
Smart Practices for Collaborative Manufacturing in British Columbia's Aerospace Industry

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EXECUTIVE SUMMARY

Introduction

British Columbia's (B.C.) aerospace manufacturing industry is primarily comprised of small and medium enterprises (SMEs) that operate in the lower tiers of the aircraft manufacturing supply chain (KPMG, 2014). Small aerospace firms like these face challenges of scale in the increasingly competitive and globalized world of aircraft manufacturing (Government of Canada, 2012, p.10). In recent years, Original Equipment Manufacturers (OEMs), such as Boeing and Airbus, have expressed a desire to consolidate their supplier base and to focus on suppliers with greater size and integrator capacity (Government of Canada, 2012, p. 10; KPMG, 2014, p. 7).

This trend of OEM supplier base consolidation, coupled with the challenges of staying competitive in a capital-intensive and technologically advanced industry, has led a group of B.C. aerospace manufacturing firms to consider forming a manufacturing network. Also known as consortia or alliances, manufacturing networks allow small firms to pool vital research and development (R&D) and production resources, share knowledge, and compete for larger contracts and work packages (Walsh & Hanna, 2008, pp. 299-300; Link & Marxt, 2002, p. 71; Kasouf & Celuch, 1997, p. 475).

The Government of B.C. has recognized aerospace as an industry where the province has high potential for economic growth and job creation, and has pledged funds to encourage industry growth and the development of a unified aerospace cluster. As a result, a client within the Government of B.C. has commissioned this study of smart practices for collaborative manufacturing networks to determine what practices will yield the greatest chances of success for a B.C. aerospace manufacturing network that will lead to growth in the aerospace industry and the provincial economy.

Methodology and Methods

This project used a qualitative approach using key informant interviews to gather data to answer the following research question:

- *What are smart practices for the development and operation of a collaborative manufacturing network for B.C.'s aerospace manufacturers?*

The following supplementary research questions were also explored:

- *What governance structure do networks use?*
- *What are the motivations that lead to network development?*

Research tasks included:

1. A literature review to discover central themes and recommendations, and to inform a conceptual model to guide the primary research.

2. A jurisdictional scan to find any existing government initiatives aimed at encouraging collaboration or network formation in the Canadian aerospace industry.
3. Semi-structured interviews with representatives from existing, North American, collaborative manufacturing networks to determine their network's formation process, structure, outcomes, and any recommendations offered on the basis of their experiences.

Findings

The jurisdictional scan findings revealed no examples of government initiatives specifically aimed at creating collaborative manufacturing networks; however, several provinces and the federal government have supported industry-academia collaboration for aerospace R&D and workforce development. Furthermore, Quebec, Ontario, and Manitoba have implemented programs or projects to encourage aerospace cluster development and supply chain optimization through collaboration.

The interview research revealed a wide range of findings, including the following:

- Most networks were developed through a combination of industry and public agency involvement, not exclusively one or the other.
- Central challenges expressed include concerns about opportunism, confidentiality, quality of work, fairness, and difficulty explaining the network concept to employees, firms, and customers.
- Most networks were incorporated non-profit organizations, and were governed by an elected volunteer board of directors.
- Membership was often assessed and valued on the basis of leader personality and attitudes towards collaboration in addition to company capabilities.
- Many networks also engaged in collaborative training and education.
- Networks entering into contracts directly with customers were a rarity, due to complications such as member concerns about autonomy, logistical complications, and customer reluctance. Instead, member firms entered contracts with the customer and then sub-contracted out parts of the work order to fellow members.
- Networks offered a range of benefits, including new customers and increased business, networking opportunities, member referrals, information about new methods and tools, access to increased capacity and capabilities, and organizational learning.
- Firm benefits were felt to be dependent on the level of engagement that a member had with the network and its activities.
- Interviewees noted that the timeframe for network development was long and many stressed the importance of establishing realistic expectations and supporting members to avoid disenchantment and loss of members during the process.

The analysis of the findings led to the development of the following set of strategic implications that the client is recommended to consider during the course of network development and before any recommendations are adopted:

1. Professional, unbiased services and advice can be invaluable in the initiation and set-up phases for legal, accounting, and research tasks.
2. External support from public agencies can be an advantageous resource but should be accompanied by industry engagement to ensure the best chance of network success.
3. Business leader attitudes towards collaboration and firm culture are critical to network success, and should be considered in membership criteria.
4. Anticipate a long timeline for network development, and keep expectations realistic to prevent disillusionment of membership.
5. The challenges of creating a network that successfully enters into contracts directly with customers can outweigh the potential benefits of this arrangement, and it can be preferable to have member firms sign the contracts and then sub-contract amongst themselves.
6. Networks offer a range of benefits beyond direct financial gain, all of which should be capitalized on for best return in investment.

Options and Recommendation

Flowing from the research findings and strategic implications, a set of network development approaches were considered:

1. *Status Quo - No Network Development:* A continuation of current aerospace industry operations without the creation of a network.
2. *Dominant Firm(s) Network:* One or more of the province's dominant aerospace firms take leadership in creating and operating a network.
3. *Industry and Government Led Network:* Government and the aerospace industry as a whole jointly form a network, with government playing an organizational leadership role.

The options above were considered according to anticipated cost, government involvement, political implications, effectiveness, and timeframe.

Both options 2 and 3 were found to be advantageous, but option 3 was ultimately selected because there are not any B.C. aerospace firms that are currently believed to have the capacity or motivation to lead a network initiative on their own.

Option 3, in combination with the strategic implications recommendations found above, is recommended in order to best guide the development of an effective B.C. aerospace

manufacturing network with the goal to improve industry growth and competitiveness and yield economic benefits for the province.

TABLE OF CONTENTS

ACKNOWLEDGEMENTS	ii
EXECUTIVE SUMMARY	iii
Introduction	iii
Methodology and Methods	iii
Findings	iv
Options and Recommendation	v
TABLE OF CONTENTS.....	vii
LIST OF FIGURES AND TABLES	xi
1.0 INTRODUCTION	2
1.1 Defining the Problem	2
1.2 Project Client.....	3
1.3 Project Objectives	3
1.4 Background	4
1.5 Conceptualizing Collaboration	4
1.5.1 Terminology	4
1.5.2 Network Motivations	5
1.5.3 Network Governance	6
1.6 Report deliverables	6
1.7 Report Organization	7
2.0 LITERATURE REVIEW	8
2.1 Definitions of Collaboration and Networks.....	8
2.2 Causes of Collaboration	9
2.2.1 Trend of Increased Collaboration.....	9
2.2.2 Motivations and Benefits.....	10
2.2.3 Innovation and Organizational Learning	11
2.2.4 Collaborative advantage	11
2.3 Public policy and the role of network agents	11
2.4 Practical Considerations for the Development of a Collaborative Network.....	13
2.4.1 Partner Selection.....	13

2.4.2	<i>Success factors</i>	13
2.4.3	<i>Structure</i>	14
2.4.4	<i>Risks, Trust, and Opportunism</i>	15
2.4.5	<i>Failure</i>	17
2.5	Conceptual Framework	18
2.6	Conclusion	19
3.0	METHODOLOGY AND METHODS	21
3.1	Methodology	21
3.2	Methods	21
3.2.1	<i>Literature Review</i>	22
3.2.2	<i>Jurisdictional Scan Internet Search and Website Review</i>	22
3.2.3	<i>Interview Research</i>	22
3.3	Data Analysis	24
3.4	Scope, Limitations, and Delimitations	25
3.4.1	<i>Scope</i>	25
3.4.2	<i>Limitations</i>	25
3.4.3	<i>Delimitations</i>	26
4.0	FINDINGS: JURISDICTIONAL SCAN	27
4.1	Federal Government	27
4.2	Quebec	27
4.3	Ontario	28
4.4	Manitoba	29
4.5	Alberta	29
4.6	Saskatchewan	30
4.7	New Brunswick	30
4.8	Conclusions	30
5.0	FINDINGS: INTERVIEW RESEARCH	31
5.1	Initiation	31
5.1.1	<i>Motivating Factors</i>	31
5.1.2	<i>Prior Knowledge</i>	31
5.1.3	<i>Challenges or Issues</i>	31
5.2	Setup	32

5.2.1 External involvement	32
5.2.2 Costs and Funding	32
5.2.3 Form and Governance	33
5.3 Realization	33
5.3.1 Membership	33
5.3.2 Customer Contracts	33
5.3.3 Benefits	34
5.3.4 Recommendations	35
5.3.5 Personality Dynamics	36
5.3.6 Progress and Challenges	37
5.4 Interview Conclusions	37
6.0 DISCUSSION AND ANALYSIS	39
6.1 Themes	39
6.1.1 Internal vs. External Involvement	39
6.1.2 Form and Governance	39
6.1.3 Managed Expectations	40
6.1.4 Benefits	41
6.1.5 Leader Personalities and attitudes towards collaboration	42
6.2 Jurisdictional Scan Analysis	42
6.3 Strategic Implications	42
6.4 Summary	44
7.0 OPTIONS AND RECOMMENDATION	46
7.1 Option 1: Status Quo - No Network Development	47
7.2 Option 2: Dominant Firm(s) Network	47
7.3 Option 3: Industry and Government Led Network	48
7.4 Summary of Option Advantages and Disadvantages	49
7.5 Recommendations	49
7.6 Implementation Plan	50
8.0 CONCLUSION	52
9.0 REFERENCES	53
10.0 APPENDICES	58
Appendix A: Structure of Canada’s Aerospace Industry	58

Appendix B: Conceptual Model: Cooperation Success Factors	59
Appendix C: Interview Questions.....	60

LIST OF FIGURES AND TABLES

Table 1: Cooperation risks.....	16
Figure 1: Risk and chance management process	17
Figure 2: Conceptual framework	18
Table 2: Summary of option assessments.....	49
Table 3: Implementation plan.....	50

1.0 INTRODUCTION

1.1 Defining the Problem

British Columbia's (B.C.) aerospace manufacturing industry is primarily comprised of small and medium enterprises (SMEs) operating in the lower tiers of the aircraft manufacturing supply chain (KPMG, 2014). Small aerospace firms like these face challenges of scale in the increasingly competitive and globalized world of aircraft manufacturing (Government of Canada, 2012, p.10). As a result of the pyramid structure of the aerospace industry (Government of Canada, 2012, p. 9), the lower tier firms supply to the upper tier firms and ultimately the Original Equipment Manufacturers (OEMs) that sell completed aircrafts to end-product customers such as airlines (KPMG, 2014, p. 15). In recent years, OEMs such as Boeing and Airbus have expressed a desire to consolidate their supplier base and to focus on suppliers with greater size and integrator capacity (Government of Canada, 2012, p. 10; KPMG, 2014, p. 7).

This trend of OEM supplier base consolidation, coupled with the challenges of staying competitive in a capital-intensive and technologically advanced industry, has led a group of B.C. aerospace manufacturing firms to consider forming a manufacturing network. Also known as consortia or alliances, manufacturing networks allow small firms to pool vital research and development (R&D) and production resources, share knowledge, and compete for larger contracts and work packages (Walsh & Hanna, 2008, pp. 299-300; Link & Marxt, 2002, p. 71; Kasouf & Celuch, 1997, p. 475). Although collaborative networks can be beneficial to firms, they can be complicated by issues regarding self-interest, risk, profit and cost sharing, information flows, and logistical considerations, amongst others (Park & Ungson, 2001, p. 37; Marxt & Link, 2004, p. 72; Hanna & Walsh, 2008). Illustrating the prominence of such issues, Marxt and Link cite three major studies of collaborative behavior that found only 40-60% of firms engaged in collaboration were able to meet their objectives (2002, p. 219).

The ability to navigate these aforementioned issues and create a functional and effective collaborative network could allow B.C.'s small aerospace manufacturers to achieve the scale of operations required to compete in the global market and ensure the future of their industry. This industry cooperation would also have the support of the Government of B.C.'s Ministry of Jobs, Tourism and Skills Training, which has a mandate to "work with communities, industry, economic development agencies and other ministries to promote regional economic growth and diversification" (Government of British Columbia [B.C.], 2015). Government support for a network would be more targeted than the general support it currently offers to the aerospace industry. Support would include a financial element, and potentially administrative staff and research resources as well.

The Government of B.C. has recognized aerospace as an industry where the province has high potential for economic growth and job creation. This is evidenced by the Government's inclusion of aerospace as a B.C. Jobs Plan priority and a recent \$5 million funding commitment to encourage industry growth and the development of a unified

industry cluster (Government of B.C., April 8, 2014). Working with B.C.'s aerospace manufacturers to improve industry competitiveness is likely to lead to economic benefits for the province, while a failure to act effectively could result in the decline of the industry and a missed opportunity for growth and job creation.

1.2 Project Client

Jeff Rafuse is the Senior Director of the Economic Initiatives and Analysis Branch (EIAB) of the Economic Development Division (EDD) of the B.C. Ministry of Jobs, Tourism and Skills Training (JTST). The EIAB is responsible for coordinating strategies to support the growth and competitiveness of industries, including aerospace, identified as priorities in the B.C. Jobs Plan: Canada Starts Here. The EIAB is working closely with B.C.'s aerospace manufacturers to develop a strategy to improve the competitiveness of the aerospace industry and to potentially develop an industry consortium or network. At present, the B.C. Government has been working with industry through a partnership and funding arrangement with Aerospace Industries Association of Canada (AIAC) Pacific and direct communication with a number of B.C.'s aerospace firms.

1.3 Project Objectives

This research project sought to provide smart practices recommendations that could guide the creation of an effective collaborative manufacturing network for the B.C. aerospace industry by surveying the literature on inter-firm collaboration and conducting a jurisdictional scan of high-technology manufacturing networks in other regions and industries. These smart practices can be utilized by the client, and shared with industry at the client's discretion, to help determine what actions the Province and industry should take to create an effective network.

The central research question was: *What are smart practices for the development and operation of a collaborative manufacturing network for B.C.'s aerospace manufacturers?*

The supplementary research questions were:

What governance structure do networks use?

What are the motivations that lead to network development?

To answer the research question, the following tasks were undertaken:

- **Literature Review:** An analysis of the literature on inter-firm collaboration in manufacturing and identification of the key trends and findings;
- **Smart Practices Scan:** An assessment of how manufacturing networks have been developed in other aerospace manufacturing regions and other advanced manufacturing industries, whether the outcomes of these networks were favourable, and what factors may have influenced their strengths or weaknesses; and
- **Jurisdictional Scan:** A scan to determine what initiatives, if any, have been undertaken by governments in Canada to encourage collaboration in aerospace.

- **Development of Strategic Implications and Recommendation:** The development of a set of options for the client to consider and then the recommendation of an option based on criteria established by the client and the smart practices research that could be used to develop a manufacturing network in B.C.'s aerospace manufacturing industry.

1.4 Background

B.C.'s aerospace industry is a major contributor to the provincial economy, with a direct gross domestic product (GDP) contribution of \$1.4 billion and a total economic impact of \$2.9-3.5 billion when indirect and induced impacts are considered. B.C. has the third largest aerospace industry in Canada, and is a national leader in maintenance, repair, and overhaul activities (MRO). Several factors indicate that B.C. has the potential to significantly expand its aerospace manufacturing industry, including proximity to Boeing's final assembly and integration lines in Washington State, one of Canada's biggest aerospace training centres at British Columbia Institute of Technology, and expertise in MRO, helicopter services, space systems, and advanced composite aircraft structures (Government of B.C., 2013; Government of Canada, 2012, p. 35). Furthermore, B.C.'s coastal location means it is well positioned to access expanding world markets, and growing air traffic to B.C. airports is expected to present growth further opportunities for B.C.'s MRO sector (Government of B.C., 2013).

Despite these strengths, B.C.'s aerospace manufacturing industry is fragmented and primarily composed of small and medium enterprises (SMEs) operating on the lower tiers of the manufacturing scale. The province suffers from a lack of Tier 1 integrators and OEMs, which typically provide industry-wide benefits through R&D investments, technology transfer, senior talent attraction, and clustering (KPMG, 2014, pp. 3-4). A diagram illustrating the structure of the aerospace supply chain can be found in Appendix A.

In recent years, international OEMs have started to indicate an unwillingness to do business with the types of small manufacturers typical of B.C.'s aerospace industry. Firms such as Boeing, Airbus and Bombardier have stated intentions to decrease the number of suppliers they do business with, thereby focussing on suppliers with the capacity for larger work packages (Government of Canada, 2012, p. 10). In response to this development, and in an attempt to expand their resources and capacity, a group of B.C. aerospace manufacturers are actively investigating the possibility of joining forces and creating an aerospace manufacturing network.

1.5 Conceptualizing Collaboration

1.5.1 Terminology

In the literature and organizations the researcher consulted, collaborative activities were described using a variety of different terms, including collaboration, cooperation, alliance, joint venture, network, and consortium. For the purposes of this project, the researcher focused primarily on examples of three or more firms undertaking long-term joint

production or marketing activities, either formally or informally, regardless of the label used to describe such an occurrence. Based on the literature and the organizations consulted, the researcher decided the word “network”, and variations such as “collaborative network” or “manufacturing network” were the most appropriate terms to describe the phenomenon under study. Yet it should be noted that the term consortium may appear when this project references literature or organizations that employ that term.

Similarly, the terms collaboration and cooperation were often used interchangeably in the literature the researcher consulted. Both words refer to parties working together to accomplish the same goal, with collaboration carrying the added meaning of parties working together specifically to produce something (“Collaboration”, 2015; “Cooperation”, 2015). The researcher primarily used the term collaboration throughout this report, as the research question considers parties working together in manufacturing; however, the term cooperation is occasionally used in instances where the author is referring to literature or examples that specifically employ that term.

Sherer describes manufacturing networks to be “groups of firms that combine forces to achieve competitive advantages that would be difficult to achieve individually” (Sherer, 2003, p. 325). Before exploring the practical implications and operations of these networks, it is useful to consider the theory that has been advanced to explain why firms form networks and how these networks are governed. The following presents a brief summary of some of the theory and perspectives that have been developed to analyze and explain inter-organizational networks such as manufacturing networks.

1.5.2 Network Motivations

One of the most common approaches to studies of networks and collaboration is the motivational perspective. The motivational perspective is centred on the motivations that drive a firm’s decision to enter into a network entity and their interactions with other members of the network. Attempts to explain these motivations have been based on intimal factors, external factors, and cost factors (Fowler & Reisenwitz, 2013, p. 24). Network motivations were examined in the literature review and interview research components of this project.

Intimal Factors: Intimal factors refer to the firm’s internal capabilities, forming the basis of the commonly used resource-based view of collaboration. According to the resource-based view, firms make decisions to collaborate on the basis of their resources, capabilities, and needs (Fowler & Reisenwitz, 2013, p. 24). This view has been invoked to explain higher incidences of collaboration amongst small firms, which typically face tight resources constraints.

External Factors: External factors form the basis of social capital theory (Fowler & Reisenwitz, 2013). Social capital theory posits that organizations are embedded in networks of social relationships, which influence a firm’s economic actions and are in themselves an asset: social capital (Soda & Usai, 1999, pp. 276-277; Gnyawali &

Madhavan, 2001, p. 431). According to Soda and Usai, social capital is distinct from other types of capital such as financial and human because “is not the property of the individual players but jointly owned by the various parties involved in the relationship” (1999, p. 277). When firms are embedded in social networks, the behavioral norms of the network can act as social governance mechanisms that prevent firms from acting opportunistically for fear of damage to their reputation and collective reprisals (Weaver & Dickson, 1998, p. 505). Jones et al. posit that structural embeddedness, which “diffuses values and norms that enhance coordination among autonomous units” (1997, p. 924), is necessary for network governance.

Cost Factors: Cost factors form the basis of transaction cost economics explanations of inter-firm collaboration (Fowler & Reisenwitz, 2013, p. 24). According to transaction cost economics, firms choose the governance structure that is most efficient for their transactions: the exchanges encountered while doing business. Three exchange conditions dictate the most efficient governance structure: asset specificity, uncertainty, and frequency (Jones et al., 1997, p. 916). Firms will join a network if network governance is perceived to be the most efficient choice given the transaction conditions they face.

1.5.3 Network Governance

Network governance occurs when autonomous firms must operate as a single entity in order to achieve common goals (Jones, Hesterly, & Borgatti, 1997, p. 916). Successful network governance will address issues that are of common member interest through a coordination mechanism and will also address conflicting member interests through aligned incentives such as ownership and control (Hendriske & Windsperger, 2010, p. 3). According to Hendriske and Windsperger, proper network governance will accomplish two goals: it will limit activities that are not in the network’s interest and it will coordinate an optimal distribution of resources across members.

Network governance goes beyond participant interactions and involves the use of institutions and structures of authority and collaboration to allocate resources and to coordinate and control joint action across the network as a whole (Provan & Kenis, 2007, p. 231). In comparison to the legal and authority-based mechanisms of other methods of governance, network governance relies upon social instruments such as reputation, collective sanctions, and occupational socialization (Jones et al., 1997, p. 916).

1.6 Report deliverables

This report provides a set of deliverables. The first deliverable is a review of the literature on collaborative manufacturing and collaborative networks. Due to the nature of the research question and the interests of the client, the review primarily focused on hard collaboration in the manufacturing sector. Hard collaboration refers to companies collaborating in business operations, such as contract fulfillment or marketing (Rosenfeld, 1996). The literature review informed the creation of a conceptual model, which is described at the end of the literature review section.

The second deliverable is a jurisdictional scan of government efforts to encourage collaboration in the aerospace industry in Canada. The jurisdictions included are Alberta, Manitoba, Ontario, Quebec, and the federal government.

The final deliverable is a set of smart practices for the initiation and operation of a manufacturing network. This was done through semi-structured interview research, conducted with 10 representatives from 8 manufacturing networks in Canada and the United States. These interviews were conducted in order to discover what has been successful or unsuccessful for similar groups of firms. These experiences and responses were then analyzed to discern suggested “smart practices” that other firms could follow to increase their likelihood of success.

1.7 Report Organization

Following this introductory chapter, the report is organized as follows. Firstly, a review of collaborative manufacturing literature that concludes with the development of a conceptual framework for the interview research. Secondly, a methodology and methods chapter that explains the research conducted for this project, which included a literature review, a “smart practices” scan using interview data, and a web based jurisdictional scan of provincial and federal government initiatives to encourage collaboration in aerospace in Canada. Thirdly, a findings chapter presents the findings of the jurisdictional scan and interviews. Fourthly, a discussion and analysis chapter will analyze the results of the interview and jurisdictional scan and compare this paper’s findings to the findings of the literature reviewed earlier in this paper. This section will be followed by a set of options and recommendations for consideration by the client, a conclusion, and references and appendices.

2.0 LITERATURE REVIEW

This chapter discusses existing literature on inter-firm collaboration and networks. Due to the extensive amount of literature available on this topic and the purpose of the research question, the literature scan was primarily restricted to works that specifically addressed horizontal collaboration in production activities. Another qualifying criterion to ensure relevancy to the client and research objectives was that the literature must address either manufacturing industries or small firms. Additionally, the literature was, with a few exceptions for particularly relevant works, restricted to the past 20 years due to the rapid rate of technological change and its impact on collaborative information sharing tools and high-tech manufacturing industries such as aerospace.

Inter-firm collaboration is a multidisciplinary topic, which makes for a rich and vast collection of literature. Illustrating this point, Nootboom notes that his textbook on inter-firm collaboration draws from the disciplines of economics, geography, social psychology, cognitive science, and sociology (2004). This lack of a specific disciplinary approach has resulted in a confused picture of the purpose and value of collaborative networks and organizations, and has also made it difficult to establish a core body of knowledge (Hanna and Walsh, 2008, p. 300). This review included works from a variety of different disciplines, with a variety of terms used to describe collaborative ventures.

Some of the topics covered in this literature review include the varying definitions of collaboration and networks, the motivations and benefits of collaboration, the role of public policy and network agents, partner selection, success factors, network structure, trust, risk, opportunism, and network failure.

2.1 Definitions of Collaboration and Networks

The term “collaboration” has been used freely to describe a range of activities involving more than one actor. According to Keast and Mandell, collaboration specifically refers to a more long-term and stable relationship than cooperation (informal, low-level, and short-term relations where actors maintain their individual goals and experience low levels of risk) or coordination (more formal relationships where actors remain independent entities but engage in information sharing and shared decision making and planning). Collaboration goes beyond coordination to a level of “reciprocal interdependence”, where actors, although separate entities, recognize a reliance on each other in order for the groups’ overall actions to be effective. Collaboration denotes a high risk, intense relationship where actors share not only resources and problem sharing capabilities, but commit to jointly developing a strategy and changing their individual operations if necessary (Keast & Mandell, 2012, pp. 12-13).

Some of the terms used to label inter-firm collaboration include consortia, networks, alliances, and cooperations. One of the most commonly used terms is “network” although this term also lacks a clear definition (Rosenfeld, 1996, p. 261). The use of the term “network” to describe collaborative business activities involving product and market

development first emerged in the Dutch government initiatives to encourage inter-firm collaboration in the 1990's (Rosenfeld, 1996, p. 261). Rosenfeld (1996) classifies networks as either 'hard' networks where three or more firms jointly undertake co-production, co-marketing, co-purchasing, or cooperation in market and product development, and 'soft' networks where three or more firms participate in joint problem solving, skills development, or information sharing (p. 248). Hanna and Walsh (2008) note that "network" has been used to describe a range of informal and formal relationships, but they support a more specific definition of a 'business network': "a complex pattern of formal and informal linkages between individuals, businesses and third parties such as brokers or not-for-profit agencies" (2008, p. 301).

Fowler and Reisenwitz use the term 'organizational network' in their attempt to summarize a range of inter-firm relationships such as research consortia, business groups, alliances, and joint ventures, and define it as an instance of two or more firms repeatedly exchanging with each other in the absence of an higher authority to manage this exchange (2013, p. 22). Similarly, Álvarez, Marin and Fonfría refer to a range of different organizational relationships as 'networks', which they define as "a hybrid form of organisation defined by interactions among agents, institutions and environmental condition" (2009, p. 410). Finally, Johansen, Comstock and Winroth (2005) use the specific term of 'collaborative manufacturing network' to describe "structures that have enabled companies to focus on their core competencies and yet still participate in the design and/or manufacture of large systems" (2005, p. 227).

2.2 Causes of Collaboration

2.2.1 Trend of Increased Collaboration

Many authors have acknowledged an increase in inter-firm collaboration over the past few decades, and have offered explanations for this trend. In general, there is widespread consensus that rapid technological change has been a factor in increased collaboration, particularly for firms in the manufacturing and technology sectors (Hanna & Walsh, 2008; McClellan, 2003; Kassouf & Celuch, 1997; Jones et al., 1997, p. 919). Manufacturers face more rapid and costly product development cycles, and quickly changing manufacturing technology and practices (Kasouf & Celuch, 1997, p. 475). Link and Marxt (2004) explain that, "the increasing complexity of technologies and products, the search for new know-how as well as the shortening of the time to profitability challenge small and medium sized companies as well as large-scale enterprises" (p. 71), which forces companies to explore new business strategies involving cooperative innovation and production processes with external partners (Link & Marxt, 2004, p. 71).

Additionally, technology increases market competition by allowing customers to easily connect with geographically dispersed suppliers. Globalization challenges firms by threatening their position in their domestic market but also offers them the opportunity to expand into new markets- working collaboratively in a network enables firms to improve their efficiency and effectiveness and successfully meet this challenge (Lo Nigro &

Abbate, 2009, p. 234). Collaboration has even been likened to a small firm 'survival mechanism' in the face of globalization (Arku, 2003, p. 325).

Technological and globalizing forces have restructured the market in a way that has encouraged collaboration between firms (Johansen, Comstock & Winroth, 2005, p. 226). Arku notes that collaboration is widely believed to be a strategic production response to changing environmental conditions and industrial restructuring (2003, p. 325). Others similarly explain collaboration as a strategic response to an increasingly competitive and uncertain marketplace environment (Bishop, 2003, p. 1965; Jones et. al, 1997, p. 911; Álvarez et. al, 2009, p. 411). On the other hand, Gomes-Casseres (2003; in BarNir & Smith 1997, p. 219) argues that the trend of inter-firm alliances has led to market restructuring, rather than vice-versa, creating a marketplace that consists of constellations for alliances. Subscribing to this "constellation" view of the market, BarNir and Smith state that firm profitability is now dependent on its ability to establish itself in a constellation and the actions of the other firms in that constellation (2002, pp. 219-220).

2.2.2 Motivations and Benefits

Collaborative networks provide a range of advantages for organizations, including "enhanced learning, more efficient use of resources, increased capacity to plan for and address complex problems, greater competitiveness, and better services for clients and customers (Provan & Kenis, 2008, p. 229). Collaboration can be particularly beneficial to smaller organizations, such as small and medium enterprises (SME), as it offers these firms an opportunity to overcome their resource constraints while still maintaining the operating agility of a smaller firm (Hanna & Walsh, 2008, p. 301; Lo Nigro & Abbate, 2009, p. 235). Arku explains that inter-firm collaboration allows firms to "access new markets, to gain skills and technologies, to share the risks and high costs of technology development, and to reduce duplication of R & D efforts" (2003, p. 325). A study of small manufacturing firms by Hanna and Walsh (2008) found that motivations for cooperation included keeping pace with technological developments and product innovation, but participants were primarily focussed on improving their position in the supply chain and offering their customers a more comprehensive service package. Furthermore, firms had more of an interest in being able to access these additional competencies through collaboration rather than developing them internally (Hanna & Wash, 2008, p. 308).

Some studies have indicated that firm size plays a role in the specific motivations for collaboration, with Arku (2003) finding that firm size influenced motivations for small electronics firms in the Greater Toronto Area and Kasouf and Celuch (1997) discovering a negative relationship between relationship orientation and firm size in their study of small firms in the United States powder metallurgy parts industry. Kasouf and Celuch hypothesize that this is because "smaller firms are more apt to use alliances in order to help overcome their limited resources and capabilities" (1997, p. 438).

According to Antonelli, Boucher and Burlat (2011), a firm's propensity to cooperate can be attributed to two central factors. The first is internal parameters: a firm's internal characteristics—including size, culture, and degree of diversification and

internationalization—that affect its capacity to form relationships with other firms. Antonelli et al. state that smaller firms and family owned organizations can have more difficulty adjusting to cooperation, while diversified and international firms will cooperate more easily. The second factor they identify is proximities, which refers to the geographical, institutional, and organizational distances between firms. Close proximity can facilitate and encourage collaboration, while distance can act as a barrier (pp. 39-40).

2.2.3 Innovation and Organizational Learning

Beyond access to expanded resources, a frequently cited benefit of collaboration is increased innovation and organizational learning. Increased innovation has long been a goal of inter-firm relationships. Innovation is generally a resource-intensive and high-risk activity, making it particularly challenging for SMEs. Collaboration with other firms is a way to overcome this challenge (Estelyiová & Žižlavský, 2012, p. 1564)

Organizational learning is the idea that “organizations can and do learn, through a process of knowledge acquisition, information distribution, information interpretation and organizational memory” (Provan & Human, 1999, p. 186). Collaborative networks induce organizational learning through the regular and ongoing interactions of member firms, where firms learn about each other’s competencies, weaknesses, resources, and strategies. This allows firms to become more aware of their competitiveness and competition (Provan & Human, 1999, p.185)

Provan and Human (1999) argue that networks stimulate organizational learning more effectively than other inter-organizational relationships because they offer the long-term commitment and high level of trust that is required for organizations to divulge information about their operating procedures and plans (p. 186).

2.2.4 Collaborative advantage

In today’s marketplace, the ability to cooperate effectively is often considered a benefit in and of itself. Hanna and Walsh (2008) describe cooperation as a “core skill of successful small firms” (p. 303). Moss Kanter (1994) uses the term ‘collaborative advantage’ to describe a firm’s ability to be an effective partner, and argues that this skill is essential in order to stay competitive in today’s global economy.

2.3 Public policy and the role of network agents

A topic that has received considerable attention within network literature is the role and value of third party agents and public policy aimed at encouraging collaborative networks. Although some networks have occurred naturally, as in the case of the oft-cited example of Italy’s traditional manufacturing districts, others are the result of government efforts. One of the first government led attempts at inducing collaborative networks occurred in the Netherlands in the 1990’s, when the Danish government funded a publicity campaign, trained and hired network “brokers”, and provided incentive grants to encourage cooperation. Rosenfeld (1996) differentiated between American states that employed an “Italian approach” of providing incentives to industry associations to encourage the development of collaboration between members, and the more interventionist “Danish

approach” where brokers (also known as network facilitators) were paired with targeted grants to create specific networks (p. 249) but found no conclusive evidence that one was more effective than the other.

Since the Danish experiment, programs have been widely employed in many developed countries to encourage inter-firm collaboration, often in the form of manufacturing networks, with varying degrees of success (Arku, 2003, p. 333; Rosenfeld, 1996, p. 247; Kingsley & Klein, 1998, p. 65). These programs are based on the assumption that collaboration will enhance firm competitiveness, particularly for SMEs, leading to positive economic impacts for industry and the surrounding economy (Rosenfeld, 1996, p. 247).

Hanna and Walsh (2008) found that broker involvement could influence the type and structure of collaboration. Their study of small firm collaboration in manufacturing revealed that networks instigated by government were more reliant on network brokers for their cohesion, and more likely to exclude members that were competitors because of a broker’s desire to avoid network conflict. This led to a prevalence of procurement and sub-contracting instead of deeper forms of collaboration (2008, p. 308-309). Somewhat contrary to Hanna and Walsh’s findings, Provan and Human also state that a broker can be particularly useful in building networks of competitor firms that may have difficulty establishing trust without an external agent overseeing the process (p. 204). Sherer (1999) similarly suggests that brokers can play a vital role, particularly in small firm manufacturing networks. She asserts that brokers can help small firms achieve the technological resources and expertise they need to implement the inter-organizational information systems required for successful co-production (p. 41). Provan and Human (1999) examined the impact network brokers had on organizational learning and found that a central broker made the learning process more centralized and become a knowledge repository for the network.

Support for network brokers is far from unanimous. Arku’s (2003) study of Toronto firms found that government policy had been inefficient at encouraging collaboration, leading him to suggest that policies must distinguish between small and large firms and better address the needs and concerns of small firms in order to be successful (p. 335). Kingsley and Klein’s (1998) findings suggest that the public sector’s role in networks can actually decrease the odds of success, noting that “public sector initiation by a state agency is more often associated with cases that result in failure” (p. 71), and that network funding was more effective if it comes from the private sector rather than the public sector (p. 70). They concluded that although public policy efforts such as brokers and grants could encourage network development, these efforts were unlikely to be successful in instances where government intervention was the primary or singular motivator (p. 72).

2.4 Practical Considerations for the Development of a Collaborative Network

2.4.1 Partner Selection

Partner selection is one of the earliest considerations when establishing a collaborative network, and arguably the most critical (Link & Marxt, 2004, p. 75; McClellan, 2003; Kingsley & Klein, 1998, p. 70). Firms must consider a range of factors when they select a partner: resources, capabilities, strategy, geographic location, and previous experiences in inter-firm arrangements. Marxt and Link suggest that “similar or at least corresponding goals are essential” (2002, p. 75), while Hanna and Walsh note that similar business reputations and working philosophies could act as a useful surrogate for trust in the early stages of relationship building (2008, p. 310).

Partnerships can be particularly challenging when the potential partners are direct competitors (McClellan, 2003). Hanna and Walsh’s study of small manufacturers revealed that firms avoided competitors when they selected partners, but were willing to accept some overlap of competencies if the partner also offered different, useful skills (2008, p. 310). Kingsley and Walsh (1998) advise that “great attention should be paid at the front end of the project to whether partners have comparable and complementary skills” (p. 70) in order to increase the odds of a positive outcome.

Beyond the capabilities and profiles of the firms considering collaboration, the personalities and relational styles of the executives can be extremely important in partner selection. Moss Kanter (1994) states that “successful company relationships nearly always depend on the creation and maintenance of a comfortable personal relationship between the senior executives” (p. 99), and suggests that strong interpersonal relationships create goodwill that may be necessary to handle future issues and tensions between the firms (1994, p.100). Supporting this view, Hanna and Walsh found that leader relationships were a significant factor in the cooperative manufacturing arrangements they studied (2008, p. 310).

2.4.2 Success factors

Many have studied the factors that impact the success of collaboration, but few have defined what constitutes a successful collaboration. Provan and Kenis (2008) state that the effectiveness of a network can be measured in terms of “the attainment of positive network-level outcomes” (p. 230) rather than individual firm outcomes. They also note that the desired outcomes vary from network to network. Marxt and Link (2002) seek to create a more comprehensive definition of successful cooperation, creating a four part criteria: “the achievement of the original objectives; the revenues for the cooperation partners as a whole; organizational learning (gaining experience and knowledge); and subjective personal feelings” (p. 221). Like Provan and Kenis, Marxt and Link acknowledge that cooperative ventures are complex and multi-faceted projects, and that specific success factors are likely to vary according to circumstance (p. 221, p. 228). They also note that not all factors are easily measurable, which further increases the complexity of assessing success (p. 221).

Sherer (2003) defines a set of high level factors deemed critical for manufacturing network success, according to the perceptions of network coordinators. These critical factors include: “(1) participant character; (2) chief executive officer (CEO) support; (3) confidence; (4) dedication; (5) capabilities; (6) external relationships; (7) intermediary; and (8) information technology” (p. 325). She notes that information technology, confidence, participant character, and external relationships were particularly vital for hard networks engaged in joint production or marketing (p. 325).

A range of studies have attempted to determine how various industry and firm factors affect the likelihood and outcomes of collaboration. For instance, Tong and Reuer examined industry structure as an impact on collaboration, and found that horizontal, domestic joint ventures are more likely to arise in concentrated industries (2010, p. 1070). Focusing in on firm and network factors, Bishop’s study of United Kingdom defense manufacturers revealed that smaller firms and firms with innovative capabilities had a greater propensity for collaboration, while Hanna and Walsh (2008) found that a balance of skills within a manufacturing network was critical. Weaver and Dickson (1998) found that resource and environmental factors did not impact alliance outcomes as much as goal-based factors, measured in terms of the financial returns of alliances, and relational factors, measured in terms of contract compliance and firm reputations (p. 506). Other researchers have narrowed down their analysis to the individual level of firm managers. According to BarNir and Smith (2002), the social networks of small manufacturing firm executives can have a significant impact on their firm’s ability to collaborate. Specifically, they found that the number of alliances these firms entered into could be attributed to three executive social network characteristics: “propensity to network, strength of ties, and prestige of network members (p. 228). Moss Kanter similarly attributes collaborative advantage to executives, stressing that managers must be adept at handling organizational, cultural and political sensitivities in order to successfully collaborate with other firms (1994, p. 108).

Srećković and Windsperger argue that the success of network relationships depends on effective knowledge transfer, which is affected by trust. Firms with higher levels of trust between them are more likely to use knowledge transfer mechanisms that involve rich information transfer, which can lead to better network performance (2013, p. 74).

2.4.3 Structure

As suggested in the wide-reaching terminology and varying definitions of collaboration presented above, collaboration can take a variety of forms. Some of the most common include networks, consortia, joint ventures, and alliances. There are further variations within these forms: Fowler and Reisenwitz state that collaborative networks can be: “horizontal, vertical, a mixture of vertical and horizontal, concentric, or intermarket” (2013, p. 26). Kingsley and Klein (1998) found that the network structure did not have a significant impact on the business growth outcomes of a network, and that a firm’s legal status as a ‘for-profit’ entity was more important than whether the network was organized in a particular form. They found, however, that structure played a critical role in the growth of the network, leading them to advise that networks require a central

organization and dedicated staff in order to obtain membership increases and other benefits (p. 70).

Depth of cooperation: Moss Kanter describes cooperative arrangements as falling on a relational spectrum that ranges from strong and close, as in instances of mutual service consortia, to weak and distant (1994, p. 98). According to Moss Kanter, there are five levels of integration that an inter-firm relationship can achieve, and the most productive relationships will achieve all five: strategic integration, tactical integration, operational integration, interpersonal integration, and cultural integration (pp. 105-106).

Formality and Legality: Beyond the relationship strength, collaboration can be characterized by whether it is informal or formal. Moss Kanter (1994) suggests that such matters should be entrusted to third-party professionals such as lawyers and bankers, but advises that leaders should stay engaged in the process to ensure the relationship does not become depersonalized during the formalizing phase (p. 103). Hanna and Walsh (2008) found that all five SME manufacturing networks they studied, ranging from 2-28 members, had avoided the use of formal, legal contracts and did not accept joint liability for the work of the network. Several networks did, however, employ membership charters or letters of intent, and in one instance a monetary tie was established between companies to act as preventative measure against opportunism (p. 311).

Governance Model: Provan and Kenis (2007) propose three structurally distinct models of network governance: participant governed networks where all members govern themselves; lead organization governed networks where governance is more centralized and takes place through the lead organization(s) in the network; and network administration organization (NAO), which is a form of governance where the network is governed by a separate, centralized administrative entity (pp. 234-236). They contend that the choice of the most appropriate governance model, as defined by the network's context and objectives, is a key determinant of overall network effectiveness (p. 247). For instance, they argue that participant governance is most suitable for small networks with high levels of goal consensus, while larger networks with more varied objectives would benefit from a lead organization or NAO governance model (pp. 238-240).

2.4.4 Risks, Trust, and Opportunism

One of the most central issues of inter-firm collaboration is the inherent risk in forming a co-dependent relationship with other firms, particularly former competitors. Aside from concerns about opportunistic behavior from fellow network members, firms engaged in hard collaboration must consider their legal and financial obligations to the network and the risk that the network will fail to meet its objectives (Lo Nigro & Abbate, 2009, p. 235). Less concrete risks also exist, pertaining to firm culture. Link and Marxt (2004) identify a set of these cooperation specific risks in the following table (Table 1):

Table 1: Cooperation risks

CULTURE	Information & communication	Insufficient information flow
		Insufficient information transfer from top-management
		Too little informal communication
		Too little communication frequency
		Unmanaged or not institutionalized information transfer
		No open know-how-transfer possible
		Transparency is missing
	Values	Less trust in the partner and/or too little build-up of trust
		Little commitment of the top-management
		Uncertainty of the employees (e.g. concerning the reason of the co-operation)
		Insufficient team spirit / change in the project team
		Little risk awareness
		Different managing principles
		Insufficient co-operation culture and willingness to co-operate
		High expenditure to harmonize the different cultures
Too little flexibility of the employees/ of the partner		

(Marxt & Link, 2004, p. 72)

Information and communication risks pertain to information flow between cooperators, while value risks are related to differing cultural principles, viewpoints, or practices.

Hanna and Walsh argue that firms can choose to either enter a network or sub-contract when they need to access capabilities that exceed their internal inventory- if they do not trust the other firms, they will sub-contract, which is a lower risk option. Their study found that firms that chose networks were willing to risk giving up operational control for the potential gains of collaboration, but only when they had minimized the risk by carefully vetting their partners and selecting those they felt they could trust (2008, p. 308). Their study also revealed that cooperative business activities are frequently ruled out by small manufacturing firms because of opportunism fears (2008, p. 310).

Edelenbos and Klijn support the notion that trust plays an important role in facilitating collaboration in the face of risk. They define trust as “a more-or-less stable perception of actors about the intentions of other actors, that is, that they refrain from opportunistic behavior” (2007, p. 30). According to Edelenbos and Klijn, trust makes voluntary, horizontal relations possible and also less expensive because of reduced transaction costs in the forms of legal contracts, monitoring, and insurance (2007, p. 31).

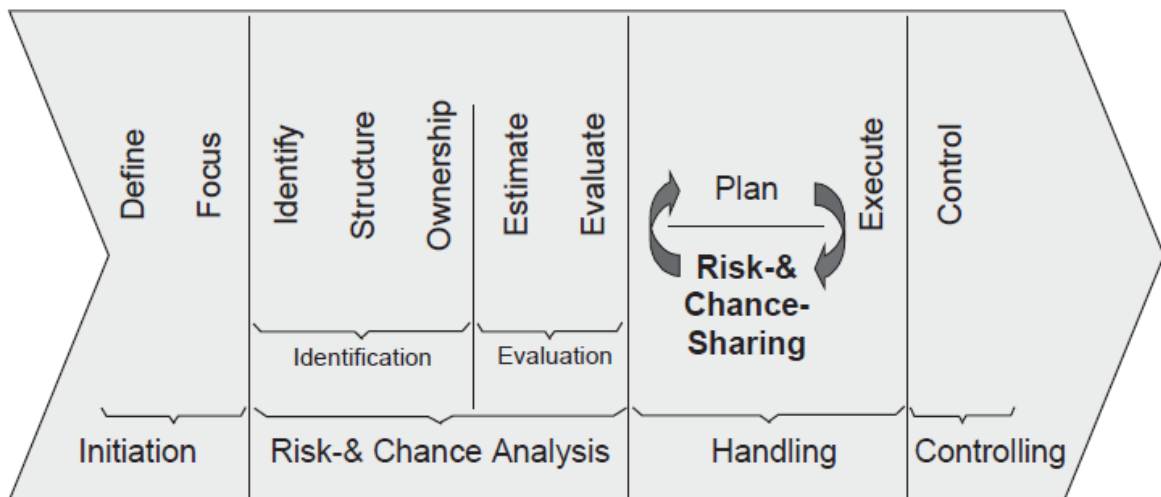
The amount of risk a firm is exposed to is related to the extent of its collaboration. Moss Kanter suggests that companies should consider the value of the relationship compared to their other operations when determining the amount of resources and accommodation they put into a cooperative venture. She further advises that each relationship involves a trade-off between risk and reward: narrow and distant relationships offer a firm greater

control and reduced risk, but fewer potential benefits are likely to result from such arrangement (1994, p. 108).

In addition to concerns about trustworthiness and opportunism, collaboration presents risks in terms of joint management. Link and Marxt note that “a special challenge of the risk and chance management in co-operative ventures is the integration of each co-operation partner into the management process [...] collaborative product development between equal partners is only possible when risks and chances (e.g. rewards) are shared” (2004, p. 72). Similarly, Lo Nigro and Abbate suggest that an effective profit-sharing mechanism can encourage firms to bear their portion of risk and help ensure networks achieve their objectives (2009, p. 235). Lo Nigro and Abbate further recommend that firms should deconstruct the risks associated with collaboration into components in order to most effectively assess and manage the multi-faceted aspects of this risk.

Link and Marxt (2004) recommend that risks should be effectively managed throughout the cooperative process as a series of stages: the initiation phase when the project is defined and tasks and responsibilities are distributed; the analysis phase when risks and chances are identified, estimated, and evaluated; and the managing phased when risks are avoided, reduced through limiting exposure to damages, or transferred through an insurance. All remaining risks must be borne by the partners, who should clearly communicate the amount of financial commitment and risk each can endure (p. 73). Link and Marxt’s risk and chance management process is illustrated below:

Figure 1: Risk and chance management process



Link and Marxt, 2004, p. 73

The figure illustrates the actions firms take through each stage of the cooperative process.

2.4.5 Failure

Despite the potential benefits inter-firm collaboration can offer, attempts at collaboration sometimes fail. Park and Ungson (2001) suggest that the reason that more than half of

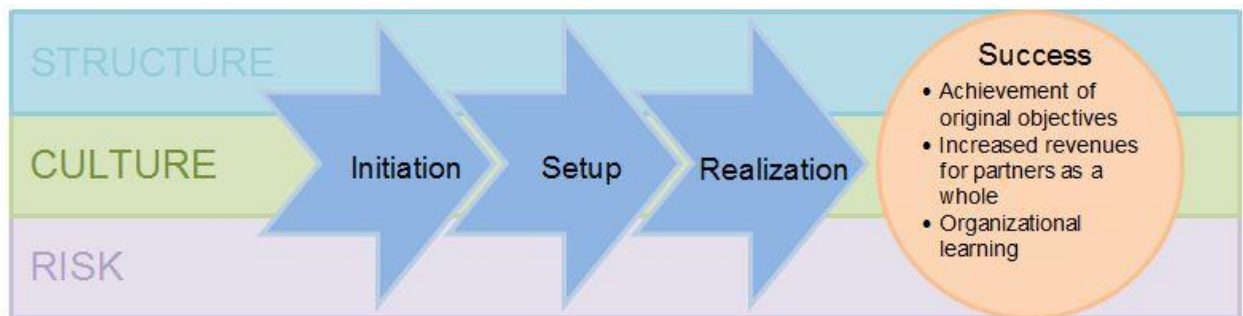
strategic alliances fail is because of the conflict between a firm's self-interest and the desire to achieve the best outcome for the alliance as a whole (p. 37). Moss Kanter (1998) observes that firms, particularly in North America, often view collaboration in narrow, financial terms and neglect the important cultural and relational aspects of a relationship. She suggests that these firms could learn from their Asian counterparts, who take a more holistic view of relationships and more often consider potential long-term benefits rather than immediate financial gains (pp. 96-97).

Some of the other, frequently cited reasons for poor performance and network termination include unsuitable structures and processes, poor communication, mismatches of capabilities and resources, and mismanagement of collective learning (Hanna and Walsh, 2008). Regardless of the reason for the dismantling of a network, Moss Kanter cautions that partnerships should be ended with diplomacy and tact in order to avoid jeopardizing future relationships (1994, p. 108).

2.5 Conceptual Framework

The literature review and the research questions have helped to inform the creation of the following conceptual framework, which is illustrated below (Figure 2). This framework will be used to guide the assessment process in the interviews in order to determine: *What are smart practices for the development and operation of a collaborative manufacturing network for B.C.'s aerospace manufacturers?*

Figure 2: Conceptual framework



This framework is based on Marxt and Link's (2002) model for cooperation success in innovation and production, which is included in Appendix B. Marxt and Link describe inter-firm cooperation as a multi-stage process: initiation, partner selection, setup, implementation or realization, and termination. For the purposes of this project, the partner selection element has been incorporated into the initiation and setup stages, where firms will choose partners to initiate a network, and will also create criteria for future membership additions. Additionally, as the research question is aimed at finding best practices for an ongoing manufacturing network rather than short-term project collaboration, the termination phase has been excluded.

Marxt and Link (2002) state that success factors for cooperative ventures are numerous, and can be grouped into the classifications of structure, culture, and risk. The specific success factors vary according to the phase of the inter-firm cooperative process, but the classifications can be defined as follows:

- Structure: refers to the group processes, goals, decision making mechanisms.
- Culture: refers to the behaviors and norms of the participants.
- Risk: Refers to how risk and reward are shared. (Marxt and Link, 2002, p. 223)

Following this conceptual framework, the jurisdictional scan and interviews will examine collaboration with regards to structure, culture, and risk in each of the three stages: initiation, setup, and realization. Furthermore, the success or lack thereof of each network will be gauged according to the criteria stated in the framework: achievement of original objectives, increased revenues for the partners as a whole, and organizational learning.

2.6 Conclusion

Inter-firm collaboration has been studied using a wide variety of approaches from numerous disciplines. This multi-disciplinary nature makes inter-firm collaboration a rich topic for study, but has also hindered the creation of a unified body of core knowledge and theory. The author's scan of the literature above revealed this fragmentation when very little of the literature encountered addressed the same specific issues or referenced common past works. Furthermore, a great deal of the literature on networks addresses the theory and benefits of network, but not the practical implications of this theory. As Provan and Kenis note, "there is still a considerable discrepancy between the acclamation and attention networks receive and the knowledge we have about the overall functioning of networks" (Provan & Kenis, 2008, p. 229). More research opportunities exist to address the practical functioning and effectiveness of networks.

Horizontal collaboration in manufacturing and production remains a relatively underexplored area. Most studies on this topic have been restrained to a specific industry and geographical area, resulting in findings that may not be applicable to other settings due to differences in cultural, economic, or regulatory factors. Some authors, such as Marxt and Link (2002) have made progress in developing practical conceptual models that are applicable to evaluations of collaborative manufacturing networks, amongst other types of networks.

Despite the fragmented nature of the literature encountered, a few central themes emerged. Firstly, public policy and network brokers can play a role in encouraging and coordinating collaboration, but for the experience to be successful there also needs to be significant will from the participants involved. Secondly, collaboration involves more than just financial considerations. Executive relationships, firm culture, firm size, and reputation all play a role in the collaborative process. Thirdly, success in collaborative networks is multi-faceted and depends on a wide variety of factors, many of which are specific to a network's specific circumstances. Finally, meaningful collaboration involves risk, particularly in instances of hard collaboration. Legal agreements, profit sharing

mechanisms, charters, and relationship building are some ways that firms can reduce their risk, but risk cannot be completely eradicated.

Increasing globalization and rapidly changing technology have significantly changed the nature of supply chains over the past few decades, and are likely to continue to do so in the future. This will present further relevant opportunities to study the phenomenon of inter-firm supply chain collaboration.

3.0 METHODOLOGY AND METHODS

3.1 Methodology

This project employed qualitative smart practices research in order to explore what factors have led to positive or negative outcomes in other instances of inter-firm collaboration, and then drew the main themes from these examples to form a set of recommendations for successful collaboration that could be employed by B.C.'s aerospace manufacturing industry. Overman and Boyd (1994) define best (alternately referred to as smart) practices research (BPR) as "the selective observation of a set of exemplars across different contexts in order to derive more generalizable principles and theories of management" (p. 69). According to Vesely (2011), BPR is an increasingly popular research approach that aims to "identify, communicate, and facilitate the transfer of practices that seem to work successfully elsewhere" (p. 99).

During BPR, the researcher examines other relevant contexts in order to observe smart practices. For this research project, the other contexts are existing manufacturing networks across North America. These examples are relevant because they are manufacturing groups that face similar economic and regulatory environments as B.C.'s aerospace industry. Additionally, several examples are involved in the same North West aerospace supply chain as B.C.'s aerospace industry. The chosen examples all had three or more members and undertook hard collaboration in joint order fulfilment or marketing activities.

The primary data collection method for this smart practices scan was interviews. Saldana states that interviewing is "an effective way of soliciting and documenting, in their own words, an individual's or group's perspectives, feelings, opinion, values, attitudes, and beliefs about their personal experiences and social world, in addition to factual information about their lives" (2011, p. 32). The individuals that were interviewed are senior representatives from these example networks were able to provide background on the network's development and speak to their perspective of the network's successes and challenges.

Additionally, this project considered the practices of other government bodies in encouraging collaboration in the aerospace industry. As the client is a government agency interested in assisting industry to create an effective consortium or network, a jurisdictional scan was conducted to determine what actions other governments have taken to encourage collaboration in the Canadian aerospace industry.

3.2 Methods

The methods used for this project included a literature review, a jurisdictional scan of government efforts to encourage aerospace industry collaboration, and interviews with representatives from various existing manufacturing networks.

3.2.1 Literature Review

The first research task was a literature review to discover central themes or recommendations, and to inform a conceptual model to assess examples of collaboration found in the jurisdictional scan. Literature from a variety of print and online academic texts and journals was consulted, along with some industry literature. Based on the literature review, a conceptual framework was developed to guide the interview research.

3.2.2 Jurisdictional Scan Internet Search and Website Review

The jurisdictional scan of government actions to encourage aerospace industry collaboration was conducted using internet searches and a review of the information available on the relevant government websites.

3.2.3 Interview Research

Phone interviews with representatives from selected organizations were conducted to ask about the networks' formation process, structure, outcomes, and any recommendations interviewees could offer on the basis of their experience.

Interviewee Search and Selection

Potential interviewees were selected through internet searches using various combinations of the following terms: collaborative, network, manufacturing, production, alliance, joint venture, cooperative, flexible, aerospace, partnership, group, extension, consortium, consortia, working together, SME, firms, industry, shipbuilding, advanced manufacturing, joint production, automotive, supply chain, various state and province names, and more.

In the United States (U.S.), the researcher focused on the 10 states with the largest manufacturing industries, relative to overall GDP. Each of these states has a Hollings Manufacturing Extension Partnership (MEP) center, which are part of a national U.S. program to provide assistance to small American manufacturing firms (Schacht, 2013, p. ii). MEPs in each of the 10 states were contacted to enquire whether manufacturing networks existing in their area.

Another way the researcher looked for interview candidates was by contacting authors of articles that mentioned particular networks, or entities that were mentioned in news releases about manufacturing networks. The researcher also contacted industry organizations, such as Canadian Manufacturers and Exporters, to enquire about potential networks within their membership.

The researcher asked interviewees and her professional contacts for recommendations of networks, with the caveat that all networks must have publically available contact information that she could use to approach them in a manner that would not cause them undue pressure to participate.

During the course of her searches the researcher also came across numerous manufacturing networks and consortia that do not, according to their available website

materials, engage in the type of hard collaboration that the researcher was addressing and functioned primarily as a trade association. These organizations were not contacted.

The interview subjects and organizations are described below, but are not identified due to anonymity requests from several interviewees:

Interview #1: A 30 member network that manufactures components for aerospace, medical and government customers. The network was established 30 years ago, and functions as a private, for-profit corporation that signs contracts directly with customers and sub-contracts work out to its members through a centralized office.

Interview #2: A network that was created with the help of a local economic development agency to help local manufacturers enter into government contracting for aerospace and defense procurement. The network began with over 40 members but following a loss of government funding its membership has dropped while it reassesses its direction. The original intention was for the network to create a LLC that would centrally accept orders and distribute work to the members, but this has not yet occurred.

Interview #3: An 18 member, non-profit network of equipment, machinery, and metal manufacturers that originally formed as an industry cluster through the assistance of economic development agencies. Members sub-contract amongst themselves when they wish to gain additional capacity or capabilities.

Interview #4: A 30 member not-for-profit alliance of companies specializing in industrial fabrication and support services related to manufacturing that was created through the efforts of a local economic development agency following a decline in oil refining and petro-chemical services in the area. Members sub-contract amongst themselves when they wish to gain additional capacity or capabilities.

Interview #5: An aerospace manufacturers association with over 60 members that was established to create a competitive and collaborative supply chain following the post 9-11 contraction in the aerospace industry. Members sub-contract to each other through the use of a custom built computer program that lists all member capabilities and allows for the tracking of orders throughout production.

Interview #6: A 30 member regional aerospace manufacturing and services alliance that was created to promote the regional cluster and improve competitiveness through an integrated supply chain. Members sub-contract to each other as needed, after attempts to formalize and centralize the sub-contracting process met resistance from members.

Interview #7: A small, rural manufacturing network that engages in member to member sub-contracting and staff and equipment sharing, as well as collaborative training and workforce development initiatives.

Interview #8: A three member manufacturing and metal fabrication alliance that was created by companies introduced through a local economic development program. The alliance was developed to increase production capacity and attract new markets. The firm with the largest share of an order signs a contract with the customer and then sub-contracts out to the other members as needed.

Interview Process

The questions for the interviews were developed by the researcher on the basis of themes discovered in the literature review and topics the client had expressed interest in. Following the conceptual framework introduced in Chapter 2, the questions were grouped into the three phases of network formation and operation: initiation, setup, and realization. Once developed, the questions were reviewed by the researcher's supervisor, the client, and one of the aerospace firms involved in the consortium planning group. The interview questions can be found in Appendix C.

The interviews were semi-structured. The researcher used the prepared questions to guide the interviews, but also followed up with additional questions when interviewee responses warranted it, or when interviewees brought up potentially valuable information that did not fit into the prepared question categories. A copy of the interview questions was provided to all interviewees prior to the interview to give them a chance to review if desired. The time spent on each question depended on the nature of the network and the responsiveness of the interviewee.

All interviews were conducted by telephone and recorded by the researcher using a digital audio recording device. The recordings were then transcribed by the researcher.

3.3 Data Analysis

The interview data was analyzed through categorization and thematic content coding. Interviews were recorded and then transcribed by the researcher. The information from these transcripts was put into a grid that recorded the answers received for each interview question. This categorizing allowed the researcher to examine the range of answers received for each question and observe any visible themes in responses. The collection, transcription, and categorization process aided the researcher's data intimacy (Saldana, 2011, p. 95) and allowed the researcher to discern additional themes in the transcripts that did not necessarily correspond with an interview question category. A coding legend was created and the transcripts were then coded for these additional themes. The coding and categorizing process followed the steps prescribed by Saldana (2011, pp. 95-98). When relevant, individual quotes that illustrated a certain theme were selected for inclusion in the findings chapter.

The key themes were then compared and contrasted to the key findings of the literature review to determine whether the results of this research support or refute the findings of other researchers.

The data analysis for the jurisdictional scan followed a similar, yet simplified pattern due to the small quantity of data that came out of this research.

3.4 Scope, Limitations, and Delimitations

3.4.1 Scope

This qualitative research examines the experiences of existing manufacturing networks, as reported by the interviewed senior representatives, in order to compile a set of smart practices for B.C.'s aerospace industry to consider in the course of establishing its own organization. This study only looked at hard collaborative manufacturing networks in North America that were discoverable through online searches, and the interviews were limited to the organizations the researcher was able to find and secure for interviews in the two month data gathering period. The data analysis was done by the researcher without the use of specialized programs.

3.4.2 Limitations

This research project faced several limitations. The first limitation was the small sample size. The researcher originally intended to conduct 12-15 interviews, but difficulties locating relevant organizations and poor response rates from organizations contacted with interview requests resulted in only 8 interviews being conducted. The researcher sent over 45 requests for participation or information to potential interviewees and organizations that were believed to have information on networks in their membership or region.

The researcher's methods of locating relevant organizations were limited to internet searches and recommendations from colleagues and interviewees. Additional relevant organizations undoubtedly exist, but many are regional in nature and do not necessarily have a strong internet presence or do not advertise the collaborative nature of their activities. As a result, the researcher only able to find a limited number of potential interview subjects.

The other element of the small sample size was the poor response rate to interview requests. The researcher was unable to provide any incentives for participation in this study. Responses to interview requests or requests for information on potential networks in a given region or organization membership had very low response rates. Participants had to be willing to take up to an hour out of their work day to speak to an unknown individual and the only benefits the interview offered to them was a knowledge that they were contributing to research and assisting a graduate student. Due to resource and capacity constraints, along with the client's timeline for the research application, the researcher was unable to find further willing interviewees.

A second limitation to this research was the potential bias associated with the data and analysis. Interview data was self-reported and responses were based on interviewee's recollections and interpretation of events, which may not be entirely factual or unbiased. This data faced further potential bias through the researcher's interpretation of data as

the analysis was conducted. As with all qualitative data analysis, the researcher's interpretation of a data is a constructed reality and other researchers with different backgrounds may draw different conclusions (Schutt, 2015, p. 321).

A third limitation pertains to the jurisdictional scan. Due to the required timeframe of the project and the researcher's capacity, a second round of interviewing for Canadian government efforts in encouraging collaboration was deemed unfeasible. As a result, the information contained in this section was limited to the information available on various government websites and other associated websites.

3.4.3 Delimitations

A delimitation of this project was the researcher's decision to limit the interviews to North American manufacturing networks. This was done because these networks and the B.C. aerospace industry face similar economic and cultural factors, which improves the relevancy for the interview findings. This decision also ensured the researcher was able to conduct interviews in English, as an interpreter was outside the resource constraints of this project.

A second delimitation imposed by the researcher was the decision to limit the examined literature to papers that specifically mentioned manufacturing and/or SMEs, with a few exceptions for notable works in the field of collaborative network research. This was done to restrict the volume of available literature to a manageable and relevant pool that would be within the scope of the project and useful for the client's interests.

A third delimitation was the decision not to delve into any cost-benefit analysis of various network configurations or options. This type of analysis was deemed beyond the scope and capacity of this study, but could be addressed by a consultant at a later date if the B.C. aerospace industry chooses to do so.

A fourth delimitation occurred in the jurisdictional scan, as the scan was restricted to provinces with sizeable transportation manufacturing industries. This was done because these are jurisdictions where aerospace manufacturing is a relevant economic contributor and government is more likely to have undertaken actions to support the aerospace industry. As no data was available for provincial aerospace manufacturing GDP, Statistics Canada's 2014 transportation manufacturing sales data was used instead (Statistics Canada, 2015).

4.0 FINDINGS: JURISDICTIONAL SCAN

Current government efforts to improve aerospace collaboration in Canada, both at the provincial and federal levels, have largely focused on soft, research-based collaboration; however, some initiatives aimed at cluster development and business collaboration were found in this scan, which looked at the Government of Canada and the provincial governments of Ontario, Quebec, Alberta, New Brunswick, Saskatchewan, and Manitoba. These six provinces, along with B.C., represent the top seven provinces transportation-related manufacturing sales for 2014 (Statistics Canada, 2015). This measure was selected to indicate the level of aerospace manufacturing capacity, as specific aerospace manufacturing sales data was not available.

Data collection for the jurisdictional scan was done through internet searches and a review of the relevant government websites.

4.1 Federal Government

At the federal level, the largest collaborative aerospace initiative to date is the Consortium for Aerospace Research and Innovation in Canada (CARIC). CARIC is a national collaborative aerospace organization that was created in 2014 following a recommendation from the 2012 Emerson Report on Aerospace. CARIC features soft research collaboration and aims to “consolidate and heighten Canada’s position as an innovative force in aerospace research and technology worldwide, promote aerospace competitiveness through collaboration and innovation, and act as a focal point for collaborative research projects in Canada” (Aerospace Industries Association of Canada [AIAC], 2014, para. 1). CARIC is an industry-led collaboration between the Aerospace Industries Association of Canada (AIAC) and Industry Canada. The model for CARIC comes from Quebec’s Consortium for Research and Innovation in Aerospace in Québec (CRIAQ), which has been widely regarded as a successful model for collaborative research by Canada’s aerospace industry (Bombardier, 2014, para. 3).

4.2 Quebec

Quebec is well established as Canada’s dominant aerospace province and Montreal is home to the country’s largest aerospace cluster. One of the initiatives the Quebec Government has undertaken to advance the aerospace industry is the creation of the Consortium for Research and Innovation in Aerospace in Québec (CRIAQ). CRIAQ is a non-profit research organization that was created in 2002 to improve innovation and competitiveness in Quebec’s aerospace industry. CRIAQ’s work focuses on five strategic priorities: conducting industry led collaborative research, training a skilled workforce for aerospace research, promoting the field of aerospace research and product development, and encouraging national and international research collaboration (Consortium for Research and Innovation in Aerospace in Québec [CRIAQ], 2015, “About CRIAQ”).

The idea for the organization came from a 2000 research paper from the University of Sherbrooke’s Jean Nicolas and François Charron that emphasized the potential economic,

scientific, technological, and societal benefits of a collaborative aerospace research body. Preliminary funding for the project came from Valuation-Recherche Québec and Quebec Fonds québécois de recherche-Nature et technologie, but 25% of project costs and total consortium operating costs were provided by the companies involved: Bell Helicopter Textron Canada, Bombardier Aerospace, CAE, CMC Electronics, EMS Technologies and Pratt & Whitney Canada. Since then, CRIAQ has received ongoing funding from the Government of Quebec and has also received some additional support from Natural Sciences and Engineering Research Council of Canada (CRIAQ, 2015).

CRIAC is governed by a board of directors comprised of industry and university representatives that oversees executive, scientific, strategic, and research committees. The CRIAC model has been used for similar university and industry consortia in Quebec and elsewhere, such as the CARIC. Additionally, CARIC has helped to develop other related networks such as the Green Aviation Research and Development Network (CRIAQ, 2015).

Another collaborative initiative the Quebec government has supported is the Aero Montreal cluster. Created in 2006, Aero Montreal is a collaborative group that brings together aerospace stakeholders, from industry to academia and unions. The group receives funding support from the Province of Quebec and the Government of Canada. Aero Montreal's mission is to "mobilize industry players around common goals and concerted actions to increase the cohesion and optimize competitiveness of Quebec's aerospace cluster" (Aero Montreal, 2015, "who we are" para. 2). Aero Montreal operates through a series of working groups that focus on six priorities: market development, national security, supply chain development, innovation, branding and promotion, and human resources.

Aero Montreal has several cluster-oriented initiatives, including the Bombardier led MACH initiative which aims to improve Quebec's aerospace supply chain by creating vertical collaborative links between customers and suppliers and addressing supply chain gaps (Aero Montreal, 2015, "MACH Initiative"). Under the MACH Initiative, SMEs are mentored by a prime contractor and receive certification on a scale of MACH 1-MACH 5 as they progress in a series of improvement initiatives (KPMG, 2014, p. 38). The program is intended to enhance Quebec's supply chain and improve the province's competitiveness in the global aerospace markets. The program was developed in consultation with members of the Montreal aerospace community. Aero Montreal is currently accepting its fourth annual cohort of suppliers into the MACH initiative program. (Aero Montreal, 2015, "MACH Initiative").

4.3 Ontario

One of Ontario's largest efforts to encourage collaboration has also developed from the recommendations of the 2012 Emerson Report. The Emerson report recommended that government should help fund hubs in areas accessible for industry, researchers, and academic institutions in order to encourage collaboration in research and production. Specifically, the report suggested the creation of a hub in Toronto's Downsview Park. The Ontario government has committed \$26 million in funding for a partnership between

Bombardier and Centennial College that will see the college's aviation program relocated to a former aircraft manufacturing facility in Downsview Park (Government of Ontario, 2015). The facility will also serve as headquarters for the Downsview Aerospace Innovation and Research (DAIR) working group, a collaborative research group composed of Bombardier, Honeywell, Pratt and Whitney Canada, Sumitomo Precision Products Canada Aircraft Inc., MDA Corporation, and UTC Aerospace systems as well as Ryerson University, Your University, University of Toronto, and Centennial College (Ontario Office of the Premier, 2013).

Another way in which the Ontario government has pursued collaborative research opportunities is through a partnership of Ontario Centres of Excellence with the Ontario Aerospace Council and the recently formed CARIC. This partnership is intended to provide an effective and unified way for the province's aerospace companies to access collaborative R&D opportunities (Ontario Centres of Excellence NR, Oct. 23 2014).

4.4 Manitoba

The Government of Manitoba and the Government of Canada, along with the AIAC and the Canada West Aerospace & Defense Industries, fund the Manitoba Aerospace Association (MAA) and the Manitoba Human Resource Council (MAHRC). The MAA is an industry organization that partners with academic institutions and government to improve the province's aerospace industry and encourage innovation and workforce development. The MAA recently put on a series of workshops in partnership with the Manitoba Aerospace Human Resources Council and EnviroTREC to encourage collaboration in the aerospace industry (Manitoba Aerospace, 2015).

The MAHRC has looked abroad for further lessons in collaboration- they have worked with the United Kingdom's (U.K.) North West Aerospace Alliance in 2010 to learn about the UK organization's Aerospace Supply Chain Excellence (ASCE) and find out how to create a comparable program in Manitoba. This experience led to the 2010 launch of the Competitive Edge Supplier Development (CESD) Program, a five-step program that allows companies to progress from "learner" to "world class" (Aerospace Review, 2012, p. 19). This program was developed in the U.K. through consultation with large international primes such as Airbus and Rolls Royce. One element of the CESD program is cluster development, where participants are encouraged to create collaborative linkages in their region to secure national and international work packages (Manitoba Aerospace, 2015, "Cluster Development").

4.5 Alberta

The Government of Alberta's efforts at encouraging aerospace collaboration have primarily centred on developing partnerships between industry and academic institutions with aerospace research capabilities. In 2014 the Government of Alberta facilitated a partnership between Lockheed Martin and University of Alberta's nanotechnology program and contributed to the \$2.7 million dollar collaborative research project the two parties are undertaking (University of Alberta, 2014).

4.6 Saskatchewan

Although the Government of Saskatchewan has undertaken aerospace-related workforce development initiatives and offers a range of tax incentives relevant to the aerospace sector, no actions specifically involving collaboration were found on the government website.

4.7 New Brunswick

In New Brunswick, the provincial government and the Atlantic Canada Opportunities Agency have helped to create the New Brunswick Aerospace and Defence Association (NBADA). Established in 2001, NBADA is an industry cluster that represents the interests of more than 50 New Brunswick based aerospace and defence companies and pursues opportunities in this sector. The Government of New Brunswick, through the Business New Brunswick Department, also promotes general supply chain development to their aerospace industry through their advanced manufacturing sector initiatives (New Brunswick Aerospace and Defence Association, 2015).

4.8 Conclusions

The jurisdictional scan of government efforts to encourage collaboration in aerospace revealed that actions to date have primarily been focused on developing educational and industry research consortia and have varied in intensity across Canada. The largest collaborative research initiatives have been Quebec's CRIAQ and the subsequent creation of the national CARIC.

In addition to research collaboration, there are some examples of initiatives targeting hard business collaboration. Manitoba has adopted the CESD program, which encourages cluster development as part of its supplier improvement curriculum. Ontario has taken cluster development efforts a step further, with the creation of the Downsview Aerospace Park project. Finally, Quebec is a provincial leader in aerospace supply chain development initiatives with its MACH initiative.

No government initiatives were found that were specifically aimed at creating a horizontal collaborative aerospace manufacturing networks or consortia.

5.0 FINDINGS: INTERVIEW RESEARCH

This section summarizes the findings from the interview research with 10 representatives from 8 collaborative network organizations. The results are grouped into the three questions categories that were derived from the conceptual framework introduced in Chapter 2: Initiation, Setup, and Realization.

5.1 Initiation

5.1.1 Motivating Factors

The first set of questions concerned the initiation period. The factors leading to network initiation ranged, although several cited economic trends as a factor. For example, one developed in the aftermath of the post 9-11 aerospace industry recession, while other organizations chose networks to cope with declines in the gas refining and petrochemical industries or general regional economic decline. The majority of interview subjects reported that an economic development professional from a state or regional organization played a role in the initiation of the network, though the extent of this involvement varied. Some organizations credited an economic development professional for developing the network idea and leading the organization process, while other reported that agencies merely introduced businesses to each other or conducted studies or programs that informed businesses of the potential for a successful network. Others brought economic development agencies in to the process after the initiation decision had been made. Some networks received grants and funding, others were entirely funded by the founding companies. An exception to this pattern is one network that developed without any public agency involvement when a doctor established a network to produce his own surgical equipment. In this case the doctor acted as an external agent that came into the manufacturing industry and organized the existing firms into a network, similar to the work of economic development agencies in other networks.

5.1.2 Prior Knowledge

Some organizations reported that companies had knowledge of each other or prior business relationships before network initiation; others reported that they had little to no pre-network relationship and in some instances were unaware of each other's existence. The number of firms initially involved was also widely varied, ranging from 3-50.

5.1.3 Challenges or Issues

The majority of subjects reported that it took approximately a year after the idea of the network was proposed until the actual setup of the network occurred. In all but two of the networks, industry played a role in the initiation process, with company owners dedicating significant time to championing and planning the project.

The issues and concerns networks encountered in the initiation and setup phase varied widely and included: concerns about the quality of the network work, particularly for aerospace and medical applications; employee concerns about their employer exposing

the company to perceived risks of collaboration such as opportunism; whether the volunteer board members would act in the interests of the group or their own companies; establishing fair and accurate cost and profit information for joint bidding; finding dedicated people to work with; and ensuring fair distribution of work opportunities. Some challenges that recurred in responses were keeping member companies engaged through the often lengthy setup process and clearly explaining the network concept to companies.

5.2 Setup

5.2.1 External involvement

No organizations reported the use of a professional network broker or agent, but several had economic development professionals involved. Those networks that had an engaged economic development professional active in the initiation phase generally continued to benefit from their involvement through the setup. Several organizations brought in accountants to assist with the setup for tasks such as assessing break-even costs for joint production projects and establishing quoting systems. Many organizations brought in legal professionals to register their organization, draw up non-disclosure agreements, or establish bylaws. Bringing in experts was cited as the largest expense, but the investment was generally regarded to be worthwhile. One interviewee stated that “having an independent outside expert is often worth the expense to validate the capabilities of the cluster and verify the value that can be achieved through working together” (Interview # 4).

Most interviewees reported that the companies themselves played a large role, with owners and other staff putting in time and money. The term “sweat equity” was used frequently by interviewees and one commented that “the effectiveness is probably a lot better when the people working on it are the actual stakeholders themselves” (Interview #6).

5.2.2 Costs and Funding

The total costs of setup ranged from less than \$1000 for smaller organizations that performed most of the setup work internally, to over \$150,000. One network spent approximately \$2 million over a span of eight years, but this cost included the development of a specialized computer application for network communication and information sharing.

Funding came from government grants, the companies themselves, or a combination of the two. Additionally, these networks benefitted from non-monetary support. In several instances economic development associations donated administrative support staff and office resources. In many associations a large amount of the setup was made possible through “sweat equity” from the involved company owners, which led to relatively small monetary costs for setup and operations, but a large investment from the involved parties.

5.2.3 Form and Governance

Networks that developed with the assistance of an economic development association nearly all incorporated as private not-for-profits or non-profits, with the exception of one small, informal network that has no legal form. These networks operated under a set of bylaws, with membership voting to elect a board of directors that will steer the network and vote on decisions. Some subjects noted that potentially controversial decisions are given to membership wide vote when the board deems appropriate. The remaining networks that did not have any public agency involvement were setup as corporations or limited liability corporations, with boards of directors and bylaws. Many networks had created their own codes of conduct or charters for members to sign, which sometimes included confidentiality clauses.

5.3 Realization

5.3.1 Membership

Current membership for the organizations ranged between 3-30 members, with the exception of one network with 60 members. Several interviewees reported a decline in membership since initiation due to members becoming disenchanted with the lengthy setup process or failing to see beneficial results from their membership in the network, particularly if membership fees were charged. Interviewees reported annual membership fees that ranged from \$0 for the small informal organization to over \$1,000. Those networks with higher membership fees typically had a larger offering of training, networking, and promotion opportunities available to members. In most instances, membership eligibility was subject to companies being in a certain region and industry, with the board sometimes reserving the right to decline a membership requests. Tiered membership was a feature in some networks, with a discounted membership status and fee option for small firms or organizations that were not manufacturing firms but wished to be part of the network (for example, associated service providers or economic development agencies). One network explicitly avoided having direct competitors within the membership out of concern that competitors would not be comfortable sharing information with each other and this might affect the collaborative nature of the network. Nevertheless, the majority of the networks did involve direct competitors.

5.3.2 Customer Contracts

Only one organization reported entering into contracts directly with customers, although several interviewees reported that this had been considered but rejected for various reasons. The reasons cited included member company concerns about autonomy, complications associated with joint quoting, and customers' hesitation to enter into contracts with a network. One interview noted that customers would not be willing to do business with a non-profit, while the network that did enter into contracts explained the lengthy process of explaining the concept to the customer who visited the network office only to discover that no physical manufacturing facilities existed on site. An additional consideration cited by one network was whether doing business through the network would jeopardize their non-profit status. To avoid this issue the network formed a

separate LLC entity to do business, but other complications prevented the network from proceeding further in this direction. Networks with aerospace customers faced the additional challenge of becoming an approved supplier, and found it easier to have an approved member sign contracts rather than attempt to have the network added to the supplier list.

Other than the exception network mentioned above, all networks operated by having a member firm enter into a contract with the customer, generally the member that was performing the majority of the work, and then that member would sub-contract out portions of the order to network members as needed for additional capacity or capability. As a result, the risk to the member firms of these networks was limited to the amount of the contracts they individually signed with customers or other network members, and there was no contract-related risk to the network as an entity. Some networks had a portal that potential customers could submit requests for quotes to, but most listed member contact information and capabilities and encouraged customers to contract companies directly. Several interview subjects noted that this option to contact members directly made it difficult to gauge network effectiveness. In no instances did subjects report that members were restricted to only doing network business or solely sub-contracting to other network members.

5.3.3 Benefits

Interview subjects described a range of benefits that had resulted from their relative networks. Frequently cited benefits included new customers and increased business that came out of networking opportunities, member referrals, and network promotion. Subjects also mentioned the ability to accept larger or more diverse work packages through the sub-contracting to fellow network members. In addition to member sub-contracting, one network's firm shared equipment and staff members through lease agreements when additional capacity was required. All but one interviewee stated that the network had brought financial benefits, but most were careful to stress that the benefits took time to develop and were difficult to accurately measure or definitively attribute to the network. One interviewee explained that "at the end of the day it's a messy process and it produces revenue. There's not a direct, straight line between that and increasing your revenue, but nonetheless the people who are heavily involved are reaping the benefits" (Interview #6).

In addition to financial benefits, increased knowledge was a recurring theme in interview responses. Subjects mentioned that an increased awareness of what was going on in their industry was helpful: the network allowed them to meet similar businesses and find out about new industry technology. Several networks regularly organized field trips to member businesses so that owners could observe operations at fellow member businesses firsthand. Describing the benefits of these trips, an interviewee commented that "every time I got through a facility I see something that could be applicable to what we are doing. Maybe something that could help with our efficiency, or a tool I didn't even know existed" (Interview #7).

One network, which had established break even cost margins for members, used the quoting process to determine which company performed a particular manufacturing process most efficiently and then arranged for the other members to visit the company and learn about how to improve on this process. This allowed the whole network to improve and become more competitive at securing contracts.

Many interview subjects reported that their networks provided training and education opportunities for the members. In some of the smaller networks this training was conducted more informally by firms inviting other member firm employees to participate when they brought in instructors to conduct training sessions for their own staff. Another reported benefit was the influence a network had on government agencies when lobbying for the interests of a sector. Some interview subjects felt their groups were given more consideration than individual companies, and received credibility as an industry voice. One interviewee explained that “the group gets a far better reception and response than individual companies would on their own and had become a ‘go to’ contact for industry comment and advice” (Interview #4).

5.3.4 Recommendations

Interview subjects had a variety of recommendations for companies looking to establish a similar network, based on their learned experiences. A frequently occurring comment was that the engagement level of a member determined the level of benefits they reaped from the network, and those that became disenchanted with the networks and left either lacked an understanding of how to utilize the network or had not invested the necessary time or resources into network participation.

Another common recommendation was to bring in professionals with legal and accounting expertise to assist with the network setup; however, the importance of industry involvement was stressed too. A few subjects emphasized the importance of having a third party conduct an impartial feasibility study to determine the willingness of industry to commit to a network initiative, and to assess the potential benefits a network could realistically yield for a given industry and region.

Most networks operated without dedicated staff, and were administrated through the efforts of member firms and/or local economic development agencies. Government funding was felt to be very important to some interviewees, with one individual reporting that an unexpected cut funding was partially responsible for the network’s failure to achieve its objectives. This interviewee commented that:

I’ve been trying to do network cluster development for years and until you get something that is up and running and functioning that provides a good service that provides a good return on investment, small business manufacturers are not going to invest in it because they would rather put it into their business than into a possibility (Interview #2).

Interview subjects also widely cautioned against expectations for short-term gain and stressed the long-term nature of network and relationship building. One interviewee advised:

I would caution everyone thinking that this is a quick fantasy to help their groups. It's a long range understanding of bringing another channel of business into your business [...] it takes time to build trust, it takes time to have proof of concept (Interview #5).

Another interviewee commented on the challenge this long timeframe posed for member engagement, stating "the biggest trick in developing consortiums is keeping the cluster, the businesses, in our case manufacturers, engaged in the initial part of developing the market because it's a slow process" (Interview #2). Suggesting realistic expectations, another interviewee warned others to "realize that it is a slow process- it will not happen overnight [...] keep your expectations low. Don't assume that everyone will see the value and want to participate" (Interview #4).

5.3.5 Personality Dynamics

Another theme mentioned was the dynamics of the involved business leader personalities. Several respondents mentioned concerns about the viability of the network beyond the present leadership's retirement, or mentioned that they were not sure their network could be replicated because it was so dependent on the personal dynamics of the group. Commenting on how others want to replicate their network model, one interviewee said:

I'm not entirely sure you can replicate what we have easily, mostly because of the fact that we have some very unique personalities that have come together here. [...] I would have to focus on the dynamics of the right personality, people with the desire to put into it as much or more as they are getting out of it for the good of the group. And if you have ones that really have the mentality of 'how can we help each other' that's really key" (Interview #7).

This theme was echoed by another interviewee who commented that "you have to find the right people to work with, the right customers, the right vendors...it's always a challenge to find the right people" (Interview #1). Another interviewee noted that business leaders who were committed to the collaborative process were key, stating that "you've got to find the right individuals who are ready to put lots of hours in with little return for several years" (Interview #2).

Similarly, some respondents mentioned that the collaborative attitude that made their network possible was linked to regional characteristics, making statements such as "that's the way [region name] usually gets stuff done. Usually everyone pulls together and gets stuff done" (Interview #6).

5.3.6 Progress and Challenges

Only two of the interviewees thought that their networks had achieved their desired aims. Many stated that they still considered their networks to be in an infancy stage and had a lot of progress to make. Some interviewees revealed that their network was still in the process of determining what it wanted to be, even years after establishment. One interview subject noted that their network couldn't be gauged a success because it had only resulted in significant benefits for one company, not the other two members.

Reported present-day challenges were similar to those experienced in the early initial stages. Many interview subjects noted that the issues and concerns that they encountered in initiation continued to be challenges in present day. Again, subjects mentioned difficulties in getting employees, customers, and members to fully understand the network concept and the benefits it could yield. Several also noted that it was still a challenge to have competitors work together amidst fears of opportunism, although this had improved over time through repeated positive interactions and guidance from the network leadership. One interviewee stated that:

Probably the biggest challenge was getting over the idea that we are all working together and some of us are competitors but there's a much bigger pie out there that we can go share. Historically a lot of the competitors had been competing locally, everyone fighting over the little chicken bone...now it's like we are going to go after the whole farm. Just that mindset transition took a little while for some people to get a hold of (Interview #6).

5.4 Interview Conclusions

The interview research presented a wealth of information and recommendations relevant to establishing an effective network. The interviewee's organizations ranged in size and sophistication, and many of their learned experiences were context dependent on the region, individual leadership, and industry. Despite this variation, several key themes emerged.

The services of legal and accounting professionals were regarded helpful in the early stages of network development. Many networks also felt the assistance of economic development professionals was invaluable. The majority of the interviewed networks were setup as formal not-for-profits, governed by an elected volunteer board of directors, and did not sign contracts with customers directly.

Explaining the network concept to employees, members, potential members, and customers was often cited as a challenging and ongoing process. Achieving collaboration between previous competitors was challenging but generally improved over time as trust was built. Building the network and establishing member relationships was a long-term process and those who expected short-term gains were often disillusioned with the network and left before gains could be realized. Many interviewees felt their network still had not achieved its intended aims.

The benefits of network creation and participation were felt to be worthwhile, but were described as dependent on firm engagement level, and difficult to measure. In addition to direct financial benefits to network participation, learning and networking and relationship building were cited as other benefits.

Additionally, individual personalities involved in the network were seen as key to its functionality and success. Interview subjects frequently mentioned leader personalities as a key consideration for membership, in addition to company capabilities.

These conclusions will be analyzed with reference to the reviewed literature and the jurisdictional scan findings in the next chapter.

6.0 DISCUSSION AND ANALYSIS

In this section, the themes drawn from the interview research will be analyzed and discussed with reference to the conclusions found in the reviewed literature. As the jurisdictional scan did not reveal any initiatives relevant to the research question or the other research methods, the jurisdictional scan is analyzed separately following the interview data analysis. Finally, a set of strategic implications will be presented at the end of the chapter based on the preceding analysis.

6.1 Themes

6.1.1 Internal vs. External Involvement

The interview findings suggested that outside involvement in the form of initiation, administrative support, and funding could be advantageous for network development, but that industry involvement was also important. For example, one network was initiated and organized by a regional economic development office with significant funding resources but it still struggled with maintaining membership because the member firms lacked sufficient long-term commitment to the project. Meanwhile other networks developed more successfully through the funding and efforts of the membership with minimal outside involvement.

This finding supports Kingsley and Klein's argument that funding and organizational assistance can be helpful in aiding network development, but should be accompanied by industry motivation in order to bring the best chance of success (1998, p. 72), but does not support their finding that public agency involvement is more likely associated with network failures than successes (p.71). In the interviewed organizations, public agency involvement in the form of local or state economic development agencies was largely described as having a positive impact on the network.

Many interview subjects also expressed that the services out outside professionals were useful in the early stages of network setup in order to deal with legal and accounting tasks, but that most of the work was done internally through "sweat equity" from the involved firms. Although industry was involved, professionals were engaged to provide expertise where needed. This finding supports Moss Kanter's recommendation that professionals should be brought into the process when setting up a network, but should not be used as a replacement for the involved leaders (1994, p. 103).

The implications of the above findings for the research question are that outside involvement in the forms of support from public agencies and professional services can be valuable during the network setup and operations. Yet this external support should be a complement to industry involvement, not a replacement for it.

6.1.2 Form and Governance

Nearly all of the interviewed networks were governed by elected volunteer boards of directors from the membership and other relevant organizations such as economic development agencies. The two networks that did have some external governance

were larger networks with no public agency involvement. This finding is partially in support of Provan and Kenis's (2008) argument that centralized and external governance is best for large and diverse networks, while participant governance is best suited for smaller networks with higher degrees of agreement amongst membership. Overall the findings of the interview research were not able to support whether the governance structure had was a causal factor in network success or failure.

All but one network was formal, and most operated as incorporated non-profit or not-for-profit organizations which gave them advantageous tax-exempt status. These organizations had corporate bylaws but many also created a less formal code of conduct or charter that members signed. Only one of the networks signed contracts and accepted liability, and this network was governed by an external commercial entity and had little to no member involvement in governance. The research findings are in support of the findings of Hanna and Walsh's (2008) findings that many networks used informal membership charters and did not accept joint liability.

The reasons interviewee's provided for the decision not to have the network enter into contracts directly included company concerns over autonomy, the complexity involved in setting up this arrangement, and customer hesitation to do business with a network. Customer concerns were highest in aerospace networks, where the customers had lengthy supplier approval processes due to the high quality standards of the aerospace industry. Several networks had tried to implement joint contract fulfillment but found it unsuccessful. Aerospace networks in particular found it easier to have an approved supplier member sign the contract directly with the OEM or Tier 1.

With regards to the research question, these findings suggest that creating a B.C. aerospace network that signs orders as a corporate entity is likely to be a complex undertaking that will require member willingness to relinquish a degree of autonomy. Additionally, B.C.'s aerospace industry's customers must be willing to do business with the network. Although one of the reasons that led to the concept of a B.C. aerospace consortia was a major OEM's aversion to doing business with a fragmented industry of small companies, the research findings suggest that OEMs and Tier 1s may not want to sign contracts directly with a network either. In this context, a network should assess the willingness of its proposed membership to give up part of their independence and the attitudes of its intended customers before proceeding with the development of contract signing network entity. It may be more feasible to sign contracts through a network member who is already an approved supplier.

6.1.3 Managed Expectations

Nearly all of the interviewees emphasized that their networks had taken longer than anticipated to develop, and many noted that they did not believe their network had achieved its original goals yet. Related to this, many of the interview subjects also mentioned that members who expected short-term results had become disillusioned

with the network concept and left before benefits could develop. This finding did not appear in the reviewed literature, but could arguably be seen to support Park and Ungson's finding that alliances typically fail because a firm's self-interest is at odds with acting for the good of the group (2001, p. 37) and Moss Kanter's argument that Western firms are more likely to overlook the cultural and relational elements of networks and solely focus on financial gain (1998, pp. 96-97). Firms who are only interested in joining a network for quick individual gain and do not fully subscribe to the longer term goal of meaningful collaboration are more likely to become frustrated with the long timeframe and leave the group.

A related finding was that many interview subjects mentioned difficulties explaining the network concept and/or garnering support for the concept. One element of this difficulty was explaining the collaborative concept to firms, particularly direct competitors who sometimes had acrimonious history. The difficulty of establishing collaborative relationships between previous competitors has also been documented in the literature (Hanna & Walsh, 2008, pp. 308-309; Provan & Human, 1999, p. 204; McClellan, 2003).

With reference to the research question, the above findings suggest that plans for a network should be developed with a realistic and lengthy timeline in mind, and that participants should be firms that value long-term relationship building not just short-term financial gains. The findings also suggest that networks should not expect instantaneous understanding of the collaborative concept, and should be prepared to invest time and resources into explaining and championing the idea to potential members, clients, and employees.

6.1.4 Benefits

Interview subjects reported a range of benefits resulting from their networks, including increased business, improved competitiveness, organizational learning, and peer support. The consulted literature also identifies these benefits (Provan & Kenis, 2008; Hanna & Walsh, 2008; Arku, 2003; Lo Nigro & Abbate, 2009). One benefit mentioned in the literature that was not explicitly present in the findings was an improved ability to keep up with technological change and innovation (Hanna & Walsh, 2008); however, interview subjects did mention that network activities such as equipment leasing and factory tours helped expand their available equipment inventory and exposed them to new tools and working styles. A notable benefit mentioned in the interviews that was not found in the literature was increased influence with government regarding industry issues.

With regards to the research question, these findings illustrate that there are numerous potential benefits to network collaboration and an effective network can take advantage of these potential benefits by offering opportunities for joint education and training, organizational learning, networking, and lobbying.

6.1.5 Leader Personalities and attitudes towards collaboration

The majority of interviewees expressed that the leader personalities were key in their network dynamics. They noted that selecting the right people to work was a critical element to network success, and they considered leader personalities and attitudes towards collaboration to be as important as firm capabilities. These findings are well supported by the reviewed literature (Scherer, 2003; Link & Marxt, 2004, p. 75; McClellan, 2003; Kingsley & Klein, 1998, p. 70). Leader attitudes are also closely linked to firm culture, which is mentioned in the literature as an important factor in a firm's ability to form relationships in a network (Antonelli, Boucher & Burlat, 2011, pp. 39-40; Link & Marxt, 2004).

These findings have direct and valuable implications for the central research question. In order to form an effective and successful network, membership should be evaluated on leader personality and attitude towards collaboration as well as firm capabilities. Leaders who value collaboration and the aims of the group are likely to be more dedicated network members and will increase the odds of network success.

6.2 Jurisdictional Scan Analysis

The jurisdictional scan revealed several instances of government taking action to encourage collaboration through industry-academia research partnerships or cluster development and vertical supply chain optimization, but no initiatives specifically aimed at creating horizontal collaborative manufacturing networks were found. It is important to note that this does not necessarily indicate that these collaborative networks are not being encouraged by the public sector in Canada. In the interview research, nearly all of the reported public agency assistance came from regional economic development agencies. Therefore, it is possible that public agency involvement in this type of initiative is more typical of more localized levels of government and was not captured in this scan of the federal and provincial governments.

With regards to the research question, the jurisdictional scan findings suggest that the client could look to Quebec and Montreal's respective MACH and CESD initiatives for examples of programs that encourage supply chain optimization, regional collaboration, and cluster development. Nonetheless, these initiatives do not involve the creation of a collaborative manufacturing network.

6.3 Strategic Implications

The themes identified and analyzed above suggest a collection of strategic implications for network development for B.C.'s aerospace industry, based on the learned experiences of other collaborative manufacturing networks. The following strategic implications were developed to better understand the decision-making environment and the development of the forthcoming options and recommendation:

Strategic Implication 1 - Professional, unbiased services and advice can be invaluable in the initiation and setup phases.

Although network members have unique knowledge of their particular industry, outside professionals can provide valuable and balanced advice and insight to a network during its formative phases. An unbiased feasibility study is suggested to gauge the potential benefits of network formation and the commitment levels of potential membership at an early stage. Similarly, bring in legal and accounting professionals to assist with the early stages of network setup and provide impartial advice.

Strategic Implication 2 - External support from public agencies can be an advantageous resource but should be accompanied by industry engagement.

Public agencies such as regional or state/province economic development entities can provide valuable funding, advice, and/or administrative support to networks; however, external involvement is not a replacement for industry engagement in the network. For B.C.'s aerospace industry, this suggests that the recent \$5 million funding commitment from the province, in combination with industry motivation, could form the foundation for successful network development.

Strategic Implication 3 - Business leader attitudes and firm culture are critical to network success, and should be considered in membership criteria.

Carefully consider leader personalities and attitudes towards collaboration when assessing membership potential, not just business capabilities. Leaders who value collaboration and create a culture of collaboration in their own companies are more likely to be dedicated and valuable network members. In order to build an enduring and effective network for B.C.'s aerospace industry, membership should be limited to companies who subscribe to the collaborative vision and are willing to commit their time and resources to the network.

Strategic Implication 4 - Anticipate a long timeline for network development, and keep expectations realistic.

Network building is a long-term process, and expectations for quick results are likely to lead to disenchantment and potential loss of membership. Secure members that are committed to long-term relationship building and have realistic expectations for the network. B.C.'s aerospace industry should include a generous timeline in any network development plans.

Strategic Implication 5 - The challenges of creating a network that successfully signs contracts directly with customers can outweigh the potential benefits of this arrangement.

The interview research indicated a range of issues that were encountered while attempting to setup this contract signing arrangement: customers were uncomfortable signing contracts with a network, particularly non-profit networks;; members were reluctant to cede part of their autonomy to a centralized system;; networks faced unfavourable tax treatment;; and implementation of a centralized system presented several cost and logistical challenges. As a result, the client is suggested to research the value and viability of this arrangement for B.C.'s aerospace industry. In particular, gauge customer attitudes towards doing business with a network, particularly in the case of aerospace clients with strict supplier approval requirements. Although aerospace OEMs and Tier 1s can benefit from the efficiency of dealing with a regional supply chain network, they may not be willing to sign contracts directly with a network, particularly a not-for-profit organization. These clients are likely to require proof of concept and a lengthy supplier qualification process before considering this type of arrangement. It may be more efficient to have an approved supplier network member sign contracts and subcontract to the group. Another important factor to investigate is how much autonomy, if any, member firms are willing to give up in the network business model.

Strategic Implication 6 - Networks offer a range of potential benefits beyond direct financial gain.

In addition to increasing membership business, networks can be useful for networking, lobbying and educational purposes. For greatest return on the lengthy and intensive process of network development, the network should be utilized to reap all potential benefits to its membership and the industry in general. For B.C.'s aerospace industry, a network could work alongside AIAC Pacific as a voice for the province's aerospace manufacturers

6.4 Summary

The research findings suggest a number of strategic implications for the client and B.C.'s aerospace industry to consider regarding the development of a collaborative manufacturing network. Firstly, professional and unbiased services are a valuable complement to industry expertise when it comes to viability studies, accounting details, and legal considerations. Secondly, public agency support can be valuable but should be accompanied by industry motivation for the greatest chance of network viability and success. Thirdly, business leader personalities are a critical factor in network dynamics, and should be considered alongside firm capabilities in membership criteria. Fourthly, network development is a lengthy process and expectations and timelines should be kept realistic. Fifthly, setting up an arrangement where the network signs a contract directly with customers can be extremely challenging and it may be more effective for network

members to sign the contracts instead. Finally, networks can afford a variety of benefits, such as networking and education opportunities, in addition to the opportunity to accept larger and more diverse work packages.

The findings and strategic implications outlined in this chapter will be applied in the next section to inform three options for the client to consider regarding next steps for network development.

7.0 OPTIONS AND RECOMMENDATION

Based on the research findings, three options are proposed for the client and industry to consider for the development of a collaborative aerospace manufacturing network in B.C. The options are as follows:

- **Option 1 - Status Quo - No Network Development:** This option is a continuation of current aerospace industry operations, without the creation of a network.
- **Option 2 - Dominant Firm(s) Network:** This option represents a situation where one or more of the province's dominant aerospace firms take leadership in creating and operating a network.
- **Option 3 - Industry and Government Led Network:** This option entails government and the aerospace industry as a whole forming a network where government plays a leadership and organizational role rather than a dominant firm(s).

The options are not entirely inclusive or exclusive, owing to the large number of variables involved in network development; however, these three scenarios were selected to represent the main categories of choices that industry and government face going forward, based on the types of networks observed in the research. Each option will be elaborated on and assessed on the basis of the following criteria:

Cost: the anticipated financial costs an option entails. A lower cost is preferable.

Government Involvement: the amount of government involvement an option requires. This criterion is included only for informative purposes, as government involvement is not assigned a positive or negative value here.

Political: the positive or negative political implications of the option, and the degree to which the option supports the government's priorities and obligations. An option with positive political implications that supports the government's agenda is preferable.

Effectiveness: the anticipated effectiveness of the option, as measured in terms of the ability to achieve the intended aims of encouraging growth and increased competitiveness of the provincial aerospace industry. A high degree of anticipated effectiveness is preferable.

Timeframe: the anticipated timeframe for network formation to begin. As a result of the client's preferences, a swift timeframe is preferable.

7.1 Option 1: Status Quo - No Network Development

Under the status-quo option, B.C.'s aerospace industry would continue to operate as it presently is, with the absence of a network. This option would result if further research revealed that the costs of establishing a network were likely to exceed the benefits the network was likely to yield. The \$5 million in funding that the government has already committed to the aerospace industry would be spent on other aerospace initiatives. The level of government involvement in a network and the timeframe for development are both non-applicable criteria, as no network would be established.

Potential Advantages: The potential advantages to this option are that the \$5 million that government has pledged to the aerospace industry would not be spent on network development and could therefore be spent on other initiatives that are likely to benefit the industry, such as workforce development, R&D incentive programs, or the creation of a business park like Ontario's Downsview Park. These initiatives could produce significant benefits for the aerospace industry, and would be in line with government's commitments to aerospace.

Potential Disadvantages: The potential disadvantages to this option are that it does not address the central issue that the network was intended to address- reducing the amount of fragmentation in B.C.'s aerospace industry in order to make it more competitive and attractive for OEMs who have indicated a desire to limit their suppliers to larger entities with greater capabilities.

7.2 Option 2: Dominant Firm(s) Network

In this option, one or more of B.C.'s larger, dominant firms would take leadership of the network initiative. They would play the primary role in creating and managing the network, with the remaining, smaller firms joining as members. Government would play a minimal role in the network. It is assumed that some government funding would go towards this initiative, but it would be less than if government was to play a central role in the network. The lead companies would also contribute funding and other resources. Membership fees would support ongoing operations.

Potential Advantages: There are several potential advantages to this option. Firstly, the province's major aerospace firms who took leadership would, by definition, be firmly committed to the network. Some government support could still be involved, but the lead companies would also contribute resources. According to the research findings, this would be likely to create an effective network. Secondly, the remainder of the \$5 million government funding commitment could go to other initiatives that would benefit the aerospace industry in other ways. Government would still uphold its commitment to aerospace, which would have positive political implications. Thirdly, this network

arrangement could be convenient for contract signing. The dominant firm(s) would be well positioned to sign contracts directly with customers and sub-contract out to the other members- avoiding the challenges the research identified regarding networks that sign contracts as legal entities.

Potential Disadvantages: One potential disadvantage to this option is that network development could take longer if the government is not actively involved to facilitate and expedite the network process. Even B.C.'s dominant firms may struggle with the capacity and resources to create the network while concurrently managing their own business. Another potential disadvantage is that any degree of government funding for a firm led network could have negative political implications if government was seen to be endorsing an initiative that benefited certain firms more than others. Government would need to carefully negotiate the support it could provide to this type of network.

7.3 Option 3: Industry and Government Led Network.

Under this option government plays a central role in network development and operations, alongside industry. Government will play an organizational leadership role, eliminating the need for any one or two dominant companies to lead the network. This means there would be a more equal balance of power and involvement amongst the member firms, although the larger firms would still be likely to play a more influential role due to their size. Network development would primarily be funded through the province's \$5 million commitment, but membership fees would support ongoing operations.

Potential Advantages: The potential advantages to this option are that the timeframe could be shorter if government was actively expediting the process, the option supports government commitments and goals, industry perceptions could be positive if industry was adequately consulted and involved, and the network could be effective if industry supported the initiative and was in favour of government's leadership.

Potential Disadvantages: The potential disadvantages to this option are that more government funds are likely to be required for staff to oversee the initiative and the aerospace industry could have negative perception if it felt like the network was being imposed on them without adequate industry consultation and involvement. There is also risk that this network approach could be ineffective if industry doesn't match government's level of commitment, as the research indicated that industry involvement was important for network success.

7.4 Summary of Option Advantages and Disadvantages

The anticipated advantages and disadvantages of each option, in relation to the assessment criteria, are summarized in the following table:

Table 2: Summary of Option Assessments

Option:	Option 1: Status Quo- No Network Development.	Option 2: Dominant Firm(s) Network.	Option 3: Industry and Government Led Network.
Government Cost*	N/A	Lower	Higher
Government Involvement	N/A	Lower	Higher
Political	Neutral implications. Government could still fulfil its commitments to aerospace through other initiatives.	Primarily positive implications. Funding support of this initiative would be in line with government's commitment to aerospace.	Positive implications. Direct involvement and funding support of this initiative would be in line with government's commitment to aerospace.
Effectiveness	Anticipated low-medium.	Anticipated medium-high.	Anticipated medium-high.
Timeframe	N/A	Anticipated midrange.	Anticipated short.

** note: any government funding for network development is assumed to come from the B.C. Government's pre-existing aerospace funding commitment of \$5 million. If these funds are not spent on network development, they are assumed to be spent on other aerospace industry initiatives.*

As illustrated above, government cost and government involvement are predicted to be lowest for the dominant firm network, and highest for the industry and government led network. None of the options are expected to yield negative political implications, but the industry and government led network is expected to have the most positive implications. Both dominant firm and industry and government led options are predicted to have the potential for medium to high effectiveness. The timeframe for development is expected to be lowest for the industry and government led network.

7.5 Recommendations

Both options 2 and 3 could both be effective choices, depending on the level of industry's level of engagement and capacity. Option 1 is not recommended as it does not address

the central issue that led to this research- reducing the fragmentation of B.C.'s aerospace industry to make the supply chain more attractive to OEMs such as nearby Boeing.

If one or more dominant firms are willing and able to take leadership of the network initiative, option 2 is likely to yield favourable results. If firms lack the capacity to take on such an initiative, government leadership is recommended through option 3. At present, research from KPMG (2014) and conversations the client has had with industry suggest that no B.C. firm is likely to have the resources or desire to take on the network initiative in the near future. As such, the current recommended option is option 3. This option is put forward with the cautionary note that government should ensure that industry is committed to the network initiative if proceeding with option 3, as the research indicated that industry engagement should accompany government support for the best chance of success. This could be assessed through a viability study and discussions with firms.

This option, in combination with the strategic implications recommendations found in Chapter 6, is recommended in order to best guide the development of an effective B.C. aerospace manufacturing network that will improve industry growth and competitiveness and yield economic benefits for the province.

7.6 Implementation Plan

The following table outlines a suggested implementation plan for the recommended option of option 3. All the suggested tasks and recommendations are assumed to be done in partnership between government and industry, except where otherwise specified. Timelines are approximate.

Table 3: Implementation plan

Phase	Tasks and Recommendations	Timeline
Initiation	<ul style="list-style-type: none"> • Engage impartial professionals to perform the following research: <ul style="list-style-type: none"> • Viability study of network contract signing arrangements with the desired customers (i.e. Boeing) • Survey of the province's aerospace manufacturing firms to determine which firms want to participate, and the extent to which they are willing to engage and/or cede autonomy if joint contract fulfillment is to be pursued. This will help determine the form of the network. • Determine the founding member firms who are ready to join immediately in the setup phase. 	0-12 months

	<ul style="list-style-type: none"> • Make contact with similar organizations who have offered assistance or advice to further leverage their expertise (Inland Northwest Washington Aerospace Network, Michigan Aerospace Manufacturing Network). 	
Setup	<ul style="list-style-type: none"> • Establish a membership criteria and fee (if applicable) • Determine the desired network goals and set a timeline for achievement • Determine the desired network form and decision making structure. Jointly decide the role government will play in decision making, if any, or whether government will only play an advisory role. • Engage legal professionals to register the network and establish bylaws and liability levels, if any amongst the membership • Engage accounting professionals as required 	12-24 months
Realization/Operation	<ul style="list-style-type: none"> • Government to participate in the network in an advisory and/or decision making capacity (extent of government involvement to be determined by industry and government during setup) • Perform annual assessments of the network's performance and progress on its goals. 	24 months-onwards

8.0 CONCLUSION

Collaborative manufacturing networks can provide a range of benefits for aerospace and other manufacturing industries, including pooled resources, increased efficiency and competitiveness, larger work package capacity, networking and referrals, and organizational learning. Despite these potential benefits, collaborative networks can also be challenging to successfully establish due to a variety of issues such as lack of trust, risk, and practical operational considerations.

The project has developed a set of strategic implications the client and B.C.'s aerospace industry are recommended to consider while forming a consortium or network, based on the experiences of other networks. Following the principle of smart practices research, the strategic implications are based on the learned experiences of these other groups. Existing literature on network theory and other network research was also consulted in the course of developing these strategic implications.

Flowing from the strategic implications this project also recommends a course of action for the client (government) and industry for the development of a collaborative aerospace network. The recommended option is a government and industry led network, which is anticipated to result in the greatest likelihood of a successful network through a combination of government support and industry involvement. Success is measured in terms of the network's ability to achieve its aims of growth and increased competitiveness for B.C.'s aerospace industry. The recommended course of action is accompanied by a high-level implementation plan for network development.

Given the contextual factors that influence network formation, a standardized set of specific and absolute recommendations would be impossible. Rather, this research presents general "smart" practices and a recommended course of action that should be used for reference, in combination with more context-specific analysis. Specifically, the client is advised to consider further research on the commitment levels of the province's aerospace firms and the viability of creating a network that signs contracts, particularly with regards to the attitudes of the networks intended customers.

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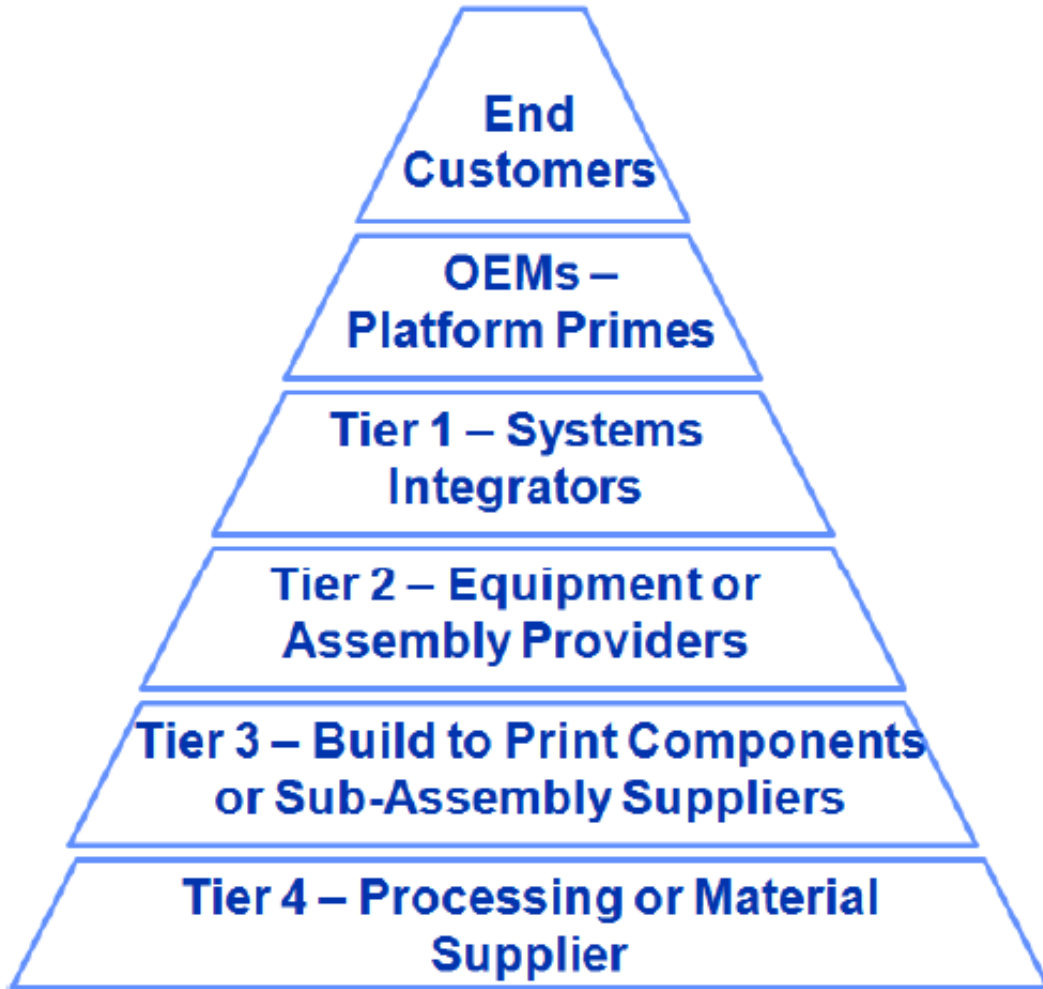
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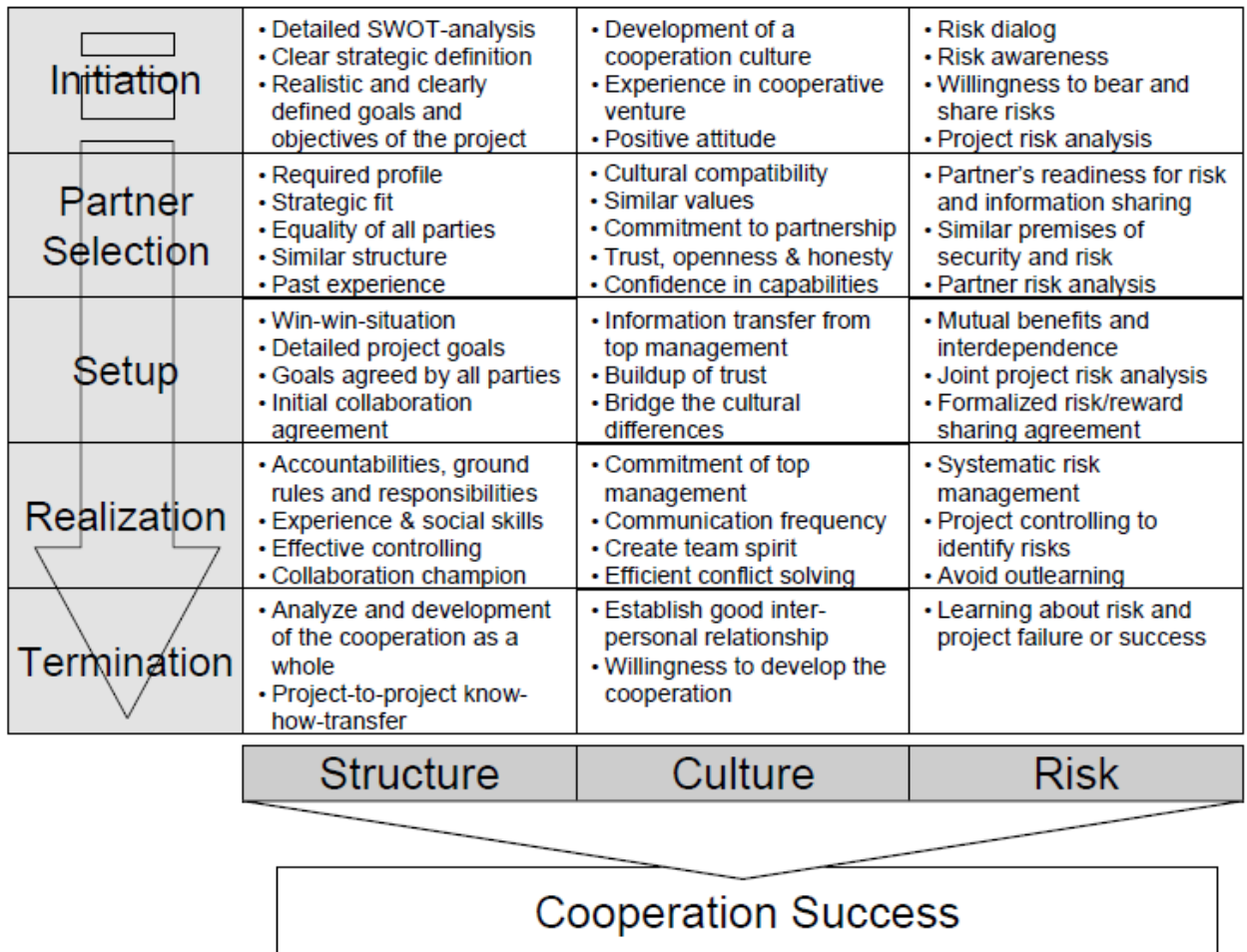
10.0 APPENDICES

Appendix A: Structure of Canada's Aerospace Industry



(Government of Canada, 2012, p. 9)

Appendix B: Conceptual Model: Cooperation Success Factors



(Marxt & Link, 2002, p. 226)

Appendix C: Interview Questions

Questions regarding Initiation

1. What factors led to the creation of this network?
2. Did a public agency have a role in encouraging the network?
3. How many firms initially were involved?
4. Did the firms initially involved have a pre-existing relationship? Describe.
5. What types of challenges or concerns, if any, were predominant in this phase

Questions regarding Setup

6. How long did the initiation period last before the network was established?
7. Was a network broker or agent involved in the network setup?
8. How was membership determined?
9. What were the approximate costs involved with setting up the network?
10. Is the network formal or informal? What is the legal form, if any? What sort of agreement or contract, if any, governs the network?
11. What were the biggest challenges and concerns, if any, at this phase?

Questions regarding Realization

12. What is current membership? (size and composition)
13. Is a network broker/ agent involved in the ongoing operations?
14. What activities does the consortium undertake?
15. How does it sign contracts and fulfill orders?
16. What is the risk to each member firm? To the consortium as a whole, if applicable?
17. What is the governance model and/or how does the network make decisions?
18. Is there a definitive end date to the current arrangement or a mechanism to dissolve the network if desired by a certain number of partners?
19. Have the member firms and the consortium as a whole benefited financially from the consortium? What other benefits, if any, have resulted (i.e. organizational learning; networking)?
20. Has the consortium achieved its intended aims?
21. What would you recommend to other firms developing a consortium? Are there mistakes you would avoid if you could do it again?