed the Consortia as a very flexible formative endeavor. Therefore, the development of a focus on fit of organizational and procedural norms cannot be discounted just because it was not in evidence during the periods and phases of development THUS far considered.

Organizational and Process Management Rules

None of the partners associated with support of Consortia "A", or its venture development team, focused on adequacy of senior management's concern for supporting technology innovation in relation to creation of an "innovating" corporate culture. Focus on a creating a so-called "learning organization" occurred at the State level. However, this was not an explicit concern of the consortia or regional level partners. The business model of the consortia supported the notion that entrepreneurial teams and environments benefit from being isolated from the culture of the firm or firms that produce and distribute existing products. This was achieved primarily by providing an off sight collaborative work site for the project team members. The matter of promoting effective

innovation to support the creation of inter-organizational self-directed teams was NOT an explicit consideration for the consortia.

The following forms of partnership could be accommodated by the Consortia operational configuration and policies:

- a) Virtual Corporation¹¹ (where pre-prototype services were contracted out by the industrial/commercial Consortia partners),
- b) Alliance (with limited coordination but composed of members driven to enhance their own relative positions)
- c) Joint Ventures (a separated legal distinct organization jointly invested in by the partners in terms of money, personnel (fixed temporary assignments), and/or other in kind investments) and
- d) Variations on Corporation Governance (autonomous divisions – e.g., a wholly owned subsidiary) or a unit contained “within” the corporation.

The specific set of organizational and operational infrastructure necessary to realize these options had not been reportedly worked out for each by the consortia.

However, all supporting partners were open to the development of each listed. Therefore, realization of this outcome remains a hope because, to date there were very few recorded

¹¹ “Virtual Corporations” as used here refers to the relatively flat new product development governance structures. They are considered to enjoy relative competitive advantages (e.g., in terms of product introduction speed and higher quality solutions effectiveness). Advantages are due to the fact that these corporations can take advantage of such underlying process technology innovations as those found in communications technology innovations (e.g., telephony’s email, video conference, and “groupware” networks) and their associated commercial cultural shifts (reduced loyalty to the firm with greater commitment to the technology). These developments support the ability to quickly assemble “r & d-to-new-product-launch” project workteams comprised of expertise which resides in various organizations.

projects underway or completed. Thus, there is insufficient data to provide further insight for these sets of issues.

As Consortia A is a relatively new start up center (i.e., it has just completed its second round of financing in Venture Capital terms), the matter of its team interactions and work styles (both formal or informal manner), mirror the entrepreneurial, management by objectives (MBO), or protocol modes. These modes are characteristic of the target product market industry norms but cannot be assessed with respect to the consortia. Whether for example, consortia 'A' is alternately a "flat" (clustered), star, or hierarchical structure interfacing with a compatible commercial partner's organizational cannot be addressed at this juncture. However, due to its formative nature and location, it is in all probability the case that the consortia structure could be managed in a way that it would provide the innovative "reservations environment". Such environments are noted as being required to accommodate innovation in all organizations.

Quasi Governmental Agency Appropriate Roles: Universities in Consortia

Interviewees felt very positive about the role the university partner played in the Consortia's development. In addition to critical advocacy at the senior university management level, mid-level support resulted in early and meaningful faculty led research, political support and some initial operating capital which were all provided by the partner university. It was the university that contributed technical faculty and organizational due diligence required to advance the idea to an initially staffed activity. A measure of venture launch "success" was highlighted when Consortia "A" was able to: (a) hire its Executive Director based on a national search, (b) become a state sponsored agency, and (c) become the recipient of a multi-year revenue multiplying federal

developmental contract. Moreover, it enjoys meaningful simulation and related software development relationships with a variety of commercial clients and/or member firms.

The kind of support found to be associated with successful efforts to launch advanced technology new ventures through university affiliated consortia where -- in the case of Consortia A's advancement " Direct capital investment". These Direct Capital Investments included leased research facilities, and Non-profit center R & D infrastructure contracts?

The federal agency service contract as well as private sector partner grant awards follow up have proven key to consortia success thus far experienced.. They were absolutely critical to current levels of success.

Contracted on-loan faculty and staff and preliminary venture/innovative technology business development or evaluation support have absolutely proven to be critical to current levels of success

Initial funding for business plan development and subsequent marshaling of the local/regional offices of the state sponsored quasi- governmental agent 's support proved vital to securing state level funding support for the center. That support in turn precipitated significant private sector firm participation. This had a domino effect and was absolutely critical to current levels of success.

The Consortia 'A' outcome further supported the idea that highly placed senior management level championship on the part of the dominant partner organizations (here in the federal Agency, the state legislature, and at the university) all key to realizing the developmental success for Consortia A. This is recognized as similar to private sector ventures.

While the most recent large contract award clearly benefited from meaningful informal private partner support among future customers, the private contribution really depended more of the clear demonstration of reduced risk associated with state governmental support.

Modifications to New Venture Support Decision

The quasi governmental state agency provided matching funds support for the initial business plan development . It subsequently provided key politically astute local area political support. It was this support that proved crucial to the success of the venture. The support allowed the Consortia venture idea made it past a second round in the funding cycle. This was primarily due to the agency's representatives ability to garner local political support necessary to bring the idea to fruition.

Several interviewees stated that the target industrial channel to be addressed by the business/venture concept was the "pre-prototype-to-commercialization" region of the technology's innovation process. The non-profit state sponsored foundation partner facilitated the acquisition of a venture with established strategically significant product market participant.

Engineering and distribution and manufacturing functional areas, generally, where the generic functional area contracts secured by Consortia A's operations. Due to the relative immature nature of the venture, there is limited information concerning the types and distribution of contract.

The Consortia venture has not developed a pipeline of products or established an R & D process to leverage the organization at this time. It is too soon in its development to assess these developments.

Appropriate R & D team staff personality profiles, selection

How or whether or not the personality of the new venture's team, or that of its champions, will generate the delegation of authority needed to realize the venture's organizational and operational objectives is not known at this point in the venture. It can be said that clear progress toward its goals of development have been registered. There are mixed assessments on the part of the interviewees concerning this aspect of the venture's characteristics.

The team assembled was viewed as very strong and effective in the advancement of the venture to its current level of success.

SUMMARY OF RESEARCH RESULTS FOR UNIT OF ANALYSIS**CONSORTIUM 'B'****CONTENTS****Introduction****Summary Organization****Background: Unit of Analysis – “B”****'B's External Environment****The Target Industry****Governmental Landscape****The University Setting****Political Realities Faces****Relevant Consortia Activities****Consortia B's Story****Overview of 'B's Development****The Need for Structure Innovation in R & D****Novel Aspects of Consortia 'B's Development****Self Reported Critical Roles Played****The Framework for Assessing 'B' as a Consortia – The Interviews Summary****Industry Dynamics Considerations****Markets—Target Markets and Consortia Venture Support****The Markets—Strategic Option-Competitor**

The Markets—Strategic Development**Organizational Structure and Process****Forms of Governance/ownership****Organizational and Process Management Rules****Quasi Governmental Agency Roles:****University Role in Consortia****Modifications to New Venture Support Decision****R & D team staff personality profiles, Selection**

Introduction — Document Purpose

This document provides an account of critical aspects in the development of Consortia “B”. For purposes of this discussion, “Consortia” will refer to the de facto organization comprised of the set of agencies that elected to allocate resources to allow the viable operational creation—or launch—of the intended organization. For this research “consortia” is a designation by participation of the following set of agencies: (a) Federal agency sponsorship, (b) a state university, (c) state agency, (d) a quasi-governmental agency with the specific objective of promoting economic development through support of technology innovation, and (e) a commercial enterprise.

Based on the filed interviews reviewed, other euphemisms for this organizational form which may have been used in reference to the consortia are: “Collaborative”, or “Partnership”. Regardless, in every case, the composition of the organizations participating and the desired favorable outcome of the thus defined units are the same: The creation of a commercially successful venture.

For purposes of discussing the specific venture which is the subject of this document, the venture will be referred to throughout as Unit of Analysis “B” or Consortia “B”.

Document Organization

This document begins with a background narrative. This is divided into a statement of (a) the goal and/or vision of the unit, and (b) the stated objective and/or approach of the unit. Next, a brief discussion of the economic, political, and technological context out of which the unit venture grew is provided. Given that

developmental context, a narrative of the consensus ‘story’ of Consortia “B” s set of events which led to its current state of commercial development is constructed.

Following this story, an integrated summary of the collective comments provided by multiple individuals through the interview process is presented. This discussion is followed by one which identifies the unique and unanticipated or atypical features which characterize the development of consortia ‘B’ either as a start-up or viable not-for-profit commercial venture.

The integrated summary is followed by a consensus listing of the critical roles played by each of the institutional partners in the consortia. Finally, technology innovation management themes, which emerged during the investigation, are discussed.

Background: Unit of Analysis – “B”

According to research documents collected in association with the conduct of the field research of “B”, the following is it’s stated goal (Vision):

“*[To develop] ...an organizational structure[that would] be realistically implemented that would meet the plan’s primary economic goals of long term economic self-sustainment, stimulation of private sector development and its educational goal of degree programs in aeronautical sciences...*”

and,

also be an organization that could be formulated in a way to also capture the potential of :
“ a market [that would] be realistically developed for the NASA facility, beyond its current customer base...”

and by accomplishing that, Consortia B would be completely in step with the *[United States of America's Presidential and Vice Presidential]* 1993 mandate to :

...move in a new direction which reaffirms a commitment to basic

science, while at the same time forging closer working partnership among industry, government, and universities. The goal is to accelerate the development of civilian technologies to ensure long-term economic growth, a government more productive and responsive to citizens' needs and world leadership in science, math, and engineering.

While contributing to the partnering federal agency's directive to:

...focus on expansion of its potential impact beyond individual companies to reach entire industry sectors. [*The partner agency*] will augment its traditional technology transfer methods with a more active and strategic approach to more effectively bridge the gap between [*the partner agency*] and U. S. Industry R & D requirements. A major emphasis will be placed on developing cooperative relationships with non-aerospace segments of the economy. Industry associations and state and local organizations will be used to reach a broad spectrum of the private sector.

The specific objectives (or mission) of 'B' are framed by the so-called driving factors behind the plan for its development. These are:

- **...Economic** – [*The partner Federal Agency is committed*] downsizing due to the significant budget cutbacks that have serious ramifications for the local economic and employment base. This plan represents a proven approach to mitigating the effects of Government downsizing. Moreover, it represents an opportunity to add a valuable asset to the region which enhances the region's attractiveness to new high tech corporations.
- **Education** – Local economic development and higher educational opportunities have been repeatedly proven in other parts of the country to be closely related with one another. This plan represents a once in a lifetime opportunity for [*the partner university*] to establish a world class aeronautical engineering program with educational research facilities that are unavailable anywhere else in the world. Such a program would have a widely based attractiveness to both partner federal agency employees, the country's best college engineering students, and firms considering relocating to southeastern [*part of the State in which the activity resides*]
- **Jobs** – An integral element of the plan is establishment of a technical training program that will produce a source of skilled technicians for industry. This program will be focused on

preparing both the new high school graduate as well as older workers displaced by *[federal]* Government downsizing for highly skilled jobs in high tech industries. “

Thus, the specific projects envisioned to be executed by "B" were those which had the effect of establishing a non-profit umbrella organization comprised of local universities and experienced private corporations. These were to assume management and maintenance of a 30' X 60' cross-section aeronautics experimental facility that was to be the core asset of the Consortia. The emerging organization was intended to address the commercially provided experimental technology advancement research and development needs of various industrial market applications. Addressing these needs was only to the extent that customers were not direct competitors to the participating partner federal agency's historical customer base.

Consortia 'B' s development was to be executed in a way that would result in the effective utilization of its transferred assets while minimizing the costs for the two primary parties *[the university and the federal agency]*. Moreover, the initial phase-¹²was envisioned to be realized during the fourth quarter of 1995. The phase-in was intended to be executed in such a manner as to return the multiple benefits articulated *[in the vision statement provided above]* to the partner federal agency, the sponsoring university, certain regional aspects of the economy of the state in which Consortia B was situated as well as to that of the entire nation for which it was a designated historical asset.

The core product envisioned was to be commercially contracted experimental aeronautical data generating test and research projects. These projects would generate

product and application development benefit to a variety of commercial customers. This would be accomplished by expanding the industrial sectors for which various aspects of aeronautical research would be supported (basic or applied) as called for by the contracted project applications

‘B’s External Environment

The general environmental context out of which Consortia “B” germinated is provided by the following consideration of: the target industry, the governmental landscape, the pertinent university setting, and a treatment of the salient political realities faced.

The Target Industry: Product-Markets Served

Review of supporting documents collected in association with the conduct of the field research performed for this unit of analysis revealed no overall size of target market nor could this be estimated. The primary basis for the assessment of product-market, judged to be “viable” for the Consortia, was the performance of a market clearing cost and “modified focus group” investigation of potential customer interest. The following are the set of key market segments identified by that research:

- Surface Transportation
- Commercial Aviation
- Architectural/Engineering
- Miscellaneous Product-Markets – in this category fell the following:

¹² or the planned 3 year period of transition from defense contract work to commercial contract work)

1. Sports equipment (tennis rackets, bicycles, sled performance, sport implement projectiles (e.g. soccer balls), sailboat sail, keel designs, race care designs, air spoilers)
2. Solar energy equipment (Windmills, Wind turbines,)
3. Wind impacted product designs (trash cans, signs, stoplights, stadium lighting fixtures, car attachments, and parachutes)

The market analyses performed were essentially “bottom up” constructions of the market opportunities. The estimates of the size of market were not explicitly performed. Nevertheless, determination of the commercial viability of the venture was arrived at based on the relative competitive advantages that the planned Consortia venture would enjoy by virtue of its advantaged cost structure. Potential customer interviews served as the basis for what market research was performed.

Historical market activity and perceived so-called “pent-up demand” for Consortia research services were used to support the 3 year market forecast employed in the initial market assessments commissioned.

Governmental Landscape

There are several pertinent governmental agencies (federal, state, local, and quasi-governmental) which constitute the regulatory, sponsored research, and/or remaining sources of funds and/or potential sources of developmental assets that collectively frame the backdrop within which the consortia studies were launched and flourished.

Federal level government agencies included: The National Aeronautical and Space Administration, Department of Defense (specifically Departments of the Navy and Air Force), US. Congressional Offices, and, the U.S. Department of Transportation.

On the state level, the economic development agencies of the state were a key characteristic of the governmental landscape. Particularly, a state government subsidized non-profit organization that facilitated state economic development through assisting in the development of viable commercial enterprises based on innovative technology.

On a local or regional level, a collection of federal agency, multi-organizational network organizations, as well as designated municipal and regional economic development organizations, constituted the primary representation of that aspect of the governmental landscape out of which Consortia B was advanced.

The University Setting

The subject university is one that has an expanding engineering curriculum. The university partner of Consortia B continues to be a terminal degree granting state subsidized institution of higher learning which includes the fields of engineering and science.

As such, specific demands were placed on the faculty that held the seeds for the development of Consortia B.

The University, the Faculty, and the Federal Agency Partner

Faculty members are expected to teach, conduct research projects and publish in a way that will secure and assure field leading scholarship.

The second expectation -- the research projects requirements, together with the existence of relevant faculty engineering expertise, resulted in a significant presence on the part of select faculty among the routine research and development operations of the

Consortia B's federal agency. This is the subject federal agency partner that defines the federal role of this unit of analysis.

Pertinent University Management Initiatives

A key aspect of the university setting that characterizes this unit of analysis – Consortia B—has to do with development of relevant university senior management initiatives which were pursued during the timeframe of this synopsis.

Specifically, what is referred to here is the fact that at the university policy level, in the years just prior to Consortia B's development, the senior leadership of the university undertook a set of goals and strategy development exercises that produced a specific set of growth and development initiatives. These goals and development initiatives thus became well articulated and promulgated throughout the colleges and schools – these being the primary divisions of the university that collectively comprise “the university”.

University Research Organization

Although the initiating university partner entrepreneur or champion in consortia 'B' s development may be viewed as having resided with the engineering dean's office, after that partner university's president decided in support of it, the primary administrative arm for development of Consortia B was an independent research foundation . The foundation funded a distinct organizational entity, one which became the champion's organizational umbrella under which all subsequent university advocacy was centered.

Initial funding was provided through the engineering academic dean's offices. Discretionary funds made available there were allocated in a way that allowed college

faculty to serve in the initial functional staff rolls required for transition of the asset in partnership with the participating federal agency. This early stage departmental level support would prove critical in garnering university support for the venture.

While it became the case that the subsequent venture's champion would continue to be attached to the aeronautics department of the university's engineering college, significant financial support for the advancement of the venture also came from University's independent research foundation.

The university president's office in question had economic development related venture support discretionary funds which it could greatly influence. The university president was the only member of the research foundation's governing board who is from the university -- a board primarily comprised of prominent regional businesspersons.

Through the mechanism of the routine operations of the independent academic research funding arm of the university's operations, these funds were made available. This vehicle for venture support was evoked in the course of the consortia B's development and subsequent commercial operations launch.

To receive a matched funding award from a quasi-state level governmental economic development agency, specific funds were required to be advanced by the innovating organization itself. These requisite funds were provided by the university through this university-university affiliated-but-independent-agency mechanism. This university investment vehicle was exercised as well as to provide major amounts of the bridge funding necessary to pursue the venture's formative development.

For the venture in question, no set formal or official process had been established whereby official university support of promising economic development partnerships

could be created. Nevertheless, as of 1995, several such activities had been evaluated. A few of those are currently being provided for through this method of resource allocation.

To the extent that a typical pattern of securing support has been identified, it adheres to the following sequence:

- (a) Faculty members champion a technology research based advanced application venture concept until it reaches a level of refinement that generates dean level interest and backing. Typically, resources in kind are invested at this point. That is, no direct funds are allocated for the project. However, faculty time is approved along with suitable facility access to take the concept to a level that suggests a feasibility analysis is warranted.
- (b) At this point, the university may lend its support in a way that it assists in securing more comprehensive university attached business assessment resources – or in locating sufficient state and other third party resources to finance such an assessment.
- (c) With continued promise being demonstrated at this point, senior management at the university will attempt to secure escalating levels of economic development support in the form of grants or critical private sector financing documentation to finance such an assessment (e.g., to finance the performance of a commercially viable business plan).
- (d) With enough justification, the president's level may actually allocate a fixed amount of money greater than \$250,000 to seed the launch of a consortia.

Notwithstanding this typical pattern, a key ingredient is the dedicated sacrifice of the principal investigator to continue to expend significant personal resources to move the idea from idea to facility to stand alone venture.

Thus, “faculty as champion” is typical and perhaps critical in early development of the venture.

In the case of this the Consortia B venture, the champion was identified through the internal (to the engineering college) advocacy-as-champion process.

Political Realities Faces

It is clear that the decision process and structure of governmental agencies are responsive to political control. For the purpose of this summary, a treatment of this governmental superstructure will be foregone in favor of a mention only of the aspects that had some clear – and reported – bearing on the consortia which is the subject of investigation.

In the case of Consortia “B”, it was acknowledged that a shift in the political interpretation of the proper role of the federal agency, and it’s ability to tolerate a phase out of the conventional transferred asset’s customer base, significantly impacted the consortia's prospects for reaching it goals and objectives.

Relevant Consortia Activities

University, industry, and federal agency consortia have been in increasing operation since 1984 – when federal legislation -- in effect – permitted increased use. As a result, a significant experience base has developed regarding their construction, management and development. A basis for “best practices“ has thus been established through experience over time.

In this case of Consortia B, it is clear that a model for formulating the specific services fee structure for the venture was patterned after a successful and established service provider competitors. While similar university industry test facility arrangements have been studied in the course of the research for the subject Consortia, no operational model has been adopted sufficiently to serve as guide to the emerging ventures operations.

Consortia B's Story

This section provides an overview of the sequence of events that chronicle venture B's development. The following sequence is based on discussions held with each of the key representatives of all of the participating agencies which collectively comprise consortia B.

The themes discussed are those suggested by the historical sequence of events associated with the venture's development, as well as any additional themes that were suggested as key and perhaps unique.

Overview of 'B's Development

Due to a shift in political will, as well as a confluence of public policy initiatives aimed at improving the subject federal government agencies effectiveness and budgetary efficiency, several budget reduction and review exercises concerning existing aeronautical test assets were evaluated. These evaluations focused on the aeronautical test assets relative anticipated contribution to fulfilling agency missions, and their potential role in realizing budgetary policy objectives. Of those found less than critical and of high potential to lessen the budgetary pressures, a review was performed of their individual or bundled privatization potential.

Senior management at the federal agency had identified what was to become Consortia B's main capital asset as one of several facilities that could be of potential educational value to the local university. The asset was viewed as one that, if properly adopted, would aid both in its the federal agency needs for community relations as well as assisting it in addressing its future staffing needs. Staffing needs might be ameliorated by potentially increasing the locally available resource pool with technical skills needed for the federal agency future.

Social Networks Are A Key

Leadership at the federal partner agency's laboratory facilities -- through a set of rather social and informal discussions with the university's senior engineering college management, explored the degree of interest that the college might have for acquiring the federal agency research assets. These discussions all occurred in the winter 1995 timeframe.

The following is the sequence of events that collectively describe Consortia B's story of development:

- 1) Changes in political orientation at the national level as well as budget constraints. These resulted in a Federal legislative and Administrative imposed requirement to have all field operations evaluated to determine which aspects of ongoing operations could be shed through privatization in the 1992- 1993 timeframe.
- 2) Internal local federal aerospace research facility senior management, in response to that national administrative charge, underwent a process whereby candidate federal assets under its jurisdiction were compiled, prioritized, and reviewed. Subsequent to this management activity, the major asset that would be the

defining asset for Consortia B was informally announced as being viewed as suitable for being closed. Thus, the asset was made available for privatization. This situation developed in summer 1994.

- 3) Informal conversations (in the 1994-1995 timeframe) between the federal research center's director and the dean of the engineering college of the local university, resulted in the mutually favorably viewed idea of the then dean's university taking over the facility. With the envisioned transfer, the federal research center would also realize its objective of so-called "privatizing" what was essentially a "mothballed" facility. A major appeal of this idea on the part of the sponsoring federal research facility senior management was that two long term objectives would be accomplished:

- a) Through its support of the transfer, the regional federal research center would extend its assistance in the development of regional aeronautical research personnel through close collaboration with local university educational programs and faculty; and,
- b) Successful asset transference would also implement the regional federal research center's compliance with its national-level federal directive of reducing budgets through shedding relatively non-essential assets that were housed on the campus of two federal facilities (e.g., a military research facility and a tenant aerospace facility).

Generating a Proposal for Consortia B

During this spring 1995 timeframe, the university senior management demonstrated its support on Consortia B's development. This support involved

interceding with an independent research organization affiliated with the university in a way that gave rise to the approval of sufficient “line-of-resources funds” -- on the part of the independent university research organization -- to allow the exploration of the requirements and desirability to take the federal agency’s transferred facility private.

Role Played by a Partnership in University and State-sponsored Technology Innovation-based Economic Development Agency

It was also the case that in the spring 1995 timeframe, the quasi-governmental agency matched funds sufficiently enough to provide support for any requisite market and business model evaluation and analysis. These were business model evaluation and analyses of promising Consortia B’s markets as well as any subsequent creation of a commercial venture development. In this way, the quasi governmental agency early on functioned in partnership with the senior management of what was an emerging Consortia B.

These funds were advocated by the regional offices of the quasi-governmental agency and successfully secured from its headquarter offices. The basis of the advocacy was due to its promise to fulfill an emerging shift in the state wide organization’s objectives toward realizing economic goals in competitiveness, job creation and new businesses. These objects were to be achieved, in part, through investments in commercially relevant technology research and development related project support.

There was an official facility shutdown ceremony held in 1995. The university support and set of informal conversations with the federal agency management served to support the Consortia’s entrepreneur – i.e., the dean of the engineering college – to work

on and subsequently submit a proposal at the time of the closing ceremony. The proposal submitted was to effect the transfer of the asset to the university for its academic programs and associated commercial services development from the federal agency.

The Seeds of Future Complications in Development

Meanwhile, the federal agent was pursuing a parallel tack of exploring various candidate approaches to off loading the asset and promoting its privatization. It was entertaining various private sector grounded approaches to reaching its “privatization” objective. One such approach considered involved expanding the role of the existing primary private sector technical operating service provider.

The Non University Partners Invest

In another parallel activity, the university senior management also began discussions with the same private sector technical operating service provider. These discussions included (a) a request for corroborative contributions to the commercial market, (b) envisioned commercialized facility’s operations and capital improvement specifications, as well as (c) provision of key support personnel referrals. These activities overlapped in time -- running from late 1994, early 1995 up until the final official transference of the asset to the university in August 1997.

Pursuant to the private sector partner fulfilling its role regarding providing commercial venture evaluations support -- as well as that of advancing operational insights, there was a period of critical demand for use of the facility. This demand was for the near immediate activation of the facility’s historical military aircraft technology development support services on the part of a key branch of the military. This military branch was the one that technically owns the land upon which the facility sits.

Thus, in late 1995-1996, an opportunity arose to provide to a paying customer a more or less traditional set of research services. These services would be provided under the auspices of the Consortia's new management structure. This development was due in large part to the efforts of the private sector partner.

An interim (i.e., a three month) agreement that would allow the performance of this contract was entered into at the strong request of the military customer in the summer-fall 1995 timeframe. It primarily allowed the preparation of the facility to address the military testing needs. Through a sequence of such temporary agreement continuations, this process also supported the subsequent execution of the service contract.

Several policy level changes heavily impacted the subsequent development of the Consortia. For one thing, in the fall of 1995, senior management at the federal partner agency changed, replacing an advocate of the transfer with a more cautious – perhaps resistant – federal research center director. The privatization plan (published in the fall of 1995) depended heavily on a 3 year phase down of services contracts with the traditional market segment customers and a gradual development of a new commercial customer basis (e.g., in the automotive, architectural, or sports implements sectors) identified by prior studies for the consortia.

Customer Driven Development of Consortia B

In the winter of 1996 – during the time of the, by all accounts, successful military customer services provision -- serious questions arose regarding the appropriateness of university faculty managed “commercial” operation of the facility. These questions emerged from the business evaluation elements associated with the university's

independent research organization. Given the results of the market and plan assessment studies of the commercial prospects, as well as Consortia management exposure, significant unresolved questions arose as well. These questions emerged from the quasi-governmental state agency's industry analysts. Executives charged with the task of assuring commercial sector strategic asset development for the potentially impacted elements state's business community were not convinced of the university managed plans commercial viability.

Functioning with a complement of 3 to 4 part time faculty and graduate students supported by the private sector partner's technical services capabilities, the Consortia began a process of converting the facility to a commercial facility significantly staffed by university personnel. This development was done in a way that further supported the assessment of capital requirements for conversion. A series of conversations were begun with potential major industrial sector strategic customers (e.g, a few of the major auto manufacturers with significant market share worldwide and nationally).

Interim agreements had allowed the Consortia to develop a revenue stream with traditional facility customers. With the investment of private sector partners, so-called "Internal Research and Development (IRAD) funds, a set of commercial vehicle tests were performed with equal customer acclaim. Moreover, other local support services providers (e.g., a specialty machinist shop vendor in the case of racecar services development) were developed and rendered enthusiastic.

Major Challenges to Consortia B's Commercial Development

In the summer of 1996, the champion suffered a severe health challenge, resulting in a further change of the engineering college and senior Consortia management

structure.

The change in federal agency senior management's conditions and evaluation criteria for transfer agreement approval, together with the absence of a permanent agreement, resulted in a suspension of Consortia B's developments. This occurred while -- in effect "due diligence" associated matters of risk of injury and of the sponsoring federal agency's exposure to environmental damage -- were performed and solutions negotiated. These ultimately were centered around the matter of securing adequate insurance as a prerequisite to receiving the official asset transference.

With the aid of dedicated legal staff on the part of the university, these issues were addressed sufficiently enough to result in an agreement to follow through on the asset transfer. The transfer was consummated in the summer of 1997.

However, potential damage was done to the commercial prospects of the Consortia. There was an immediate marketing warrant. That is, the university facility was banded from supplying services to ANY traditional federal agency clients-- period. Thus, the initial smooth transition from defense contracts to commercial services contract-based research was accommodated and rendered implausible.

Coincident with this development was final complete billing to the Consortia financial arm (e.g., essentially the private partner's services which were provided in the course of supporting the set of military successful client tests performed). These expense charges had been effectively born by the Consortia's primary private sector partner.

Consortia B Faces a Commercial Business Assessment Challenge

Incurring financial obligations which increasing raised alarms, the university

research organization and the state quasi-governmental agency – through the commission of commercial feasibility study efforts in the late fall of 1996, further attempted to clarify – for university senior management – a viable business model for Consortia B.

On the university programs development front, as of fall of 1997, a new master's program concentration in the aeronautics department in experimental aeronautics and methods was developed and world class faculty and student populations assembled.

Current efforts are focused on finalizing a viable commercial customer business model , market development planning, as well as securing a redefinition of the center as a designated commercial aerospace and aeronautic research and development infrastructure center for transportation as well as university research.

The Need for Structure Innovation in R & D

The matter of whether Consortia B is properly structured to secure a viable commercial presence has not been addressed directly thus far in its development.

From the experience garnered in conjunction with tests for race car clients, it is clear that the role and mode of services provision to them is dramatically different from that experienced with the historical military systems, commercial aviation systems development, and scientific experimentation communities. However, the Consortia management has yet to effect organizational – i.e., those of structure, and procedure – modifications which return commercial viability or address the issue of securing competitive advantage.

Nevertheless, from these experiences, as well as a result of various conversations held with the traditional and potentially major automotive client base, clear developments in this regard will have to be advanced if commercial prospects are to move from goal to

reality. For example, it was noted by all consortia partners that the security requirements imposed by commercial clients are categorically different and severe relative to defense systems client base.

Moreover, the demand for infrastructure development to secure competitiveness in these non-defense product market applications areas imposes not only a major capital investment requirement (estimates of \$20 million are not uncommon) but clear business cultural challenges as well.

Novel Aspects of Consortia 'B's Development

Several aspects of consortia B's development appear novel. For one, the facility enjoys what appears to be an "inherent advantage". This advantage is one that is based on the history of physics of the situation it addresses.

Namely, this facility is referred to as the "reference" facility in its competing traditional product-market of subsonic aeronautical testing facilities. A critical aspect of Consortia B is that it offers an asset whose physical location, technical ownership, and government organizational layering, impose perhaps a commercial venture killing restriction. Thus, the commercial potential may be restricted. The facility is not able to be moved from where it is – within the confines of a Military base.

The associated security issues impose an investment challenge in that all subsequent potential private sector investments must somehow overcome the fact that it is an asset which cannot be attached or collateralized. Moreover, it's location imposes limitations on its client base. For example, foreign governments or multinational clients face the prospect of incurring staff access and actual property transport problems due to National governmental security restrictions.

The fact that the facility rests on an active fully operational military facility as a tenant is a unique complication relative to the other Consortia concepts explored in the course of this research.

The other major unique developmental issue is the unknown – an potentially horrendous – environmental hazards risks and financial liability exposure associated with the aging facility itself as well as the immediate grounds around which it rests.

Self Reported Critical Roles Played

There is almost uniform adherence to the view that perhaps THE most critical role played was that done by the recognized champion – the former dean of the engineering. It was through that dean's set of personal contacts, professional history, and persistence, that the consortia moved from an “idea” to it’s current state of organizational maturation and commercial gestation.

The enthusiastic initial support on the part of senior university management was recognized as key to the consortia. This management intervened for provision of the “pre-organizational” prototype investments. These investments were required to advance the consortia idea from concept to venture advocacy unit and eventually into an operating organizational enterprise.

The participation of the historical private sector partner seems to have been crucial at several junctures in Consortia B’s development. The first commercial customer came through that vendor’s networks. Meaningful planning and design inputs were received through this avenue as well.

Clearly, the initiating role of the federal legislative statute, and the associated congressional and national governmental executive branch initiatives precipitated

fundamental rethinking of assets and how they should be managed. This resulted in the opportunity to acquire the asset being presented to the university.

The Framework for Assessing 'B' as a Consortia – The Interviews Summary

This section synthesizes results of interviews with representatives of each of the four sector partners – (1) university, (2) federal agency, (3) state sponsored agency, and (4) key private sector enterprise participant. The results are organized to reflect a synthesis from interviews, documentation collected in association with the interview, and other documentation concerning the venture.

The discussion of the summarized results that follows is organized around response to four key areas explored for during this effort. These areas are listed as the headings of the various sections and include: (1) Industry Dynamics Considerations in Consortia Venture support, (2) Target Markets and Consortia Venture Support, (3) Organizational Structure and Process, and (4) Modifications to New Venture Support Decision.

Industry Dynamics Considerations

The following are the answers inferred or explicitly provided by the collective responses of the venture partners associated with Consortia 'B'.

1. The forms of support provided by the partners in Consortia B were not motivated to leverage underlying maturity of the industry patterns in the industrial sector (information technology) most closely aligned with the venture. The venture was not primarily concerned with patterns which could be conceived in terms of the trends in technology and business systems innovation unfolding in the industrial sectors that would be targeted by the

venture. In addition, considerations of these industrial and technological dynamics were neither evaluated nor considered in garnering partner support for Consortia B. To the extent industry maturity and patterns might have been considered, such considerations were not explicitly evaluated or used to further galvanize partner support. However, some effort is being currently expended to do just that.

2. Some venture assessment frameworks have been applied to development of the consortia. These included: (1) Internal (to the university senior management) venture support for feasibility assessment, and (2) various private sector investor explorations which were conducted by state sponsored agency industry sector planning and asset development executives. These efforts supported the application of venture assessment frameworks applied to secure the asset and decide to proceed with university ownership of the technology research and development services operational ownership. The effort to characterize the Consortia concept in a way that made clear how it effectively would harness the underlying business and technology cycles attached to each of the targeted potential industrial sectors, has just recently gotten underway.

Consideration of the technology cycles of the target industry sectors simply has not been applied. Consortia "B" in its current form, has only been in operational existence for less than a year. With the exception of the initial military systems tests, and a few commercial racecar tests, very little revenue has been generated to date.

Major effort is being currently directed at formulating a viable business model, its associated marketing development plan, and organizational structure for realistic commercial success.

The traditional position occupied as regards the phases of research still apply in this regard. Namely, the facility is positioned to be a basic research facility with some attempt to properly upgrade the infrastructure of the facility. This will permit the consortia to viably address competitively advantaged commercial clients. It is too soon to tell or verify whether or not Consortia B sponsored R & D succeed (or at least satisfy clients) when their focus is on well suited products or services which are in concert with the fundamental phases of the technologies .

Collaboration across university and corporate cultures, a clear goal of the venture, has not been experienced or worked out. That kind of collaboration, although a consistently held “vision” and objective of the participating Federal agency senior management, remains a distant and as of yet unrealized objective. Nonetheless, preliminary conversations and trial contract research services provided to the race car representatives – for example – have already shown this objective to be perhaps the most important aspect of the Consortia’s product development to address.

Markets—Target Markets and Consortia Venture Support

The organizational and managerial composition of Consortia ‘B’ is arranged as a traditional basic research structure. This structure that was adopted was intended to address both the traditional defense systems developers as well as the aerospace systems development product markets it served.

As such, the consortia has extended its primary position to support the conditions which characterize a well established, exceedingly competitive – and cyclical – as well as highly segmented commercial auto and truck product development market. These product market segments, while stable in the past, are undergoing vast reconfigurations. These reconfigurations are due both to dramatically shifting business models shown to enjoy competitive advantages and the evolving market dynamics in the markets served by the consortia. The truly global commercial automobile and truck manufacture product development organization is illustrative of these shifts.

For example, in the case of both subsonic personal air transport, and that of automotive and truck industries, the issue of defining the proper organization structure which must be adopted by the consortia to effectively relate to these entities is not being explicitly addressed. At issue here is the determination of which specific structure best supports a view of the product-markets¹³ in which the major product-markets are being: (1) actively discovered by the various global competitors outsourcing aggressively locally, and (2) the most effective ways to compete – given organizationally as well as geographically dispersed product development partners – in a way which will maximize system wide wealth generation.

The consortia “B” s products are “by definition” primarily testing service provision contracts. The planning documents for the consortia development focused on the relative price/cost/performance price points associated historically with each of these.

¹³ Here a “product-market” is conceived to be the rather unique segment of a market defined by a distinct and meaningful set of uses to which a product is put. It is a segmentation that lends itself to providers formulating distinct strategies for effecting the products, price, position, promotion and place which affects the buyers’ purchase decisions

The initial business plan was based on these planning documents. The venture is an initial foyer into the commercial market place. Thus, the primary focus is on the development of a set of strategic commercial allies for which the facility's infrastructure can be modified to return leading edge remotely distributed and managed tests and results. Therefore, the matter of which generation in services innovation captured by Consortia B's business model is evolving.

Regardless, it was NOT a consideration in the "go no go" decision that was associated with the advancement of Consortia B partnership to its current point. The entrepreneurs, in the form of the Consortia partner organizations championing the new product, were all of the opinion that their proposed product or business model was uniquely the first of its kind -- and thus innovative. Although other university-- national research laboratory collaboration examples were identified in the earlier business plan development efforts, it was suggested by at least one of the interviewees, that Consortia B's development served as a model for that federal agency's asset privatization policy.

With the exception of the specific sector under consideration, it is nonetheless true that with regard to the subject of university R & D consortia, that more advanced and well thought out example Consortia could be found that existed elsewhere in the state. They could also have served to provide models for senior management and technical project team building. It should be noted that the quasi-governmental agency in this case, was actively attempting to facilitate cross- university faculty team formation in a way that would provide comparative advantages to all product-markets addressed. Particular focus was being applied to those that would prove useful for so-called "smart highways

truck and car development” projects and “experimental high speed rail service” developments currently underway throughout the state.

The Consortia B specific product-market organizational models developed were envisioned to provide a basis upon which – in the future – the venture could fashion its operations and economic models. Regardless of this ideal, considerations WERE NOT used in any way during Consortia B’s venture “go ahead” decision process.

The Markets—Strategic Option-Competitor

It was pointed out that very few – if any -- consortia competitors have a substitute service/product. Potential substitute services/products were only found in one or two situations world wide.

The venture support issues of how to identify these competitors generated the basis for this consideration. It was noted that only a few such centers existed worldwide and none regionally. Thus, consideration of this matter was not rigorously pursued. Nonetheless, this sense of the competitive landscape served to justify the sponsorship of the Consortia B by the university and federal levels.

The primary private sector partner was more interested in two objectives. First, being the so-called reference facility, the facility enjoyed a strategic advantage that could not be circumnavigated. Secondly, business was being left “on the table developing”. Operating facilities in Germany, as well as at other sights throughout the nation, the vendor was acutely aware and convinced of the commercial potential for the asset.

The Markets—Strategic Development

In this case, the Consortia partners had a rather inconsistent perspective of product distribution. On one end of the spectrum was the perspective of service product

distribution to be via bellwether market provision on the part of the highly fragmented race car market segment. At the other end was the perspective of a clearly defined and innovative business model which would be arrived at through close developmental relationships. These relationships would be with a participating strategic customer or ally—in the cases of the architectural, or automotive and truck product-market development alliances.

On a state infrastructure level, the facility's role was viewed differently still. Here the core vision was for the facility to serve as shared asset for various advanced transportation technology basic and applied research initiatives. These initiatives would be based on standards setting operations, becoming a well spring (or incubator) for corporate and technical talent development. Regardless, at a minimum it could be viewed as providing a mechanism for corporate citizen attraction.

This would suggest that the partners viewed as proper a strategic vision of the consortia as: *being organized in a way that would support a product-market orientation in which technology for research and development testing services of products would accommodate any project associated user or industry standardized applications.*

The consensus orientation left as “unconsidered”, and necessary, further strategic focus on the matter of product's distribution issues in the consortia's design or operations.

Although it was viewed as key in some of the interviewed opinions, it is clear that such product distribution concerns did not weigh in the positive decision to support of the Consortia's launch.

Organizational Structure and Process

The assumed appropriate culture for the Consortia Venture – among its partners organizations (with the exception of the private sector, the federal agent and the center champion) seemed to be absolutely entrepreneurial.

This culture was punctuated with the desire to establishing limited strategic alliance based project teams. Thus, organizationally, Consortia “B” was receptive the kind of collaboration of strategic alliance-based project teams.

Regardless of this uncertainty, it was clear that effectively forming traditional R & D structures, which depended upon a given industry’s standard collaborative or subcontracted research and development practice, WAS NOT an explicit aspect of the vision of neither the champion nor any of the remaining partners.

Organizational Structures – Technology Innovation Management and R & D Strategy Implementation

The market and strategic development plans for commercial sector support by Consortia ‘B’ are still in their formative stages.

The primary objective remains to support the commercially available modification of advanced commercially developmental products. This support involves full scale performance though testing.

Defense service contracts are specifically forbidden as a condition of the transfer. Thus, the current organizational structure accommodates novel non-defense public sector applications. The focus is to establish appropriate channels so that Consortia “B” would eventually become a “wellspring” commercial strategic asset for various commercial new product development organizations.

Center project team efforts were NOT formulated with a mind toward assuring that the vital business culture of the target product markets were addressed through its operations or strategic development. Cultural compatibility with target product-markets did not serve as structural design constraints to be accommodated in the center's design.

Forms of Governance/Ownership

The Consortia organizational structure was not defined at the point a decision was made to proceed. Thus, it is not clear to what extent the structure could be made to facilitate collaboration with commercial partners, or at least open to developing an appreciation of how to facilitate collaboration.

Senior management, did not appear to have given much thought to this issue. The implicit model in apparent use was that of "business as usual" but targeted to commercial markets. These markets were ones which none on the staff had any measurable experience in successfully addressing.

Moreover, comments made regarding collaboration suggests that any kind of team collaboration structure required by customers, might well represent a challenge to the Consortia management team. This was particularly suggested if collaboration entailed other engineering universities located throughout the state.

In this regard, the center is very much in the formative stages of its development. Therefore, regarding its organization as well as any other team structure it is the stated policy, that it will be accommodated and supported by the center facilities, senior management, and the board of directors.

With respect to the matter of securing Consortia venture development resources from its partners, it can be said that no explicit consideration was given as to whether

consortia 'B's projects needed to be matched up well with the organization and procedural norms which characterize the product-markets targeted. This issue emerged as a result of several of the interviews held as part of the research.

A demand is emerging for better defining the business case for the Consortia. This demand is emerging, at the university research organization, the state quasi-governmental agency, and various other private investor quarters which focused on the Consortia's viability is emerging. Given this development, a focus on "fit" of organizational and procedural norms cannot be discounted just because it was not in evidence during the periods and phases of development THUS far considered.

Organizational and Process Management Rules

None of the partners associated with support of Consortia "B" ,or its venture development team, focused on adequacy of senior management's concern for supporting technology innovation in relation to creation of an "innovating" corporate culture.

Focus on a creating a so-called "learning organization" occurred at the State level. However, this was not an explicit concern of the consortia or regional level partners.

The business model of the consortia supported the notion that entrepreneurial teams and environments benefit from being isolated from the culture of the firm or firms that produce and distribute existing products. This was achieved primarily by providing an off-sight test results collaborative work site for the project team members.

There was a vision that competitive advantages could also be secured based on the option to have results accessed remotely – given suitable advanced infrastructure installation.

The matter of promoting effective innovation to support the creation of inter-organizational self-directed teams was NOT an explicit consideration for the consortia.

The following forms of partnership could be accommodated by the Consortia operational configuration and policies:

- a) Virtual Corporation¹⁴ (where pre-prototype services were contracted out by the industrial/commercial Consortia partners),
- b) Alliance (with limited coordination but composed of members driven to enhance their own relative positions)
- c) Joint Ventures (a separated legal distinct organization jointly invested in by the partners in terms of money, personnel (fixed temporary assignments), and/or other in kind investments) and
- d) Variations on Corporation Governance (autonomous divisions – e.g., a wholly owned subsidiary) or a unit contained “within” the corporation.

The specific set of organizational and operational infrastructure necessary to realize these options had not been reportedly worked out for each by the consortia.

Moreover, such considerations were not articulated save at various factions of the state quasi-governmental agency –e.g., at the regional, industrial sector and partner organizational level.

¹⁴ “Virtual Corporations” as used here refers to the relatively flat new product development governance structures. They are considered to enjoy relative competitive advantages (e.g., in terms of product introduction speed and higher quality solutions effectiveness). Advantages are due to the fact that these corporations can take advantage of such underlying process technology innovations as those found in communications technology innovations (e.g., telephony’s email, video conference, and “groupware” networks) and their associated commercial cultural shifts (reduced loyalty to the firm with greater commitment to the technology). These developments support the ability to quickly assemble “r & d-to-new-product-launch” project workteams comprised of expertise which resides in various organizations.

Therefore, realization of this outcome remains a hope because, to date, there were very few recorded projects underway or completed. Thus, there is insufficient data to provide further insight for these sets of issues.

As Consortia B is a relatively new start up center (i.e., it has just completed its second round of financing in Venture Capital terms), the matter of its team interactions and work styles (both formal and informal manners), mirror the entrepreneurial , management by objectives (MBO), or protocol modes. These modes are characteristic of the target product market industry norms but cannot be assessed with respect to the consortia. Whether for example, consortia 'B' is alternately a "flat" (clustered), star, or hierarchical structure interfacing with a compatible commercial partner's organizational cannot be addressed at this juncture.

Nevertheless, due to its formative nature and location, it is in all probability the case that the consortia structure could be managed in a way that it would provide the innovative "reservations environment". Such environments are noted as being required to accommodate innovation in all organizations.

Quasi Governmental Agency Roles:

The quasi governmental state agency provided matching funds support for the initial business plan development.

It subsequently provided incentives for inter organizational collaboration that might well impose an adjustment to the culture that will allow for its enhanced future viability.

The role of its regional and university associated partner organizations in establishing the criteria for venture evaluation cannot be overstated. It was this

consideration that has precipitated a battery of considerations that could provide future mission and goal attainment.

As of this point, however, these considerations have not impeded the progression of Consortia B's development in a meaningful way.

University Role in Consortia

Interviewees felt very positive about the role the university partner played in the Consortia's development.

In addition to critical advocacy at the senior university management level, dean's level support resulted in early and meaningful faculty led research, political support, and some initial operating capital which were all provided by the partner university.

It was the university, through its sanctioned support of the independent research organization, that contributed technical faculty and the organizational due diligence required to advance the idea to an initially staffed activity.

The kind of support found to be associated with successful efforts to launch advanced technology new ventures through university affiliated consortia where -- in the case of Consortia B's advancement " Direct capital investment". These Direct Capital Investments included a major line of resource (or budget item like) account coverage for the facility's interim operations. In addition to these, the quasi governmental agency in partnership with the university's independent research organization, provided the necessary resources to operate as well as have performed the business plan development.

Modifications to New Venture Support Decision

The Consortia venture has not developed a pipeline of products or established an R & D process to leverage the organization at this time. It is too soon in its development to assess these developments.

Appropriate R & D team staff personality profiles, selection

How, or whether or not the personality of the new venture's team, or that of its champions, will generate the delegation of authority needed to realize the venture's organizational and operational objectives is not known at this point in the venture.

There has been some reservation expressed among interviewee's regarding the appropriateness of the current team's composition and orientation for realizing the commercial objectives laid out for Consortia B.

As regards the educational objectives, similar reservations have been expressed. It can be said that clear progress toward its goals of development have been registered. Nonetheless, there are clearly mixed assessments on the part of the interviewees concerning this aspect of the ventures characteristics.

The team assembled was viewed as the weak link in the advancement of the venture to its desired level of commercial success. As has been stated, this is also an area where the stated educational goals may be placed at risk as well. That outcome might develop as a result of the Consortia management's team evident bias toward (turf) defense against perceived extra university or commercial partner threats.

SUMMARY OF RESEARCH RESULTS FOR UNIT OF ANALYSIS**CONSORTIUM 'C'****CONTENTS****Introduction****Summary Organization****Background: Unit of Analysis – “C”****‘C’ s External Environment****The Target Industry****Governmental Landscape****The University Setting****Political Realities Faces****Relevant Consortia Activities****Consortium C's Story****Overview of 'C's Development****The Need for Structure Innovation in R & D****Novel Aspects of Consortia 'C's Development****Self Reported Critical Roles Played****The Framework for Assessing 'C' as a Consortia – The Interviews Summary****Industry Dynamics Considerations****Markets—Target Markets and Consortia Venture Support****The Markets—Strategic Option-Competitor**

The Markets—Strategic Development

Organizational Structure and Process

Forms of Governance/ownership

Organizational and Process Management Rules

Quasi Governmental Agency Roles:

University Role in Consortia

Modifications to New Venture Support Decision

R & D team staff personality profiles, Selection

Introduction

This document provides an account of critical aspects in the development of consortium “C”. This review process provides feedback to ensure the accuracy of the preliminary results. And interpretations drawn from interview and other research data.

For purposes of this discussion, “Consortia” will refer to the de facto organization comprised of the set of agencies that elected to allocate resources to allow the viable operational creation—or launch—of the intended organization. For this research “consortia” is a designation by participation of the following set of agencies: (a) Federal agency sponsorship, (b) a state university, (c) state agency, (d) a quasi-governmental agency with the specific objective of promoting economic development through support of technology innovation, and (e) a commercial enterprise.

Based on the filed interviews reviewed, other euphemisms for this organizational form which may have been used in reference to the consortia are: “Collaborative”, or “Partnership”. Regardless, in every case, the composition of the organizations participating and the desired favorable outcome of the thus defined units are the same: The creation of commercially successful venture.

For purpose of discussing the specific venture that is the subject of this document, it as a unit of analysis will be referred to throughout as Unit of analysis “C”

Document Organization

This document begins with a background narrative. This is divided into a statement of (a) the goal and/or vision of the unit, and (b) the stated objective and/or approach of the unit. Next, a brief discussion of the economic, political, and

technological context out of which the unit venture grew is provided. Given that developmental context, a narrative of consensus ‘story’ of Consortia “C” s set of events which led to its current state of commercial development is constructed.

Following this story, an integrated summary of the collective comments provided by multiple individuals through the interview process is presented. This discussion is followed by one which identifies the unique and unanticipated or atypical features which characterize the development of consortia ‘C’ either as a start-up or viable not-for-profit commercial venture.

The integrated summary is followed by a consensus listing of the critical roles played by each of the institutional partners in the consortia. Finally, technology innovation management themes, which emerged during the investigation, are discussed.

Background: Unit of Analysis – “C”

According to research documents associated with “C”, the following is it’s stated goal (Vision)

...[*The University*] in partnership with the state quasi governmental economic development agency, the partner federal agency, and the active cooperation of the selected representative private sector participants of the [*regional*] maritime industry— [*wants to go about the business of*] promoting area economic development through the creation of a “seaport center of excellence. ...

The concept [*that was to advanced was one*] is whereby four distinct areas of operation are to be evaluated. The four key areas we regard as having potential impact are:

Real Estate Development

Training

Research

Communication and Coordination

The general idea is that by developing a focus on any one of these areas, critical synergies may accrue. That is, through effective [area] business and university partnerships we may secure strategic advantages for the region's businesses that might enhance out seaport's long term commercial viability and competitive advantages. ...”

This vision was grounded in the idea that an existing research center would serve as an organizational anchor upon which the commercial venture would build. That center historically supported by the State Council of Higher Education [for the state in question]. That 1991 established center's Goals statement is :

The State Council [*of the subject state*] establishes the Commonwealth Centers of Excellence to recognize existing eminence in various disciplines. The Commonwealth Center for Coastal Physical Oceanography as [*the subject university*] was established in 1991 to promote research on the physical oceanography of the coastal ocean and related oceanographic processes. The coastal ocean is the focus of increasing research for reasons relating to both short-term anthropogenic impacts and longer term global change. There is a variety of fundamental questions about coastal ocean physics that need to be answered if human impact and global change are to be assessed properly.

Research Goals

The Center supports and facilitates innovative research on the physical oceanography of the coastal ocean and other coastal related process through funding which allows the faculty, visitors, students, consultants and research associates to focus there efforts on specific research areas. The Center also participates in cost sharing activities with federal and [*state*] agencies on research of common interest and conducts outreach activities through the local public television station, museums and schools systems.

Research supported by the Center includes: particle trajectory analysis, large scale alongshore flow, modeling cross-shelf transport mechanisms, effects of buoyancy forcing and description of coastal ocean systems. The Center is particularly interested in the coupling of realistic physical models to ecosystem models in new, innovative ways.

Consortium 'C's External Environment

The general environmental context out of which Consortia "C" germinated is provided by the following consideration of: the target industry, the governmental landscape, the pertinent university setting, and a treatment of the salient political realities faced.

The Target Industry: Product-Markets Served

While the supporting documents collected in association with the conduct of the field research performed for this unit of analysis, no overall size of target market was developed or could be estimated. The primary basis for the assessment of product-market judged as "viability" was the performance of a market clearing cost and "modified focus group" based investigation of potential customer interest as suggested through point of contact conversations.

Nonetheless one source indicated that the target market could be characterized in the following Universal market sizing estimates:

- Ranked #11 out of 205 United States seaports, with greater than \$10 Billion of import tonnage processed in 1995, the subject seaport in annual commercial import tonnage received – when the total US was > \$391 Billion;
- Ranked 5 out of 214 United States seaports, with greater than \$13 Billion of import tonnage processed in 1995 in annual commercial export tonnage ship in 1995 -- when the total US shipments was > \$228 Billion;
- Ranked 8 out of the top 25 seaports in the United States, with regard to the size of the North American Container Port Rankings in 1995; and,

- **With over 225% growth, ranked highest percentage increase container traffic for all ports surveyed by the Wall Street Journal in a 1997 article.**

. **The product- markets identified in conjunction with a spring 1997 feasibility analysis of the potential venture model for the consortium were as follows:**

1. Architects
2. Associations and Trade Organizations
3. Attorneys—Maritime, Admiralty and Related
4. Automobile Shipping & Processing
5. Barges and Barge Operators
6. Bulk Handling
7. Cables, Reels and Equipment
8. Commodities Transport and Trading
9. Computer Services and Information Systems
10. Consultants – Port, Maritime and Transportation
11. Container Handling Equipment and Container Services
12. Cranes & related Services
13. Diving and Underwater Services—Commercial
14. Dock Fenders
15. Dredging Contractors, Services and Supplies
16. Dry Bulk
17. Electronic Data Services
18. Electrical Systems and Supplies
19. Electronics and Automated Systems
20. Engineering Services
21. Environmental Services
22. Executive Search
23. Expositions and Trade Shows
24. Financial Services and Consulting
25. Heavy Lift Equipment and Services
26. Insurance and Risk Management
27. Lubricants
28. Marine Construction
29. Marine Engines
30. Marine Equipment & Supplies
31. Maritime Education & Training
32. Maritime Security
33. Marine Surveyors
34. Marine Technical Publishers
35. Navigation Equipment and Contractors
36. Port Captains
37. Publications—Industry and Trade
38. Ship Agents and Brokers

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|---|------------------------------------|
| 39. Shipping Lines of the Americas | 43. Systems Integration |
| 40. Shipyards, Shipbuilding and Ship Repair | 44. Terminal Operators |
| 41. Steel Sheet Piling and Steel Products | 45. Terminal Tractors |
| 42. Stevedoring Services | 46. Towing, Tugs & Harbor Services |
| | 47. VTS—Vessel Traffic Systems |

The following are the set of key market segments identified by that research with direct relevance to Consortium C. They were adopted for further evaluation of its business model:

1. Real Estate Development – A planned plot of land targeted for Commercial development on the part of the sponsoring university
2. Training;
3. Ocean Science Research
4. Maritime Management Systems Development – in Communication and Coordination

Governmental Landscape

There are several pertinent governmental agencies (federal, state, local, and quasi-governmental) which constitute the regulatory, sponsored research, and/or remaining sources of funds and/or potential sources of developmental assets that collectively frame the backdrop within which the consortia studies were launched and flourished. Federal level government agencies included: The National Aeronautical and Space Administration, Department of Defense (specifically Departments of the Navy and Air Force), The Department of the Interior, the US. Congressional Offices, and, the U.S. Department of Transportation.

On the state level, the economic development agencies of the state, particularly the quasi governmental technology driven economic development agency that is key subject of this research, was primary. Local and regional business development and planning organizations also play a meaningful role.

The University Setting

The university partner in consortia 'C' s development may be viewed as having resided with the college of science, oceanography department chair's office. It was through this academic chair's offices that discretionary funds were allocated -- or made available -- to allow a key federal agency staff on loan to the college faculty serve in the initial liaison roll with the federal agency and with the private sector. Out of this major maritime commercial and governmental community organizations were organized into a working group. This was a group that is to this day, ostensibly focused on advancing Consortium C's realization. This development was perhaps critical in extending university support for the venture.

While the subject academic college's venture champion was attach to the oceanography department of the university, significant support for the advancement of the venture also came from university's independent research foundation with the blessing of the university's senior management.

The university partner of Consortium C continues to be a terminal degree granting state subsidized institution of higher learning which includes the fields of engineering and science. As such, specific demands are placed on the faculty that held the seeds for the development of Consortium C.

The University and Faculty And the Federal Agency Partner

In general, faculty members are expected to teach, conduct research projects and publish in a way that will secure and assure “field leading” scholarship.

The second expectation – the research projects requirements, together with the existence of relevant faculty engineering expertise, resulted in a significant presence on the part of select faculty among the routine research and development granting operations of the impacted federal agencies. The federal agency partner that primarily defines the federal role of this unit of analysis is one that has the charge for advancing commercial related understanding of the science of oceans, bays, and waterways with commercial significance.

Pertinent University Management Initiatives

A key aspect of the university setting that characterizes this unit of analysis – Consortium C—has to do with development of relevant university senior management initiatives which were pursued during the timeframe of this synopsis.

Specifically, what is referred to here the fact that at the university policy level, in the years just prior to Consortium C’s development, the senior leadership of the university undertook a set of goals and strategy development exercises that yielded in specific set of growth and development initiatives. These goals and development initiatives thus became well articulated and promulgated throughout the colleges and schools – these being the primary divisions of the university that collectively comprise “the university”.

University Research Organization

Although the initiating university partner entrepreneur or champion in consortia 'C' s development may be viewed as having resided with the college of science, after that partner university's president decided in support of it, the primary administrative arm for development of Consortium C was an independent research foundation. Given that a research center is currently attached to the department, the foundation is funding the effort in an attempt to form a distinct organizational entity. This is to be one that is to become the champion's expanded organizational umbrella under which all subsequent university advocacy was centered.

Discretionary funds made available there were allocated in a way that allowed college faculty to serve in the initial functional staff rolls required for transition of the asset in partnership with the participating federal agency.

The university president's office in question had economic development related venture support discretionary funds which it could greatly influence. The university president was the only member of the research foundation's governing board who is from the university -- a board primarily comprised of prominent regional businesspersons.

Through the mechanism of the routine operations of the independent academic research funding arm of the university's operations, these funds are being made available. This vehicle for venture support has been evoked in the course of the consortium C's development.

For the venture in question, no set formal or official process had been established whereby official university support of promising economic development partnerships

could be created. Nevertheless, as of 1995, several such activities had been evaluated. A few of those are currently being provided for through this method of resource allocation.

To the extent that a typical pattern of securing support has been identified, it adheres to the following sequence:

- (a) Faculty members champion a technology research based advanced application venture concept until it reaches a level of refinement that generates Dean level interest and backing. Typically, resources in kind are invested at this point. That is, no direct funds are allocated for the project. However, faculty time is approved along with suitable facility access to take the concept to a level that suggests a feasibility analysis is warranted.
- (b) At this point, the university may lend its support in a way that it assists in securing more comprehensive university attached business assessment resources – or in locating sufficient state and other third party resources to finance such an assessment.
- (c) With continued promise being demonstrated at this point, senior management at the university will attempt to secure escalating levels of economic development support. That support which will be pursued will be that in the form of grants writing or critical private sector financing documentation to finance such an assessment (e.g., to finance the performance of a commercially viable business plan).
- (d) With enough justification, the president's level may actually allocate a fixed amount of money greater than \$250,000 to seed the launch of a consortium.

Notwithstanding this typical pattern, a key ingredient is the dedicated sacrifice of the principal investigator to continue to expend significant personal resources to move the idea from idea to facility to stand alone venture.

Thus, “faculty as champion” is typical and perhaps critical in early development of the venture.

In the case of this the Consortium C venture, the champion was identified through the internal (to the college of engineering and technology) advocacy-as-champion process.

Political Realities Faces

It is clear that the decision process and structure of governmental agencies are responsive to political control. For the purpose of this summary, a treatment of this governmental superstructure will be foregone in favor of a mention only of the aspects of it that had some clear – and reported -- bearing on the consortia which is the subject of investigation.

In the case of Consortium “C”, it is now the case that a shift in the political interpretation of the proper role of the federal agency, and it’s ability to tolerate a phase out of conventional transferred asset’s customer base, significantly impacted it prospects for reaching it goals and objectives.

Thus it is the case that -- when given the opportunity -- as a matter of policy, local university research expertise is to be organized in a way that will bring forward to the indigenous commercial sector world class and rigorous impact and waterway dynamics understanding. It is state and federal level policy that such organizations are to be used

to provide competitive insights to the regions served by the university and its regional commercial and defense units. This is just a matter of policy.

Relevant Consortia Activities

University, industry, federal agency consortia have been in increasing operation since 1984. This is the point when federal legislation permitted increased use of consortia ventures. As a result, significant experience base has developed regarding their construction, management and development. A basis for “best practices“ has thus been established through experience over time.

In this case of Consortium C, it is clear that a model for formulating the specific services fee structure for the venture has yet to be formulated and established service provider competitors remain to be defined. While similar university industry test facility arrangements have been studied in the course of the research for the subject Consortia, no operational model has been adopted sufficiently to serve as guide to the emerging ventures operations.

Consortium C's Story

This section provides an overview of the sequence of events that chronicle venture C's development. The following sequence is based on discussions held with each of the key representatives of all of the participating agencies that collectively comprise consortium C.

The themes discussed are those suggested by the historical sequence of events associated with the venture's development, as well as any additional themes that were suggested as key and perhaps unique to Consortium C's progression.

Overview of ‘C’s Development

Although the individual that would become the champion of the Consortia had began his early career in west coast commercial salmon fishing, in 1985 he joined the faculty of the subject university’s college of science in its oceanography department having demonstrated a successful background in related science research center development.

Champions History in Federal Agency Contract Analysis

Just prior to his to the university matriculation, the champion had done for the US Department of Interior significant community and related non-governmental organizations (NGO) environmentally sound policy consensus building work.

Efforts executed under research contracts in conjunction with a supporting federal interest in facilitating off shore resources exploitation and commercial development. At this time, the champion was also made acutely aware of the relative advantages -- in terms of assured research quality -- of the approach to conducting such research in university-anchored harbor, bay and ocean science research centers.

Federal Budgetary and Advocate Community Development Efforts Drive the Development

Due to federal level budgetary constraints – as well as executive level imposed moratoria such efforts, work in this area was suspended until the Gulf War effort in the 1995-1996 timeframe precipitated renewed interest in key natural resource sufficiency.

In a related but parallel set of activities, in 1992, efforts were initiated on the part of the Champion to develop effective regional business and trade association and regional

governmental awareness of the potential and need for a maritime research center located in the region served.

Noting the assemblage of world class oceanographic sciences faculty and science capability at the local university, local trade, commerce and development organizations with a shared interest in fostering the expanded commercial prospects for the port served where introduced to the potential role of the local university in this regard. Here, the primary effort was placed on developing the connections to key impacted organizations. Through these it was hoped that center management might better clarify the extent and form of that community's potential interest in the creation of a research center. The research center was to be one that could provide much need research to enhance the commercial maritime business climate for the region.

Federal Budgetary Impacts

The effort was ill defined and relatively unfocused until 1994. It was in that timeframe that federal level budgetary constraints (and planned reductions) – and a well established informal collegial network – rendered available to the Consortium's champion, a mission critical economic development talent. Through the mechanism of a Intergovernmental Personnel Act agreement, a collaboration with the National Oceanographic and A Administration and the universities research center was formalized. Under this arrangement a key national level government- and industry-relations skill set was added to the center's senior developmental management staff.

From that timeframe to the present, that relationship yielded a virtual explosion of awareness to federal resources put aside to aid in the organizational development and creation of research centers with maritime research interests. Similarly, key and mission

compatible private sector sources of developmental funds and services needs were also clarified through this staff addition.

University Sanctions “Seed Funds” – Strategic Imperatives

Using discretionary funds made available through university and research center upper management sources, Consortium C’s champion continued to advocate the idea of the creation of a viable research infrastructure for the performance of good science that would serve a world wide clientele in the course of its operations.

From 1992 to 1995, the formative vision as advanced by the Champion was to essentially create a virtual organization whereby scientist and engineers with funded research interest could benefit from the synergies associated with their individual research by virtue of the group’s interactions that the center would afford.

In 1994, at the university senior management level, the strategic directions for what would become the sponsoring university developed and articulated its strategic growth directions. In connection with that activity, Consortium C’s focus fit well into that scheme. It was justified on the grounds of its contribution to university academic programs development and the extent to which it addressed university commercial and civic community relations objectives.

In the fall of 1995, benefiting from the addition to staff of a federal level government and national business level policy and relations specialist, discretionary funds were allocated to fund a strategy formulation and development activity. This was a facilitated planning session that had the result of generating an integrated view of critical commercial, and regional institutional constituents into a further clarified vision of what was to become referred to as Consortium C’s mission and operation.

Shared Sense of Need – the Region’s Commercial Sector Feels the Need

Coincident with this development, in 1995, was a commercial real estate development initiative and vision for such a venture advanced by an independent private sector agent. That individual had independently fashioned a concept statement for a research and training facility and organization that would serve the underlying infrastructure and regulatory issues associated with capturing a regional competitive advantage for the commercial maritime community of the region.

University, State, Private and Federal Involvement

In June 1996, Consortium C’s champion receive university senior management approval and support for advancing the development of Consortium C through it’s pre commercial launch stages, justifying the expense on the grounds of academic program development, university commercial asset development, and the advance of sound civic and business community relations. It was through this approval that a mix of departmental level funds and those authorized by university senior management, that effectively the formative stage funding was secured.

Spring 1997, brought the requirement to evaluate the suitability of the Consortia for inclusion in university plans for real estate assets slated for joint university-city commercial development through the creation of a research park. It was the first effort to create and evaluate a viable business model for the consortia.

As of November 1997, a major aspect of Consortium C’s funding is provided by a university research foundation.

Quasi Governmental Agency Roles

The contribution of the state quasi-governmental agency had been limited to steering committee membership, funded commercial feasibility and market assessment surveys. Perhaps very significantly – that agency in issuing a solicitation for proposal for receiving funding, has established standards for significant state funded center development awards if they are done in conjunction with related university attached commercial shipping construction, maintenance and services technology research center development and advancement. This is promoting unprecedented corroboration for Consortium C's related university organizations.

The current state of development is the formulation of the commercial venture plan and strategy for consortium C as well as the FY 1998 anticipated award of Federal agency commercially and environmentally focused ocean science grants.

The Need for Structure Innovation in R & D

With the exception of a quasi-governmental agency grant sponsored feasibility analysis, the matter of whether Consortium C is properly structured to secure a viable commercial presence has not been addressed directly thus far in its development.

The role and services provided by the consortium is based on the experience garnered in conjunction with federal, shipping, marine personnel training organizations and oil exploration company clients. However, it is clear that the role and mode of services provision to them is dramatically different from that experienced by the historical military systems, commercial shipping systems development and waterway scientific experimentation communities.

Consortia management has yet to define -- let alone effect -- organizational modifications that will return commercial viability, let alone the issue of securing competitive advantage.

Nevertheless, it is clear that developments in this regard will have to be advanced if commercial prospects are to move from goal to reality. For example, it was noted by all consortia partners that the vested interest imposed by commercial clients and existing maze of grant funded organizations in the category impose a entrepreneurial challenge that CAN cause the Consortia to fail.

Moreover, the demand for the kind of infrastructure development that defines consortium C -- developments that will in truth secure competitiveness in these non-defense product market applications areas addressed by the commercial community -- imposes not only a major capital investment requirements. In addition noting the target commercial and military client base to be served by the consortium along with its current academic heritage, clear mission threatening business cultural challenges exist as well.

Novel Aspects of Consortium 'C's Development

The coincidence in the consortium's development is the common recognition that the consortium potentially plays a critical role in dramatically improving the regional economy's world level viability. This recognition is shared by the university and federal agencies involved.

On one hand, due to its relative immaturity, it is clearly "too soon to tell" about the prospects for commercial success of consortium "C". In a way, it is NOT a venture yet. It is quintessentially "formative"—both as an academic programs venture, a commercial venture or a vital (to the regions economy) infrastructure venture.

Self Reported Critical Roles Played

There is almost uniform adherence to the view that perhaps THE most critical role played was that done by the recognized champion – chair of the academic department and reference existing research center for Consortium C.

It was through that individuals set of personal contacts, professional history, and persistence, that the consortia move from an “idea” to it’s current state of organizational maturation and commercial gestation.

The enthusiastic initial support on the part of senior university management to intervene for provision of the “pre organizational” prototype investments required to advance the consortia idea form concept to venture advocacy unit to an operating organizational enterprise, is also recognized as key.

It is at the level of securing a well organized set of historical private sector partner participants that Consortium C’s development now turns. Their have been -- to date -- no commercial customers. Meaningful planning and design inputs are currently being pursued through this avenue.

This consortia concept has not gotten to a level of concept maturity that has warranted higher levels of political and private sector support (e.g., state budget item consideration or venture capital or other financial institutional financing).

The Framework for Assessing ‘C’ as a Consortia – The Interviews Summary

This section synthesizes results of interviews with representatives of each of the four sector partners – (1) university, (2) federal agency, (3) state sponsored agency, and (4) key private sector enterprise participant. The results are organized to reflect a

synthesis from interviews, documentation collected in association with the interview, and other documentation concerning the venture.

The discussion of the summarized results that follows is organized around response to four key areas explored for during this effort. These areas are listed as the headings of the various sections and include: (1) Industry Dynamics Considerations in Consortia Venture support, (2) Target Markets and Consortia Venture Support, (3) Organizational Structure and Process, and (4) Modifications to New Venture Support Decision.

Industry Dynamics Considerations

The following are the answers inferred or explicitly provided by the collective responses of the venture partners associated with consortium "C".

Role of Industrial Structure Considerations on Consortium C's Go-no Go decisions

The forms of support provided by the partners in Consortium C were not motivated to leverage underlying maturity of the industry patterns in the industrial sector (maritime technology) most closely aligned with the venture. The venture was not primarily concerned with patterns which could be conceived in terms of the trends in technology and business systems innovation unfolding in the industrial sectors that would be targeted by the venture. In addition, considerations of these industrial and technological dynamics were not evaluated or considered in garnering partner support for Consortium C. To the extent industry maturity and patterns might have been considered, such considerations were not explicitly evaluated or used to further galvanize partner support.

Stage of Technologies Innovation Cycle

This consortium venture has not come to the official attention of state sponsored quasi governmental agency's industry sector planning, and asset development executives. As a real estate development option, some venture assessment frameworks have been applied. Be that as it may, the venture investing decision making frameworks applied to secure the asset and decide to proceed with university ownership of the technology research and development services operational ownership, as a general rule, as yet to be determined. It is just too soon in the commercial concept's maturation process for that to be consideration. The business model has not been developed as yet.

There is a clear need to characterize the consortium concept in a way that will make clear how it effectively would harness the underlying business and technology cycles attached to each of the targeted potential industrial sectors. This effort has yet to be recognized as needed. Consideration of the technology cycles of the target industry sectors simply has not been applied. Consortium "C", in its current form, should actually be viewed as pre-operational at best. To date, it has primarily been in operational existence as a grants recipient. Major effort is being currently directed at formulating a viable business model, its associated marketing development plan and organizational structure for realistic commercial success should that prove the correct focus. In addition to the more traditional oceanographic research projects, a current vision is for it to accommodate for commercial clients, simulation assisted training on maritime related functions (e.g., cargo vessel and other commercial pilot training or emergency crises training)

The traditional position occupied as regards the phases of research (i.e., technology research projects that are categorized as either of the so-called “basic”, “applied”, “pre-prototype”, or “commercial demonstration”) in the 15 to 80 year cycle of any given technology’s advancement still apply in this situation. Namely, the facility is positioned to be a basic research facility with some attempt to properly upgrade the infrastructure of the facility to permit it to viably address competitively advantaged commercial clients. It is too soon to tell or verify whether or not Consortium C will execute sponsored R & D.

Thus there is no way to assess their potential for commercial success (or at least their potential to satisfy clients) when their future focus maybe on well suited product or services which are in concert with the fundamental phases of the technologies development.¹⁵

Collaboration across university or corporate cultures, a clear goal of the venture, has not been experienced or worked out. That kind of collaboration, although a consistently held “vision” and objective of the participating Federal agency senior management, remains a distant and as of yet unrealized objective.

Markets—Target Markets and Consortia Venture Support

The organizational and managerial composition of Consortia ‘C’ is arranged as a traditional basic research structure. Any structure that will be adopted must be done in a way to address both the traditional defense systems operational environmental support as

¹⁵ For example, given this consideration, it could be argued that the sponsored venture should have as its main product: the performance of **research services contracts** for the conduct of basic research, applied research or developmental research R & D phases. Alternately it should **provide product/process licensing services contracts** for the new venture technology’s developmental and initial introduction phase);

well as the naval and commercial shipping systems development product-markets it served.

As such, little is known about the market's targeted to be served. These product market segments, while stable in the past, are undergoing vast reconfigurations. For example, in the case of both optimal harbor operations and personnel training for private commercial shipping, and use has not been addressed.

Knowing the emerging mechanisms whereby these services will be provided is key to the determination of which specific structure best supports to a view of the product-markets¹⁶ in which the major product-markets are being: (1) actively discovered by the various global competitors outsourcing aggressively locally; and, (2) the most effective ways to compete -- given organizationally as well as geographically dispersed product development partners -- in a way which will have the effect of maximizing system wide wealth generation.

The consortium "C" s products are "by definition" primarily testing service provision contracts , natural hazards impact assessment, and unique operations staff training. The planning documents focused on the relative price/cost/performance price points associated historically with each of these.

The initial business plan is yet to be developed based on testing service provision contracts, natural hazards impact assessment, and unique operations staff training. As the venture was to a be an initial foyer into the commercial marketplace, the primary focus of necessity had to be on the development of a set of strategic commercial allies. Based on

¹⁶ Here a "product-market" is conceived to be the rather unique segment of a market defined by a distinct and meaningful set of uses to which a product is put. It is a segmentation that lends itself to providers formulating distinct strategies for effecting the

these allies, the facility's infrastructure could be modified to return leading edge remotely distributed and managed products, and services. It can be concluded that the matter of which generation in services' innovation that was to be captured by Consortium C's business model had yet to be evolved.

Regardless, to date, these kinds of considerations have NOT been a consideration that is central to the "go no go" decision that continues to be associated with the advancement of Consortium C partnership to its current point.

The entrepreneurs, in the form of the Consortia planning partner organizations championing the new consortium's products, were all of the opinion that their proposed product or business model should be uniquely the first of its kind -- and thus innovative. Nonetheless, other university-- national research laboratory collaboration examples were identified in the course of the performance of the feasibility assessment done in connection with the assessment of the consortium's commercial potential.

With the exception of the specific sectors under consideration (e.g., pilot training sectors), it is nonetheless true that with regard to the subject of university R & D consortia, that more advanced and well thought out examples Consortia could be found that existed. Models for senior management and technical project team building are clearly needed.

It should be noted that recent quasi-governmental agency solicitations in this case, were clearly identified as actively influencing the Champion's attempts to facilitate intra-university faculty team formation in a way that would provide comparative advantages to all product-markets addressed. On the level of traditional grants funded

products, price, position, promotion and place which affects the buyers' purchase decisions

research, this multi and cross-organizational project staffing practice enjoys a long tradition.

These Consortium C specific product-market organizational models were envisioned to provide a basis upon which – in the future – the venture could fashion its operations and economic models.

Regardless of this ideal, these considerations WERE NOT used in any way during Consortium C's venture "go ahead" decision process.

The Markets—Strategic Option-Competitor

It was pointed out that very few – if any -- competitors have a substitute service/product – the cross section was only found in one or two situations world wide.

The venture support issues of how to identify these competitors generated the basis for this consideration. It was noted that given one of the world largest military fleets, as well as one of its largest warm water ports, a clear basis existed for it be developed as one of only a few such relatively unique centers that might existed worldwide.

Given its formative stages, consideration of this matter was not rigorously pursued. Nonetheless, this sense of the competitive landscape served to justify the sponsorship of the Consortium C at the university, and federal levels.

The primary private sector partners appeared to have been interested in two objectives. First, from a defensive posture, the private sector partners wanted to assure that they were not absent when a strategic opportunity with significance for their employer presented itself. Secondly, they wanted to influence a relatively benign (to their business or organizations agenda) consortium development.

The Markets—Strategic Development

In this case, the consortium partners had a rather inconsistent perspective of product distribution to the extent that there was one at all. There were vague references to operations training (e.g., pilots' simulation-based training), the conduct of ocean science and its advancement research, and simulation based inter-disciplinary crisis management training.

There was no consideration of various market considerations. For example, little treatment was given to the perspective view of the consortium having products that were in effect service products that might serve as bellwether product- market solutions on the part of the highly fragmented maritime products and services market segments.

Similarly, there was no discussion of whether a clearly defined and innovative business model would be arrived at through close developmental relationships with a participating strategic customer or ally. These customers or allies might have included the naval architectural, or oceanography researchers, and related sciences instrumentation product-market alliances.

Quasi Governmental Agency Roles:

On a state infrastructure level, the facility's role was not clearly viewed. It simply had not been a part of their considerations or deliberations. To the extent that it would, the facilities would fall under the auspicious of the director for intellectual property and little else at this stage of its definition and commercial venture definition.

The consensus orientation left as "unconsidered" and necessitating "further strategic focus" with regard to the matter of product distribution that might be facilitated or hindered by the consortium's envisioned design or operations. Although it was

viewed as key in some of the interviewed opinions, it is clear that such Product distribution concerns did not weigh in the positive decision to support of the Consortium's launch up to this point.

Organizational Structure and Process

The matter of what should be the appropriate culture for the Consortia Venture -- among its partner organizations (with the exception of the private sector, the federal agent and the center champion) was not given any meaningful consideration. The issue of the venture's culture and its suitability to intended clients or customer cultures was not discussed.

This consortium's culture was punctuated with the desire to establishing limited strategic alliance based project teams. Thus, organizationally Consortia "B" was receptive the kind of collaboration of strategic alliance-based project teams.

Regardless of this uncertainty, it was clear that effectively forming traditional R & D structures, which depended upon a given industry's standard collaborative or subcontracted research and development practice, WAS NOT an explicit aspect of the vision of neither the champion nor any of the remaining partners.

The assumed appropriate culture for the consortium venture -- among its partners' organizations (with the exception of the private sector, federal agent and the center champion)—seemed to be absolutely entrepreneurial.

Forms of Governance/Ownership

The consortium organizational structure was not defined. Thus it is not clear to what extent it could be made to facilitate collaboration with commercial partners, or at least open to developing an appreciation of how to facilitate collaboration. Senior

management, did not appear to have given much thought to this issue. The implicit model in apparent use was that of business as usual but targeted toward federal science grants markets. Little focus was given realistically to commercial markets requirements, as those segments had not been sufficiently defined so that that insight could be appraised.

However, comments made regarding collaboration suggests that any kind of team collaboration structure required by customer, will most likely NOT represent a challenge to the consortium management team – there is a rich collaborative research tradition in the Champion's experiences.

As with most commercial ventures though, developmental product secrecy is key to product market success. Therefore, it is a closely guarded activity. This is no doubt an area of significant operational challenge that must be organizationally and procedurally overcome to realize the consortium's venture potential. Thus, it can be seen that in this regard center is very much in the formative stages of its development.

With respect to securing consortium venture development resources from its partners, it can be said that no explicit consideration was given as to whether consortium 'C's projects needed to be matched up well with the organization and procedural norms which characterize the product-markets targeted. This issue was raised in the course of a few of the discussions held. That is, an awareness of the need to address specific business cultural norms for a given target product-market by the consortia operations was not uniformly considered by all participants – to the extent that it was at all considered.

A demand for better defining the business case for the consortium both at the university research organization, the state quasi-governmental agency, and various other

private investor quarters which focused on the Consortium's viability is clearly emerging. Given this development, a focus on "fit" of organizational and procedural norms cannot be discounted just because it was not in evidence during the periods and phases of development THUS far considered.

Organizational and Process Management Rules

None of the partners associated with support of consortium "C", or its venture development team, focused on adequacy of senior management's concern for supporting technology innovation in relation to creation of an "innovating" corporate culture.

Focus on a creating a so-called "learning organization" occurred at the State level. However, this was not an explicit concern of the consortia or regional level partners.

The business model of the consortia supported the notion that entrepreneurial teams and environments benefit from being isolated from the culture of the firm or firms that produce and distribute existing products. This was achieved primarily by providing an off-sight test results, clearly packaging uniquely innovative training systems for dissemination and adaptation to the work sites of the participating project team members. There was a vision that competitive advantages could also be secured based on the option to have results accessed remotely – given suitable advanced infrastructure installation. The matter of promoting effective innovation to support the creation of inter-organizational self-directed teams was NOT an explicit consideration for the consortium.

Due to the fact that it has not be clearly settle upon, any specific forms of partnership that could be accommodated by the consortium operational configuration and policies could not be assessed:

The specific set of organizational and operational infrastructure necessary to realize these options had not been reportedly worked out for each by the consortia. Moreover such considerations were not articulated save at various factions of the state quasi-governmental agency –e.g., at the regional, industrial sector and partner organizational level. Therefore, realization of this outcome remains a hope because, to date, there were very few recorded projects underway or completed. Thus, there is insufficient data to provide further insight for these sets of issues.

As consortium C is a relatively new start up center (i.e., it has just completed its second round of financing in Venture Capital terms), the matter of its team interactions and work styles (both formal or informal manner), mirror the entrepreneurial , management by objectives (MBO), or protocol modes. These modes are characteristic of the target product market industry norms but cannot be assessed with respect to the consortia. Whether for example, consortium ‘C’ is best suited to become alternately a “flat” (clustered), star, or hierarchical structure interfacing with a compatible commercial partner’s organizational could not be addressed at this juncture.

Nevertheless, due to its formative nature and location, it is in all probability the case that the consortia structure could be managed in a way that it would provide the innovative “reservations environment”. Such environments are noted as being required to accommodate innovation in all organizations.

University Role in Consortia

The role the university partner played in the consortium’s development was viewed positively.

In addition to critical advocacy at the senior management level, permission to employ departmental discretionary funds has proved key to current level of achievement by the consortium. Nevertheless, in the case of Consortium C, it is recognized that significant development of the business case remains to be advanced. There is an apparent “wait and see” attitude on the part of university senior management regarding its prospects for future viability.

Modifications to New Venture Support Decision

As this consortium concept has yet to be advanced to a launched commercial stage, little in its development suggests developments in new venture support decision making process. It has yet to be fully subjected to this framework as candidate business models have yet to be advanced from a consensus generated by the working group.

R & D team staff personality profiles, Selection

How or whether or not the personality of the new venture’s team or that of its champion, will generate the delegation of authority needed to realize the commercial venture’s organizational and operational objectives is not know at this point in the venture’s development.

The traits of the champion have been uniformly acknowledged as key to the level of success the concept has experienced thus far. It is recognized that the suitability of the venture team’s composition must be appraised in the future. However, it is also recognized that the current state of the business model for the consortium has not been sufficiently defined to afford a commercial cultural assessment. Simply put the data do not speak to the matter of team composition adequacy sufficiently enough to consortium members to address it at this point in the consortium’s development.

SUMMARY OF RESEARCH RESULTS FOR UNIT OF ANALYSIS**CONSORTIUM 'D'****CONTENTS****Introduction****Summary Organization****Background: Unit of Analysis – “D”****‘D’ s External Environment****The Target Industry****Governmental Landscape****The University Setting****Political Realities Faces****Relevant Consortia Activities****Consortium “D”’s Story****Overview of ‘D’s Development****The Need for Structure Innovation in R & D****Novel Aspects of Consortia ‘D’s Development****Self Reported Critical Roles Played****The Framework for Assessing ‘D’ as a Consortia – The Interviews Summary****Industry Dynamics Considerations****Markets—Target Markets and the Consortia’s Venture Support****The Markets—Strategic Option-Competitor**

The Markets—Strategic Development

Organizational Structure and Process

Forms of Governance/ownership

Organizational and Process Management Rules

Quasi Governmental Agency Roles:

University Role in Consortia

Modifications to New Venture Support Decision

R & D team staff personality profiles, Selection

Introduction

This document provides an account of critical aspects in the development of Consortia “D”. This review process provides feedback to ensure the accuracy of the preliminary results and interpretations drawn from interviews and other research data.

For purposes of this discussion, “Consortia” will refer to the de facto organization comprised of the set of agencies that elected to allocate resources to allow the viable operational creation—or launch—of the intended organization. For this research “consortia” is a designation by participation of the following set of agencies: (a) federal agency sponsorship, (b) a state university, (c) state agency, (d) a quasi-governmental agency with the specific objective of promoting economic development through support of technology innovation, and (e) a commercial enterprise.

Based on the field interviews reviewed, other euphemisms for this organizational form which may have been used in reference to the consortia are: “Collaborative”, or Partnership”. Regardless, in every case, the composition of the organizations participating and the desired favorable outcome of the these units are the same: The creation of a commercially successful venture.

For purpose of discussing the specific venture which is the subject of this document, that unit of analysis will be referred to throughout as Unit of Analysis “D”.

Document Organization

This document begins with a background narrative. This narrative is divided into a statement of (a) the goal and/or vision of the unit, and (b) the stated objective and/or approach of the unit. Next, a brief discussion of the economic, political, and technological context out of which the unit venture grew is provided. Given that

developmental context, a narrative of the consensus ‘story’ of Consortia “D” s set of events which led to its current state of commercial development is constructed.

Following this story, an integrated summary of the collective comments provided by multiple individuals through the interview process is presented. This discussion is followed by one which identifies the unique and unanticipated – or atypical – features which characterize the development of consortia ‘D’ either as a start-up or viable not-for-profit commercial venture.

The integrated summary is followed by a consensus listing of the critical roles played by each of the institutional partners in the consortia. Finally, technology innovation management themes which emerged during the investigation are discussed.

Background: Unit of Analysis – “D”

According to research documents associated with “D”, the following is it’s stated goal:

“...[*Consortium “D”*] is a multifaceted project which involves two primary business segments: a multi-use Spaceport and a Center for Excellence in research and education in aerospace related endeavors. It is intended that it be a regional effort, involving several states with a stake in aerospace development and education.”

“The Spaceport will provide space launch facilities and support services to commercial government and scientific/academic customers, on a fee basis. It will support launch vehicles with solid fueled boost stages capable of achieving sub-orbital and orbital missions with payloads of up to 8,500 pounds of mass. The Spaceport will operate in partnership with [*the partner federal agency*] and the commercial space industry to provide timely, low cost, highly reliable access to space.”

“The Center of Excellence, a consortium of industry, government and academia, will provide technical/vocational, secondary and higher education opportunities relating to the technology and processes involved in aerospace activities. It is envisioned that [*the partner federal agency*], the [*specific federal agency’s state located asset*] space flight facility and the

Consortium “D” activities would provide a hands on laboratory to support the learning process.”

“The [*Consortium “D”*] will also generate research opportunities in aerospace related areas, in partnership with industry, government and academia. It is envisioned that [*Consortium “D”*] will act as a magnet to establish and accelerate industrial development in the region.”

“In addition to the two business elements, [*Consortium “D”*] will, as it develops, spin-off other revenue generating activities in cooperation with [*the partner federal agency*] and industry. These spin-offs will seek to employ existing [*federal partner assets*] which are currently underutilized.”

(The Business Plan for the Consortium “D”, dated August 1996)

‘D’s External Environment

The general environmental context out of which Consortia “D” germinated is provided by the following consideration of: the target industry, the governmental landscape, the pertinent university setting, and a treatment of the salient political realities faced.

The Target Industry: Product-Markets Served

The general description of the target product-markets addressed by the Consortia suggests that significant commercial markets are expanding and substantial. Just focusing on one aspect of the aggregated market, a rather conservative estimate obtained. By examining just the so-called “commercial orbital markets” aspect of the market, estimates suggested that there will be a ten year expansion of \$5.5 to \$7 billion in the segments that comprise this component of the aggregate.

This key segment could be dis-aggregated into the following sub market segments:

- Commercial Satellite and related services (US Department of Commerce’s Standard Industrial Codes 3761, 4813 and 4832)

- **Satellite Fleet Systems Operators (SIC 4899) (These include: (a) so-called GeoStationary Systems, (b) “Large” low- to medium- Earth Orbiting Systems (or LEO and MEO systems, respectively); (c) “Small” low- to medium- Earth Orbiting systems (also referred to as “little LEO’s);**
- **Satellite Systems Operator (SIC 4899)**
- **Non-US manufacturers (SIC 3761);and,**
- **Consulting Services (firms with practice areas in space related products or services)**

It was recognized that these market activities should be viewed from the primary perspective of their derivative product-market impact (i.e., potential launch market for the Consortium “D”). Nonetheless, it was noted that even with this caveat, conservative estimates of potential launch activity would yield between five and seven commercial launch business opportunities per year, over the period 1997 to year 2008.

The market opportunities for Consortia B were also clearly recognized to exist in such product market areas as: suborbital, scientific, military and earth observation applications. These other markets were noted as being able to provide significant additional market opportunities.

Governmental Landscape

There are several pertinent governmental agencies (federal, state, local/regional, and quasi-governmental) involved in Consortia "D". These agencies constitute the regulatory, sponsored research, and/or remaining sources of funds and/or potential sources of developmental assets that collectively frame the backdrop within which the consortia studies were launched and flourished. Federal level government agencies

included: The National Aeronautical and Space Administration, Department of Defense (specifically U.S. Department of the Air Force), the federal Department of Commerce, US. Congressional Offices, and the U.S. Department of Transportation (DOT/ FAA.

Key Legislative Frames

A key aspect of the consortia development was also the legislative basis for the work. The Space Act of 1954 authorized the US government's support of space activities. Another significant legislative development was the passing, in 1984, of the Commercial Space Launch Act. This act sought to establish incentives in support of the development of commercially cost competitive alternatives to relatively costly existing conventional space launch systems.

Although an early effort to create a commercial space launch company would eventually not succeed, a clear motivation of the 1984 Act was the effort on the part of a former US astronaut to create a commercial space launch company and his subsequent report of the "bureaucratic red tape Horror's" encountered in that frustrated pursuit.

Irrespective of this initial failure, the state located federal space launch asset senior management had developed its initial understanding of the challenges faced as a result of these first commercialization efforts. Specifically, the former astronaut's firm and its booster vendor had entered into a precedent setting initial set of agreements with the partner federal agency in the mid 1980's.

This precedent setting agreement process would later serve as a reference model for the ultimate commercial use of federal property. The consortia "Memorandum of Agreement's" with its associated subagreements entered into by the State through the consortia's ultimate legal entity, were based on this reference model. These agreements

were in effect innovated through the first successful agreements established with that former astronaut -- Deac Slayton.

On the state level, the economic development agencies of the state -- particularly the state legislature's budget committee staff and membership and the quasi-governmental economic development agency would prove absolutely essential to the ultimate form and operations of the Consortia's commercial configuration. The agencies influential roles were advanced through technology based commerce programs offices. These agencies would establish the Consortia's future operations potential as well.

The University Setting

The specific vehicle, in the case of the university partner in consortia 'D' s development, may be viewed as having organizationally resided within the college of engineering and technology's dean's office. It was through this academic dean's office that discretionary funds were allocated to allow college faculty to serve as the initial center developments champion.

This support would prove to be critical in concept advancement. On several -- what came to be -- "mission critical" occasions, together with the champion team's determination to see it through, the dean's level support would sufficiently "undergird" a protracted university level of support for the venture. In effect, this support effectively provided the requisite pre-commercial venture incubation resources needed to advance the Consortia concept.

Although, the academic college's faculty venture champion was attached to an engineering department of the university's engineering college, significant "in-kind" support for the advancement of the venture would come from University's senior

management staff. This support was provided through its association with an legally independent university research foundation. Additionally, significant financial and political support for the advancement of the venture would eventually also come from the level of the president's office.

The university presidential office of the university entity had influence over economic development related venture support discretionary. During the later stages of development of Consortium "D"'s true "commercial" advancement, funds from this level were made available through evoking an independent academic research funding arm of the university's operations. This funding vehicle for venture support was invoked in the course of the consortium "D"'s development and launch.

During the establishment of consortia "D" no set formal or official process had been established to develop university support or creation of promising economic development partnerships. However, as of 1995 several venture advancement activities have been evaluated. Several such venture advancement activities are currently being provided for through the university resource.

To the extent that a typical pattern of securing support has been identified, it adheres to the following sequence: Faculty champions a technological research based advanced application venture concept until it reaches a level of refinement that generates dean level interest and backing. Typically, resources in kind are invested at this point. That is, no direct funds are allocated for the project, faculty time is approved along with suitable facility assess to take the venture concept to a level that suggests a feasibility analysis is warranted. Here the university may lend its support to assisting in securing

more comprehensive university attached business assessment resources or in locating sufficient state and other resources to finance such an assessment.

With continued promise being demonstrated at this point, senior management at the university will attempt to secure escalating levels of economic development support (in the form of state or federal agency grants writing support). With enough justification, the president's level may actually allocate a fixed amount of money greater than \$250,000 to seed the launch of a consortia.

Regardless of this, a key ingredient is the dedicated sacrifice of the principal investigator to continue to expend significant personal resources to advance the initiative from idea to facility to stand alone venture. Thus, the pattern of "faculty-as-champion" is typical.

That was the case in the development of consortia "D".

Political Realities Faces

It is clear that the decision process and structure of governmental agencies in the development of consortia "D" were responsive to political control. For the purpose of this summary a treatment of this superstructure will be foregone in favor of a mention only of the aspects of it that had some clear – and reported -- bearing of the successful outcome under investigation.

In the case of Consortia "D", it was found necessary for the partnering university president's office to directly intervene in state legislative committee level deliberations. This emerged in a coordinated effort to support the promoting impacted region's political contingent at state – and latter federal – level budget allocation deliberations. These

efforts eventually yielded a budgetary and bonding authority and line item for the consortia.

In addition, through relationships established with local elected officials by university senior management, sufficient political constituent pressure was developed and exerted to enhance the likelihood of that desired outcome.

Relevant Consortia Activities

The consensus view is that key personnel at the quasi-governmental agency (focused upon in this research) attempted to evaluate the state's strategic commercial sector potential for initiatives which might also serve to also provide educational and technology research and advancement opportunities to its universities and companies. In that context, the technology arena referred to as space launch and related technology was viewed as holding significant promise.

The scenarios for economic development considered in consortia evaluation can be demonstrated with an example. As an example of the economic development thinking, researchers considered the case of communications systems. The agency's analyst suggested that a sound programmatic thrust to be pursued. This thrust would be one that attempted to isolate, define the research and development requirements, and enhance the commonwealth's university--level research and educational focus in some specific relevant physical subsystem developments.

A specific example regarding this concept was in the area of the typical communications satellite's transponders subsystem. This was a recognized area of expertise at the state institution of higher learning. As such, the competency captured

there should be leveraged as much as possible to garner commercial competitor advantages to any vendors that choose to reside in the state.

In connection with this quasi-governmental agency led effort, various other sectors were identified – for example sectors in transportation, aerospace, energy, etc. In all cases the idea was to leverage, as much as possible, the existing university and private sector “brainpower”, university available federal research facilities, and other such assets. Moreover, initiatives were adopted to attempt to better organize a more credible industrial sector presence throughout the state. The idea in all cases was to garner – through the use of well-targeted project funding initiatives -- concerted efforts to provide a comparative competitive advantage for resident enterprises throughout the state in the industries in which they compete.

Consortium “D”’s Story

This section provides an overview of the sequence of events that chronicle venture D’s development. The following sequence is based on the discussions held with each of the key representatives of all of the participating agencies that comprise consortium “D”.

The themes discussed are those suggested by the historical sequence of events associated with the venture’s development, as well as any additional ‘key’ and perhaps unique themes that emerged with respect to Consortium “D”’s maturation process.

Overview of ‘D’s Development

The Consortia may be justifiably viewed as having received it’s start as a result of a confluence of national and state level agencies. These agencies were concerned with development of science and technology research development policy initiatives.

With severe budgetary constraints, significant pressure was placed on non-defense agencies to reduce programs and associated budgetary outlays in 1984 and again in 1992. These pressures resulted in state level technology development advocates becoming aware of opportunities for former federal asset transfers that could provide long term economic competitive advantages.

The drive to take advantage of federal asset transfers placed some emphasis of the direct advocacy, on the part of the quasi-governmental agency of facilitate the state's science and engineering assets to focus on benefiting from this federal policy shift. Ultimately, these incentives clearly had the effect of precipitating, among the industrial sector development staff of the state's quasi-governmental technology based economic development agency, high program development advocacy in the fall of 1991.

Although the university faculty had seized an initiative sponsored by the quasi-governmental agency in the spring and summer of 1991, a clear catalyst for rapid development in this regard arose with the quasi-governmental development agency's personnel addition in the fall of 1992. The individual hired would become a competitor spaceport's chief executive to direct sector asset development.

This state level, interest and development advocacy coincided nicely with related federal agency staff cutbacks and efforts to downsize. The possibility of utilizing the existing 1200-manned federal agency space launch facility – that was underutilized at the time -- together with the subject university's faculty and students in collaboration for creating education and research opportunities was germinated in that context.

Due to the inherently multidisciplinary nature of any space flight facility research and educational opportunities, as well as the fact that the engineering department was

desperate for augmented funding, the university with the support of the college of engineering, the soon-to-be Consortia champion -- together with his department chair, pursued and secured funding from the state level quasi-governmental technology innovation management agency. The champion was a Ph.D. student in his final phase of dissertation research at the time.

The development of this official arrangement allowed for the exploration of the research and commercial possibilities of a collaboration with the federal space agency's space launch facility. Subsequent grant support received from the state level quasi-governmental agency allowed the addition of a graduate research assistant -- one that would play a key team roll in the future. This graduate research assistant would become the sole precursor Consortia staff to be fully supported. The research assistant would eventually afford a more thorough investigation of what where the issues that had to be addressed to develop the association of the federal and university partner organizations' assets into an integrated engineering educational and academic research program facility and programmatic center.

During the period 1994 through winter 1996, the primary research focus of this center was placed on conducting the set of investigations into the market expectations, competitive realities, and models for university and government aerospace infrastructure centers.

Various investigative studies were performed. The assembled team began to identify center development funding as well as future sources of such institution commercial aspect's developmental funding. The research was performed by leveraging the "seed" funding initially secured from the quasi-governmental state agency. This

effort identified the federal space agency site and transferable assets as a potential “Jewel”.

Perhaps the major impetus further consortium development came with the emerging commercial market for smaller payload space launches. These launches were suggested by the takeoff of such space based applications as those implied by wireless communications or positioning satellites. There was a recognized shortfall in critical launch infrastructure assets to accommodate the future payload needs.

The critical question addressed by the quasi-governmental agency advocate, with support and guidance of the partner university’s commercial space Infrastructure team, was:

“ what would it take to develop the existing federal agency’s state located space flight center into a commercial infrastructure support? One which would render the state’s businesses that comprised the industry representation in the region as significantly market competitive in the emerging aerospace-based commercial [product-market] firms’ (e.g., small booster systems and communications satellite systems) marketplace?”.

Thus as of the fall of 1993, THE primary justification for the center development activity was:

- (a) The university’s engineering departmental needs for program development,
- (b) That university’s engineering college dean level interest; and,

- (c) The sponsoring quasi-governmental agency's staff level promotion of the investigation and development of the potential commercially significant infrastructure asset transfer to state control
- (d) Ownership and use of the Federal agency managed aerospace asset, and
- (e) That it was this potential "educational and research program development" asset which was THE one justification clause that would also eventually come to be viewed as having major commercial prospects and economic development significance for the state.

Initial Consortia Support was justified on Mission not Market

As of the fall of 1993, little impetus for the center's continued development could be attributed to a favorable consideration of the existence of a compelling new business venture case. The basis for that kind of assessment, together with an effort to better define the technological needs, was being funded by the quasi state governmental agency and the university's research foundation.

Specifically, a one year grant award was awarded to the university's infrastructure research center by the state agency. This grant was to support definitional studies of the venture. For example, one such study was to be conducted to assess the potential commercial viability of the venture. This study would provide for an assessment of the extent to which a proposed center could be devised that would have significant potential market and likelihood of commercial success as a Center.

The State Sponsored Agency and Partner University's "Story"

The initial 1991 grant proposal –submitted to the quasi-governmental agency -- was approved in 1992 for the engineering department of the university's engineering

college to develop a "Blueprint" for the commercial space infrastructure center. Together with "in-kind" contributions from the University, an agency grant-- for \$84K was provided. This grant covered the champion's salary ½ time, his departmental chair -- the then designated center head -- 1/2 time, and, a graduate assistant full time for one year. This funding seeded the program development venture. Both the department chair and the champion had full-time teaching loads at the time.

As with so many others outside of the military and NASA spaceflight community, this team reported that it knew little about the space "Business". At that time, the same was reported to have been true concerning knowledge of the associated existing and emerging competitive situation, and the requirements for winning development grants, and securing commercial launch service contract business.

Together with the engineering college, the university's senior management committed to providing significant resources from the university's program and research development functional area.

Thus in the winter and summer of 1991 through 1992, the primary objective of the grant was to address the recognized shortfall or limit in understanding about the "business" of the venture. Together with the research foundation staff support, the team began to investigate alternative sources of funding that could be pursued. This funding would be developed after receiving a commitment of launch infrastructure assets to the university's engineering college. These assets would be for research as well as science and engineering academic program development/enhancement.

Associated with this investigation, the following was unearthed:

1. In March 1993, it was discovered that there existed a U.S. Air Force Alternate Launcher Development Program grant competition. This program, known as the so-called “Dual Use” grant program, had an April 1993 call for proposals deadline. The Consortia management office responded with a bid.
2. In connection with that effort, it became known that the state located assets of the federal partner – used significantly in the past for orbital and sub-orbital space experimental as well as limited scientific payloads launch and transport system support, was experiencing under-utilization. This underutilization existed while maintaining a 1200 person workforce. They were down to a 1 to 2 per year launch frequency – itself a highly “underutilized “ situation.
3. The commercial vendor systems that utilized the facility were Westinghouse and CTA ER.
4. A sponsoring Departmental agreement for programmatic alliance was established. This was staffed with relatively experienced and knowledgeable Commercial Space Research Program faculty with relevant expertise and practical experience at the University of Tennessee – Tullahoma.

It should be noted that the Dual Use program was designed to support the development of new lower cost launch vehicles whose payloads could be both military as well as commercial.

It was in pursuit of determining the design requirements of the latter launch system application that discussions with potential commercial payload and launch system vendors where initiated. There was also the need to gain a feel for the commercial

potential of the infrastructure facility. Thus, considerations of future application market assessments were initiated.

From Failed Bid to Success

The bid for Dual Use funding was not successful. However, the university and interested regional area political leadership learned from the unsuccessful attempt. For example, it was learned that there would definitely be a flow up bid the following year. Furthermore, in pursuit of the desire to develop a stronger proposal – one that had real prospects of award, the initial grant proposal rejection was followed up with a series of fact finding discussions with the Air Force program office as well as discussions with identified technical experts and institutions that could be placed under the category of future bid “fix it” discussions.

For example, The consortia management in this timeframe became aware of the need to secure certain federal agency facility use license agreements. Similarly, on the side of the technical systems involved, the need to establish access to knowledgeable space launch design and support systems expertise became clear and was pursued.

What the champions learned was, as with any unknown commercial entity, the Air Force had a need to award grants to outfits/organizations that were known to be credible.

As a university-led group – one that was also relatively new to the space launch business – the partner university consortia involved team that had a credibility problem to overcome in the eyes of both the US Air Force and certain key industry participants. It was later discovered that the credibility issue was also the case with regard to the federal partner agency senior management as well.

Federal Agency – The Introduction to Emerging Commercial Facility Development Partners

In the process of determining what it would take to improve the prospects for securing the Air Force Dual-Use infrastructure development support grant, the consortia management entered into discussions with various agencies that would prove essential for future commercial space infrastructure development.

At the end of academic year 1994-1995, the initial state agency funding ran out. Therefore, the center activity was forced to be carried on at a significantly reduced rate. The consortia management team was able to eventually receive 8K from the state quasi-governmental agency in support of a graduate assistant. The faculty involvement at this stage became that developed by belief in the promise of the idea – in other words it was done as “sweat equity”.

There were, however, some independent developments that would prove essential to further advances in the development of the commercial space infrastructure project’s eventual success.

Related Developments Save the Day

At the federal agency there was a new Administrator installed. This senior official had the charge of reducing the agency’s bureaucracy while increasing its commercial relevance. Associated with this thrust came the announcement of his intention to shut down the state located facility in the 1993-1994 timeframe. In addition, the management and staff at the launch facility site became more assertive in advancing the unique and underutilized assets of the site as it related to the state government.

It was noted for example that the facility had a requisite missile launch range, booster and payload tracking capability as well the requisite staff technical expertise to rather advantageously support < 8k pound low earth orbit (LEO) launches. In addition, the facility provided the state with ~ 1200 tax paying jobs.

The Quasi-Governmental Agency's Mission Re-emphasis

In the summer of 1995, there was a shift in program emphasis at state sponsored quasi-governmental agency. That mission shift was from one focused on educational program development to a mission centered on programmatic impacts on economic development goals and objectives. Thus the agencies new mantra became " Jobs, Commercial Companies, and their Competitiveness (or so-called "JCC's") together with the enhanced potential for tax revenue generation and state economic soundness. This served to underscore that the economic development objective took on a new importance -- and grant awards emphasis -- for assessing the relative merits of projects to be supported by that organization. With this, the quasi-governmental agency began to champion the clarification and development of the initial space infrastructure research center as a potentially attractive commercial development.

In the meantime, the Air Force bid opportunity once again presented itself. The requested award (for funding of facility design and operations concept development) were assessed by an industry recommended team of infrastructure experts to be on the order of a \$2 million Architectural and Engineering (A & E) Design and capital outlay budget. There was also a requirement for the proposing organization to secure matching funds from state and local governments.

Due to its past efforts, the center once again responded in the fall of 1994-1995 (this time with a far superior proposal – particularly with regard to the commercial infrastructure development aspect of the bid). Nevertheless, this bid too was turned down.

Subsequent investigation in early 1995 suggested that the outcome was politically motivated (of 12 sources selection members, 7 were from the U.S. Air Force and 5 were not). It became safe to assume that an agency so-called ‘known entity’ bias had to be overcome.

An Alternative Source of Developmental Funding

As of the fall 1994, on a parallel track to the Dual Use effort, at least in response to the uncertainty of that funding realization, as well as in association with an indigenous leadership interest in the venture, consortia senior management readily participated in nurturing a grass roots political sentiment in favor of public support of the idea of the center.

Having protested the outcome of the Air Force funding decision--to no avail -- the team was presented rather serendipitously with an alternative source of funding.

In a significant parallel development, a local Economic Development Official in the so-called “Eastern shore” area of the state, through professional networking normal operations, came to be aware of another federal agency’s economic development program (in this case The U. S. Department of Commerce) that seemed to suit the situation.

This Department of Commerce program was judged as a strong potential supporter of the consortia’s well thought out capital outlay project. This DOC vehicle

for funding the consortia's development however required state and local governmental support of any public-private commercial capital outlay projects.

At this point the partner university also got into the advocacy fray on behalf of the Consortia's development. Key state level support was garnered in addition to that propelled by the immediate area's political contingent. As a result, contact with key elements of the state legislatures finance committee resulted in an invitation to present the concept and financing requirement to the committee. There was a 1-hour presentation that resulted in a budget appropriation for the center. This yielded the requisite budget commitment and annual outlay authorization. This resulted in a April 6, 1995 state general assembly approval for the creation of the official bonding agency known as the state's space flight entity – a development that transformed what was the “center” into an official space authority – and the ultimate form of Consortium “D”. This development also resulted in the consortia senior management team receiving the Department of Commerce's matched award. However due to the congressional budget debate, that grant award was suspended until it was resolved, some 9 months later – that is, in the fall of 1996. During that 1995-1996 time period, the university housed center staff was maintained primarily through senior consortia staff volunteering its time and the university 's continued in-kind support.

It was noted also that it was during this time, the initial official head of the former research center stepped down, judging the project “a losing proposition” and waste of faculty time. This was to be a future prognosis of the consortia and opinion with regard to the consortia's commercially viable future that would prove “errant” at best.

Organizational Developments

The state approval of the venture came with a “tax”. Attached to the budget line item was a requirement for the establishment of an oversight body and official unit (known/referred to as the state’s space flight infrastructure authority). It was populated with a board that had the authority to withhold funds. Those awarded funds were withheld until recently – i.e., until the later part of 1997.

With local political support, the Department of Commerce’s grant award decision was appealed first to the state capital area offices of the Federal Government, and then subsequently to the Federal Regional offices in Philadelphia, Pennsylvania.

As of November 1996, the net result was that there was a pledged commitment on the part of the state to provide a guaranteed 20 percent (and then later on a 50 percent) match funding of the 2 million infrastructure facility would eventually be secured. The money was awarded.

It would take 9 months, however, for the award to be released to and secured by the new state Commercial Space Flight Authority.

Novel Aspects of Consortia ‘D’s Development

Perhaps unique to the advancement of Consortium “D” is the fact that its progressive development was clearly benefited by a political advocacy. This advocacy took the form of an extensive and effective local elected official-led political advocacy contingent. At critical junctures in the progression of Consortium “D”’s commercial formation, this political contingent -- together with active support by the partner university -- successfully interceded with state government agencies to secure an absolutely critical official organizational authorization. Likewise this political contingent

intervened at the federal level to assure the allocation of Consortia saving federal funding and agency cooperation. Novel to this Consortia's development was the extent of well –formulated political support and its development advocacy.

Perhaps equally novel – and vital to the Consortia's commercial viability—was the strong pervasive but discrete industrial partner advocacy and substantial knowledge work contributed throughout the early stages (that is through the pre planning and business concept formulation) of the venture's advancement. This was to include the industrial sector partner's significant operational experts contribution to the venture's development up to the commercial scale.

That partner had been pursuing a range of commercial launch needs solutions on a national scale. The unique aspect of its pursuit with regard to Consortium "D", was the extent to which it's desire for a university led venture advocacy fell on receptive ears. That is in the case of Consortium "D", the industrial partners efforts to promote a university industry, state and federal agency partnership for such a commercial venture essentially "got nowhere" BUT in the Consortium "D" situation. There, "it worked". A university champion was developed, multiple potential vendors corroborated to assure facility universality and a receptive state apparatus worked to realize the commercial potential. This was to prove to be essential – and perhaps unique.

The Development of Grass Roots Political Support for the Consortia

With the announcement of this loss as well as the coincidence of the federal agency's planned shut down of the state located space flight facility, consortium "D"'s management, in concert with Eastern Shore area political leadership, suggested that future efforts to advance the any commercial space infrastructure should be focused on

realizing significant political support for the project. Minimally, it was felt that official support would lend much needed credibility to any proposal advanced. Officially recognized support would significantly improve the chances of receiving a grant award.

Local Political Advocacy Proves Key

To that end, led by local eastern shore state legislative advocates, representatives of the State legislature were targeted for cultivation of state and federal government elected official support.

Discussions with potential commercial partners (e.g., state based payload and launch systems vendors) resulted in an emerging understanding that the competitive infrastructure decisions would be based on the facilities' ability to provide "Access" to desired commercial space payload orbits cost effectively. Under those considerations, the associated university partner and the state situated flight facility concept was found to be commercially competitive. Creditably was developed in a way that would demonstrate a commercial competitive entity viz. a viz. alternative nationally (and internationally) deployed commercial payload launch options.

Self Reported Critical Roles Played

The following appear to have played critical roles in the course of the successful development of Consortium "D":

- (g) The identification and dedication of the consortia's champion;
- (h) An effective sequence of Quasi-governmental Agency's sector directors' advocacy and support for the Consortia's venture advance;
- (i) Effective formation of political advocacy -- both at the state and federal levels -- grounded in solid local-level elected official advocacy;

- (j) In part as a direct result of item ‘c’ above, the creation, in April 1995 by an act of the legislature of the sponsoring state government, of an official (legally liable) Consortia organizational entity. This was viewed a absolutely key to Consortium “D”’s commercial viability and development;
- (k) The meaningful allocation of in-kind resources as well as the approval of limited financial support on the part of the partner university during the pre-commercial launch of the Consortia. These resources were essential for sustaining consortia management and operations expenses; and,
- (l) The meaningful and compatible federal agency development policy initiatives that set the stage for the redefinition and creation of the current form of the commercial space industrial sector – and thus this [i.e., consortium “D”] venture.

The Framework for Assessing ‘D’ as a Consortia – The Interviews Summary

This section synthesizes results of interviews with representatives of each of the four sector partners – (1) university, (2) federal agency, (3) state sponsored agency, and (4) key private sector enterprise participant. The results are organized to reflect a synthesis from interviews, documentation collected in association with the interviews, and other documentation concerning the venture.

The discussion of the summarized results that follows is organized around response to four key areas explored for during this effort. These areas are listed as the headings of the various sections and include: (1) Industry Dynamics Considerations in Consortia Venture support, (2) Target Markets and Consortia Venture Support, (3)

Organizational Structure and Process, and (4) Modifications to New Venture Support Decision.

Industry Dynamics Considerations

With the exceptions of:

- (d) The pre-state legislative approval for the official space flight authority authorization – that is in the form of a set of market and venture assessment studies and analyses performed in support of the creation of the venture’s business plan;
- (e) The main private sector partner’s decision procedures for agreeing to participate in partnership with the consortia venture commercial planning and development; and,
- (f) Subsequent private sector financing of the Consortia’s further development;

Virtually no consideration was given to the matter of product/service positioning and model development based on the industrial dynamics faced by the proposed venture.

The Industrial Partner’s Role Was Key

Be that as it may, the input from the industrial partner’s venture advocate team did provide an invaluable awareness of the commercial realities that the venture faced. The actual design , competitive cost performance targets as well as the operations and business model that would eventually become that of the venture were developed with the strong input to these topic areas by the industrial partner advisory team.

The actual legislative, legal entity as well as organizational model for the consortia was developed in corroboration with the industrial partners active input and

guidance. That input was early (1993), protracted (current input is still being provided by the initial team members) and industry wide in sweep (input came from a team that was addressing on a national commercial markets scope -- space launch competitive realities and imperatives).

Perhaps a quote from the enabling state legislative document (a state legislative act that passed into law before the authorization of bonding authority was granted) will underscore the relative absence of exacting level of market and business analyses performed:

... Whereas, the [*former academic center*] for commercial space infrastructure has been chartered by the [*host state's quasi-governmental agency*] to foster, through research, development, and education, the growth of technological systems and organizational entities required to engage in commercial space activities; and
 Whereas, the commercial space flight field has enormous potential to benefit many fields of human endeavor, including life sciences, telecommunication, and environment protection; ...; and,
 Whereas, it is the desire of the [*host state*] to establish a commercial space flight center on [*a specific area of the state*]

The act goes on to establish the specific rights, duties and authorities of the new consortia's organizational legal and state sponsored entity.

Be that as it may, limited assessment of the commercial competitive requirements were conducted or allowed to guide decisions and its operations management.

The following are the answers inferred or explicitly provided by the collective responses of the venture partners associated with Consortia 'D':

1. The forms of support provided by the partners in Consortium "D" were not motivated to leverage underlying maturity of the industry patterns in the industrial

sector (information technology) most closely aligned with the venture. The venture was not primarily concerned with patterns which could be conceived in terms of the trends in technology and business systems innovation unfolding in the industrial sectors that would be targeted by the venture. Although in the case of this Consortia, some consideration was given to this issue in the course of the business plan development. In addition, with the possible exception of the commercial partner's evaluation process, considerations of these industrial and technological dynamics were not evaluated or considered in garnering other partner support for Consortium "D". To the extent industry maturity and patterns might have been considered, such considerations were not explicitly evaluated or used to further galvanize partner support. It must be noted that some effort is being currently expended to do just that.

2. Both at the internal (to the university senior management) venture support for feasibility as well as for various private sector investor explorations conducted by state sponsored agency industry sector's planning and infrastructure asset development executives, some venture assessment frameworks have been applied.

Be that as it may, the venture investment "decision making" frameworks applied to secure the asset – or even those employed to aid the decision to proceed with university ownership of the technology research and development services, as a general rule, was not in use during development of the consortia. The business plan did clearly articulate a need to characterize the Consortia concept in a way that made clear how it effectively would harness the underlying business and technology cycles attached to each of the targeted potential industrial sectors. This concept was secured through a set of

recently signed Memoranda of Agreements and sub agreements entered into on the part of both the federal and state sponsored partners of the consortia.

Thus, in a limited way, some consideration of the technology cycles of the target industry sectors have been applied in the case of Consortium “D”. Consortia “D” in its current form, has only been in operational existence for less than a year.

In this case a viable business model together with its associated marketing development plan and organizational structure for realistic commercial success will be tested in the marketplace. Thus it will either prove itself as having the correct focus or be called upon for refinement.

Given it’s two pronged programmatic thrusts, Consortium “D” does not conform to traditional university research positioning – that is, that occupied by the typical university consortia as regards the phases of research still apply in this regard.

Specifically this facility is positioned to be a commercial services broker and management and technical training facility. In this capacity, as a so-called Center for Excellence branch, it will hold the potential for accommodating advances in engineering management topics through various forms of applied research.

It is too soon to tell or verify whether or not Consortium “D” sponsored R & D projects will succeed (or at least satisfy clients) when there focus is on well suited product or services which are in concert with the fundamental phases of the technologies development? ¹⁷

¹⁷ For example, given this consideration, it could be argued that the sponsored venture should have as its main product: the performance of **research services contracts** for the conduct of basic research, applied research or developmental research R & D phases. Alternately it should **provide product/process licensing services contracts** for the new venture technology’s developmental and initial introduction phase);

Collaboration across university or corporate cultures, a clear goal of the venture, has not been experienced or worked out. That kind of collaboration, although a consistently held “vision” and objective of the participating Federal agency senior management, remains an untested and thus as of yet unrealized objective. Nonetheless, preliminary conversations and contracted services provide a basis for future evaluation of the consortia D’s effectiveness in this regard.

Markets—Target Markets and Consortia Venture Support

A shared view of a “product-markets” based assessment of the competitive dynamics and associated market potential for Consortium “D” HAD NOT been developed. As a result, a viable commercially credible evaluation of the Consortia business model’s market potential did NOT inform the successful advocacy of the Consortia as it was discussed among the partner university, or federal level officials whose support had been expressed.

In effect, there was a “gut feeling” that it was commercially viable concept and essentially “a good thing” for academic and economic program development. However, there was not a model of the market or marketing and business development plan that served to support the assertion of commercial promise during its early stages.

The Consortium’s business plan -- containing estimates of the anticipated level of commercial space flight activity, break even estimates, service pricing models, requisite launching frequencies, etc.-- was required in connection with the State finance committee Space Flight Authority deliberations. Prior to that stage in its development, it was not needed or prepared before the timing of that requirement.

The Markets—Strategic Option-Competitors

Review of key product market competitor landscapes showed that – in terms of commercial product or service market shares erosion -- international competitors were exerting major commercial competitive pressure on markets in which US launch services vendors.

In one reference year (February, 1996 for example), non-US launch services vendors were estimated to have accounted for about 60% of all intermediate-to-heavy payloads of commercial satellites launched --world-wide. A mere 35% of that total market was attributed US based launch services providers. Industry reports attributed this expanding foreign commercial market presence to payload cost profile advantages being enjoyed by competitors.

Securing a more cost effective payload launch services assumed a status of “commercial strategic imperative” for the consortia. This was due in no small part to the widely recognized inherent cost advantages enjoyed by increasingly strong international competitors. This need, together with a general recognition of an aging fleet of payload launch systems designs, precipitated efforts to create a viable commercial space launch sector on the part of national policy makers.

This call resulted in the initial US Commercial Space Act of 1984 and its subsequent amended appropriations legislation. That legislation provided for a sequence of U.S. Air Force administered so-called “Dual Use” \$10 million program development competitions. These competitions served to identify at least 5 competitive formerly government agency operated space launch facilities that were assessed to also be able to

support – and advance – commercial space flight centers. These 5 were identified to be those facilities located in Alaska, Virginia, Florida, California, and New Mexico.

Thus five strategic competitors were identified. These are currently defining their unique strategic approaches to competing for this strategic product market.

As stated in a reference consortia business planning document:

“ The only significant competitor capable of accessing the same orbits as Consortium “D” is Spaceport Florida. The lower costs and faster turn-around for launch missions that should be achievable at Consortium “D” will give the Consortia a competitive advantage.”

The Markets—Strategic Development

Consortium “D”’s partners had a rather inconsistent perspective of product distribution. The view pretty much centered on a perspective view of service product distribution to be via so-called “bellwether” market provision. With the possible exception of the private sector (or corporate) partner. The industrial partner developed a consensus view among each of the remaining partner organizations through a process of interaction and corroboration with each that had the effect of developing a consensus.

In the case of Consortium “D”, the apparent approach selected for its strategic market development was one in which a clearly defined and innovative business model would be arrived at through close developmental relationships with a participating strategic customers or allies. The industrial partner was clearly viewed – and positioned to be – the primary example of this group.

On a state infrastructure level, the facility’s role was viewed consistently with respect to this market development focus. Here the core vision was for the Center of

Excellence aspect of the Consortia operations. This center was to serve as a shared asset for various advanced space flight as commercial transportation technology applied research initiatives. These activities would also be such that they would provide a set of standards setting operations. Thus the consortia was envisioned to become a well spring (or incubator) for corporate and technical talent development.

This would suggest that the partners viewed as proper a strategic vision of the non commercial services provision aspect of the consortia as: being organized in a way that would support at most a product-market orientation in which technology for research and development testing services of products would accommodate any project associated user or industry standardized applications.

The consensus orientation left as “unconsidered” and necessary further strategic focus on the matter of product’s distribution issues in the consortia’s design or operations.

Although it was viewed as key in some of the interviewed opinions, it is clear that such product distribution concerns were given limited consideration in the course of arriving at a positive decision to support of Consortium “D”’s commercial operations launch.

Organizational Structure and Process

The assumed appropriate culture for the Consortia Venture -- among its partners organizations (with the exception of the private sector, the federal agent and the center champion) seemed to be absolutely entrepreneurial.

This culture was punctuated with the desire to establishing limited strategic alliance based project teams. Thus, organizationally, Consortia “D” benefited from the

kind of collaboration of strategic alliance-based service provision contracts and project team developments.

Regardless of this uncertainty, it was clear that effectively forming traditional R & D structures, which depended upon a given industry's standard collaborative or subcontracted research and development practice, WAS NOT an explicit aspect of the vision of either the champion or any of the remaining partners.

Organizational Structures – Technology Innovation Management and R & D Strategy Implementation

The market and strategic development plans for commercial sector support by Consortia 'D' are in their refinement stages.

The primary objective remains to support the commercially available modification of advanced commercially developmental services commercial contract performance through iterations and testing.

Defense service contracts are not specifically forbidden as a condition of the transfer. Thus, the current organizational structure accommodates novel non defense public sector applications as well as those emerging modifications called for in defense related service provision. The consortium management is open to novel approaches that establish appropriate channels so that Consortia "D" to further secure competitive advantages in its emerging global market place. Under the research aspect of the concept, Consortium "D" may well serve to become a "wellspring" for commercial space launch related products and services in addition to being a strategic asset for various commercial new product development organizations.

Through the support of the private sector industrial partner venture team members , the Center project team efforts, with respect to operations and strategic development, were clearly formulated with a mind toward addressing considerations of the established and emerging vital business culture of the target launch product markets. Cultural compatibility with target product-markets is a structural design constraint that was intended to be accommodated in the center's operational designs and procedures. Significant commercial space industry expertise has already been factored into the center's operational designs and procedures.

Forms of Governance/Ownership

With the advent of the official establishment of the state space flight center authorization, the Consortia organizational structure was not defined. Thus, it is not clear to what extent the structure could be made to facilitate collaboration with commercial partners, or at least be open to developing an appreciation of how to structurally facilitate such collaboration.

The Authority has a board of directors that includes: (a) the partner state quasi-government agency's president as the committee chair, (b) the university president as a permanent board member, and (c) several prominent commercial space sector and financial sector related corporate executives and technical experts – a significant portion of whom hail from the private sector.

Senior Consortia management is of necessity very concerned with this governance issue. Until recently, the consortia executive director was not allowed to expend any of the available capital resources. The implicit model in apparent use was that of business as usual but targeted to commercial markets. For these markets, no one on staff had any

measurable past experience in successfully addressing. That experience was to be developed via strategic alliances formed in conjunction with private sector partnerships.

Comments made regarding collaboration suggests that any kind of team collaboration structure required by customers, will most likely represent no major challenge to the Consortia management team . They look forward to the advancement of their knowledge of the business that will be obtained through the required collaboration with both corporate allies as well as with other faculty of engineering schools of the various universities located throughout the state.

In this regard, the center is very much in the formative stages of its development. Therefore, its organization as well as any other team structure, will be executed in a way that will be accommodated and supported by the center facilities, senior management, and the board of directors.

With respect to the matter of securing Consortia venture development resources from its partners, it can be said that explicit consideration was given as to whether consortium 'D's business model matched up well with the organization and procedural norms which characterize the product-markets targeted.

A demand has emerged for continually redefining the business case for the Consortia at the university research organization, the state quasi-governmental agency, and various other private investor quarters which focused on the Consortia's viability. Thus, a focus on "fit" of organizational and procedural norms is a focus of Consortia management team.

Organizational and Process Management Rules

Both at the level of the state quasi-governmental agency as well as the private sector partners of Consortia “D” – which includes its venture development team – both of these partners focused on adequacy of senior management’s concern for supporting technology innovation in relation to creation of an “innovating” corporate culture.

Focus on a creating a so-called “learning organization” occurred at the State level. However, this was not an explicit concern of the consortia or regional level partners.

The business model of the consortia supported the notion that entrepreneurial teams and environments benefit from being isolated from the culture of the firm or firms that produce and distribute existing products. This was achieved primarily by providing an off-sight test results collaborative work site for the project team members.

There was a vision that competitive advantages could also be secured based on the option to have results accessed remotely – given suitable advanced infrastructure installation.

The matter of promoting effective innovation to support the creation of inter-organizational self-directed teams was NOT an explicit consideration for the consortia.

The following forms of partnership could be accommodated by the Consortia operational configuration and policies:

- e) Virtual Corporation¹⁸ (where pre-prototype services were contracted out by the industrial/commercial Consortia partners),

¹⁸ “Virtual Corporations” as used here refers to the relatively flat new product development governance structures. They are considered to enjoy relative competitive advantages (e.g., in terms of product introduction speed and higher quality solutions effectiveness). Advantages are due to the fact that these corporations can take advantage of such underlying process technology innovations as those found in communications technology innovations (e.g., telephony’s email, video conference, and “groupware”

- f) Alliance (with limited coordination but composed of members driven to enhance their own relative positions)
- g) Joint Ventures (a separated legal distinct organization jointly invested in by the partners in terms of money, personnel (fixed temporary assignments), and/or other in kind investments) and
- h) Variations on Corporation Governance (autonomous divisions – e.g., a wholly owned subsidiary) or a unit contained “within” the corporation.

The specific set of organizational and operational infrastructure necessary to realize these options had not been reportedly worked out for each by the consortia.

Moreover, such considerations were not articulated outside of various factions of the state quasi-governmental agency –e.g., at the regional, industrial sector and partner organizational level.

Therefore, realization of improved organizational and operational infrastructure outcomes remains a hope because, to date, there were very few recorded projects underway or completed. Thus, there is insufficient data to provide further insight for these sets of issues.

As Consortium “D” is a relatively new start up center (i.e., it has just competed its second round of financing in venture capital terms), the matter of its team interactions and work styles (both formal or informal manner), mirror the entrepreneurial , management by objectives (MBO), or protocol modes. These modes are characteristic of the target product market industry norms but cannot be assessed with respect to the

networks) and their associated commercial cultural shifts (reduced loyalty to the firm with greater commitment to the technology). These developments support the ability to quickly assemble “r & d-to-new-product-launch” project workteams comprised of expertise which resides in various organizations.

consortia. Whether for example, consortium 'D' is alternately a "flat" (clustered), star, or hierarchical structure interfacing with a compatible commercial partner's organizational structure cannot be addressed at this juncture.

Nevertheless, due to its formative nature and location, it is in all probability the case that the consortia structure could be managed in a way that it would provide the innovative "reservations environment". Such environments are noted as being required to accommodate innovation in all operations.

Quasi Governmental Agency Roles:

This is a clear case of an absolutely vital role having been played on the part of the quasi- governmental agency roles. Initial business venture model development avocation and concept vision was essentially authored by this agency.

Staff changes, together with funding for concept feasibility development and subsequent assessment was key to success. Clearly, a vital political support garnering role continues to be played by the senior management of the agency – its president is the chair of the authorities board of directors.

It was noted by several respondents, that the state governor as well as the university president had to be developed into advocates of the Consortium "D" concept and reality. Both have been brought to that position.

In short the significance of the agencies role cannot be overstated.

University Role in Consortia

Interviewees felt very positive about the role the university partner played in the Consortia's development.

In addition to critical advocacy at the senior university management level, the engineering dean's level support resulted in early and meaningful faculty led research, political support, and some initial operating capital which were all provided by the partner university.

It was the university, through its sanctioned support of the independent research center organization, that contributed technical faculty and the organizational due diligence required to advance the idea to an initially staffed activity.

The kind of support found to be associated with successful efforts to launch advanced technology new ventures through university affiliated consortia where -- in the case of Consortium "D"'s advancement "direct operations expense investment". The expenses covered included a major line of resource (or budget item like) account coverage for the facility's interim operations. In addition to these, the quasi-governmental agency, in partnership with the university's independent research organization, provided the necessary resources to operate as well as have performed the business plan development which served as a critical reference in the course of securing state fiscal authority as well as critical commercial partner support.

Modifications to New Venture Support Decision

The Consortium venture has not developed a pipeline of products or established an R & D process to leverage the organization at this time. It is too soon in its development to assess these developments.

Appropriate R & D team staff personality profiles, Selection

How, or whether or not the personality of the new venture's team, or that of its champions, will generate the delegation of authority needed to realize the venture's organizational and operational objectives is not known at this point in the venture.

There has been some reservation expressed among interviewee's regarding the appropriateness of the current team's composition and orientation for realizing the commercial objectives laid out for Consortium "D".

With respect to the consortia educational objectives, similar reservations have been expressed. It can be said that clear progress toward its goals of development have been registered. Nonetheless, there are clearly mixed assessments on the part of the interviewees concerning this aspect of the venture's characteristics.

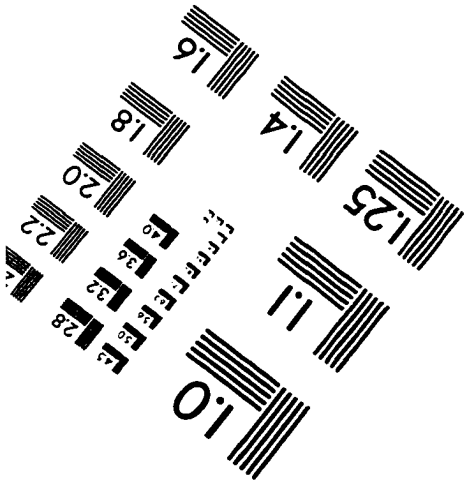
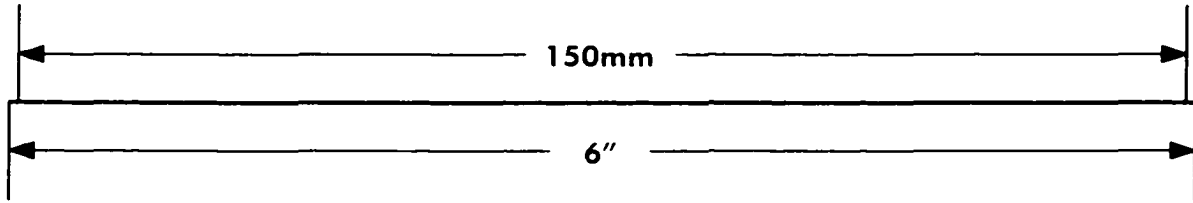
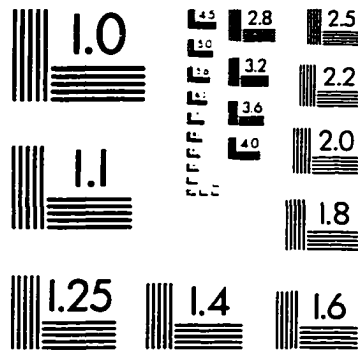
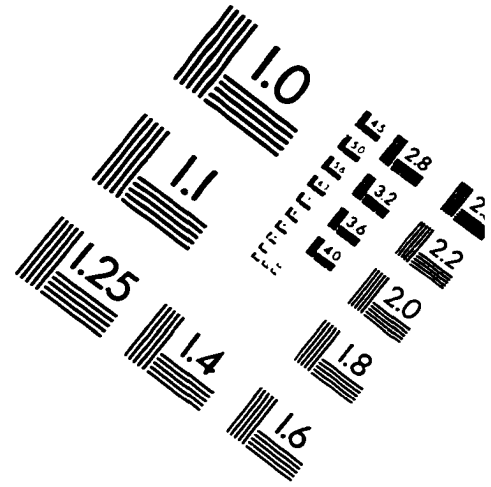
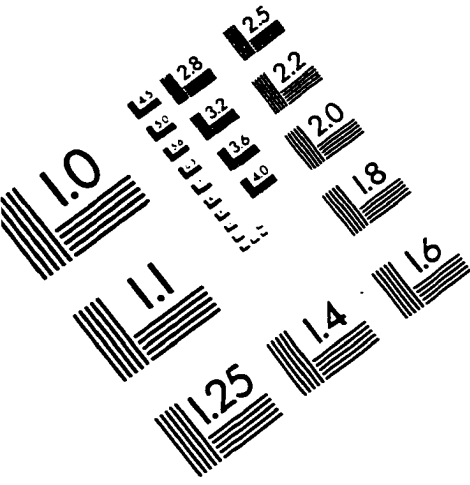
The team assembled was viewed as a strong link in the advancement of the venture to its current level of commercial success.

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