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The Transient Collaboration Model: Theory Building, Structural Formation, And Operationalization

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THE TRANSIENT COLLABORATION MODEL:

THEORY BUILDING, STRUCTURAL FORMATION, AND OPERATIONALIZATION

by

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THESIS

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Dedication

I dedicate my dissertation work to my family and friends who have supported me throughout the process. I will always appreciate all they have done, especially my parents for their very philosophical attitudes in the face of any setback, my siblings and friends for their morale-boosting faith and hope, and my wife and child for their loving support. I also dedicate this work to my fellow graduate students, past and present, for the mutual support freely given to one another during a unique time of our lives.

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Thesis

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Abstract

This thesis seeks to describe the Transient Collaboration Model as a business model, its underlying theoretical principles, its empirical evidence, and its types of possible collaboration structures. The research seeks to determine how companies may build sustained competitive advantages through the structural design of their collaboration associations as a strategic option. Companies' ability to retain long-term competitive advantages is limited in more unpredictable environments. Companies could not afford to internally build and hold all the possible varieties and quantities of resources and capabilities to build future competitive advantages. Collaboration can provide companies with access to multiple partners with diverse resources and capabilities. The full potential of companies to configure collaborations to match resources and capabilities to requirements is achievable through the goal-based transient collaboration model. The thesis extends Structural Contingency Theory to the network-level to study inter-organizational structures and contingencies. It develops novel propositions to explain the links between these structures and contingencies with focus on innovation research networks. Through a case study, the thesis verifies or partially verifies four of these theoretical principles by comparing these with the transient collaboration practices of companies in the field. Next, the thesis creates and analyses simulations of transient collaborations to provide understanding of how collaboration structures affect both company and network-level performances. The contribution of the thesis is to extend the academic literature with the theoretical principles of transient collaborative associations, to acquire empirical evidence for such collaborations, to improve understanding of collaboration structures formations, and to lay the foundation for additional research undertakings in the area. This thesis uses the term "transient collaboration meta-organization" as

a specific reference to a group of companies engaged in transient collaborations with one another, and the term "network" as a more general reference to collections, associations or congregations of companies.

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1. INTRODUCTION

1.1. The Transient Collaboration Model as a Business Model

Increasing dynamism to markets, technologies and competitors have made it no longer possible for companies to count on the relative permanency of their competitive advantages. Rather, competitive advantages are increasingly seen to be only transitory by nature (McGrath, 2013). To prosper or to survive, companies must thereby be able to build new competitive advantages as and when the need for these arises. To do so, companies need rapid access to new and diverse resources or capabilities as building blocks for these new competitive advantages (Amit & Schoemaker, 1993). However, a paradox arises because companies cannot possibly predict all the types of resources or capabilities they will require to build the unknown competitive advantages of the future. Gulati, Puranam and Tushman (2012) suggest that by strategically entering into collaborative associations, companies can access the assets of collaborative partners to meet such competitive requirements. Within such associations individual members can seek out and work with partners who can be quicker and more responsive than their own internal business units (Gulati et al., 2012).

Companies can realize the full potential of such collaboration associations to create new competitive advantages by adopting the collaboration logic to work on a transient basis with the best available partners, as drawn from an established set of multiple partners, to match a particular competitive goal at a particular time (Dekkers, 2009a; Noori & Lee, 2009). The process of transient collaborations will enable companies to leverage fully the resources or capabilities of their collaborative associations to build the competitive advantages that will match

their future supply requirements. By designing their collaboration associations appropriately, companies may thereby build dynamic capabilities that can create new competitive advantages for them over time (Teece, Pisano, & Shuen, 1997).

The transient collaboration model draws fundamentally from the concept that considers how as a result of constantly changing environments, today's companies may at best only achieve temporary, rather than long-lasting, competitive advantages (McGrath, 2013; D'Aveni, Dagnino, & Smith, 2010). This creates the strategic need for companies to look beyond their current resource bases, and to seek alternatives. Given that the future is unknown, companies that seek to stay competitive should not lock themselves into fixed resources bases, be those either internally or externally contracted resource bases. Rather, we argue that companies that adopt the transient collaboration model can access a wider range of external resources, while maintaining the flexibility to adjust their resources mix in response to changing future requirements. This underlies the fundamental nature of the model as a business network that benefits the individual companies. In our view, a company's competitive resources and capabilities will be mainly located within its inter-organizational network, and outside that of any one company's boundary. In this regard, the model questions the traditional view that the competitive capabilities of a company lies within the boundary of the firm (Kogut, 2000; Takeishi, 2001), and relates instead to organizational literature that views competition among companies as taking place at the level of their networks (Gomes-Casseres, 1994; Ring & Van de Ven, 1994).

Noori and W. Lee (2006, 2009) describe the Dispersed Manufacturing Network model as a business perspective in which independent companies come together to work on goal-specific purposes through transient collaborations. In this perspective, companies adopt a flexible mindset toward collaborative relationships so that they may freely adjust and re-configure the membership of these groups to find synergies to meet customized production, organizational, or management requirements. Observations show that elements of the transient model are in practice across different industries.

For instance, consider the Shanzhai companies found in China. These companies rely on collaborative partners to create innovations and cope with volatile business environments. Though individual Shanzhai firms are relatively small and vulnerable, they are able to achieve performance success because of their ability to quickly assemble collaborative groups of partners to address specific opportunities or threats that may suddenly arise in their environments (Shi, 2009; Tse, Ma, & Huang, 2009). These goal-based transient collaboration groups are able to create innovative products that can meet rapidly shifting market demands (Noori, 2009; Tan & Noori, 2011a).

The movie industry in North America also illustrates the competitive advantage of transient collaborations. Movie making is a complex process that requires the efforts of multiple specialist parties (Shamsie, Martin, & Miller, 2009). These specialist parties typically consist of independent agents such as actors, directors, producers, writers, special effects companies, distributors and others, and they may change from movie to movie to reflect the respective

requirements of each movie. After a movie is completed, the set of specialist parties will disperse and the various parties may then sign up to work on other movie projects. These constant changes in movie-making collaborations act to inspire ideas and spur imaginative creativity in the industry. The remarkable flexibility and capability of the North American movie industry to create transient collaborations to manage specific productions ultimately lead to more efficient and effective movie-making, and more collective profits for the industry as a whole (Wiesenfeld & Cattani, 2010; Hennig-Thurau, Henning, Sattler, Eggers, & Houston, 2007).

Similarly, recent studies have suggested that companies will improve on their innovativeness and performances by engaging in collaborative associations for their R&D efforts. Factors such as prior collaboration history, technological relatedness, physical distance (Petruzzelli, 2011), serial-innovativeness, industrial clustering (Libaers & Meyer, 2011), and information sharing (Sampson, 2007) are found to contribute to R&D innovation success. In addition, R&D associations that are adaptable and that can change or rotate their resources mix according to their environments are better at avoiding network inertia, and in achieving higher performances (Davis & Eisenhardt, 2011; Maurer & Ebers, 2006). These findings suggest that the R&D function in companies may benefit through participation in a transient collaborative associations.

For another example, consider the case of Valve Corporation, a software development company in Bellevue, Washington. The organization of the company does not include a formal hierarchical management structure to encourage emergent collaborations among employees. The

employees at Valve decide for themselves which projects they will choose to join to work (Suddath, 2012). Employees have complete freedom to join or leave projects, or else to contribute simultaneously to multiple projects at a time. Each employee's pay cheque depends on a peer review of their individual contributions or value rankings to the company (Valve, 2012). To note, Valve only hires highly self-motivated and skilled employees who seek to work on innovative and creative tasks. Valve's style of enabling very flexible and creative collaborations among their employees has made them an important market leader in video games development (Varoufakis, 2012; Abrash, 2012).

In the transient collaboration model, companies maintain sets of internal resources that are combinable with multiple sets of diverse external resources that are deployable to achieve different purposes. Through collaboration, organizations can combine resources so that they may achieve joint objectives that would not be possible or would have incurred higher costs if attempted by individual organizations (Camarinha-Matos & Afsarmanesh, 2005). Collaborative benefits are enhanced within the model because the temporary goal-based duration of each collaboration group provides greater flexibility for companies to easily enter into or exit from collaborations with each other (Dekkers, 2009b; Kuhnle, 2009; Noori & Lee, 2009). A collaboration group will hold together only for as long as it takes the members to attain an agreed objective. Following goal attainment, the group will disperse so that members may join other collaboration groups. The ability to quickly disperse no-longer required groups, together with the ability to create new collaboration groups to suit fresh objectives, make companies collaborating

in the transient collaboration model more efficient and effective at getting to the resources required to attain specific objectives (Noori & Lee, 2009).

Companies need to decide if these benefits of participation in a transient collaboration association outweigh the costs of their participation. These costs will include not only the outlay to support governance and coordination efforts within the association, but also the opportunity costs to a focal company. To take one, a company entering a transient collaboration association will hitherto have to abide by governance rules on the allocation shares of new opportunities to the members. For instance, the first company in the association to identify an opportunity may have the first right of refusal to be the lead company to front this opportunity, and has the right to request resources from other companies in the association to support it. This will be unlike the situation if these other companies were free agents and could thereby attempt to take up any new opportunity directly.

Gulati, Puranam and Tushman (2012) use the term "meta-organization" to denote such an association. This thesis borrows their term, and defines "transient collaboration meta-organizations" as collaboration associations in which members can emergently pull together diverse resources for goal-based durations to achieve shared objectives. Table 1-1 shows the main attributes of transient collaboration meta-organizations compared with those of traditional collaboration networks. The remainder of the thesis explains the various terms and concepts listed in the table. Our research suggests that some companies, especially those in technology-based industries, already practice some elements of transient-type collaborations among

themselves. It is likely that companies that do not adapt to the new environment may eventually find themselves at a disadvantage compared with those companies. This thesis seeks to further academic and practitioner understanding of this new organizational form so that more companies may in the future eventually possess the informed choice to decide on the transient collaboration meta-organization form as their strategic option. By operating in configurable goal-based transient meta-organizations, these companies may take advantage of more opportunities and achieve additional growth over time.

Table 1-1: Comparison of Attributes - Transient Collaboration Meta-Organizations and Traditional Collaboration Networks

Attributes	Transient Collaboration Meta-Organizations	Traditional Collaboration Networks
Structure	Multi-Boundaries	Single-Boundary
Process	Emergent, Goal-Based Collaborations	Contract-Based Collaboration
Governance	Dominant Companies	Dominant Company
Coordination	Hub Company	Dominant Company or 2nd Tier Supplier
Support Infrastructure	Dominant Company or Self-Company Supported	Dominant Company
Relationships	To Suppliers - Contractual and Relational To Customers - Market-Based	To Suppliers - Contractual To Customers - Market-Based

1.2. Background of the Problem

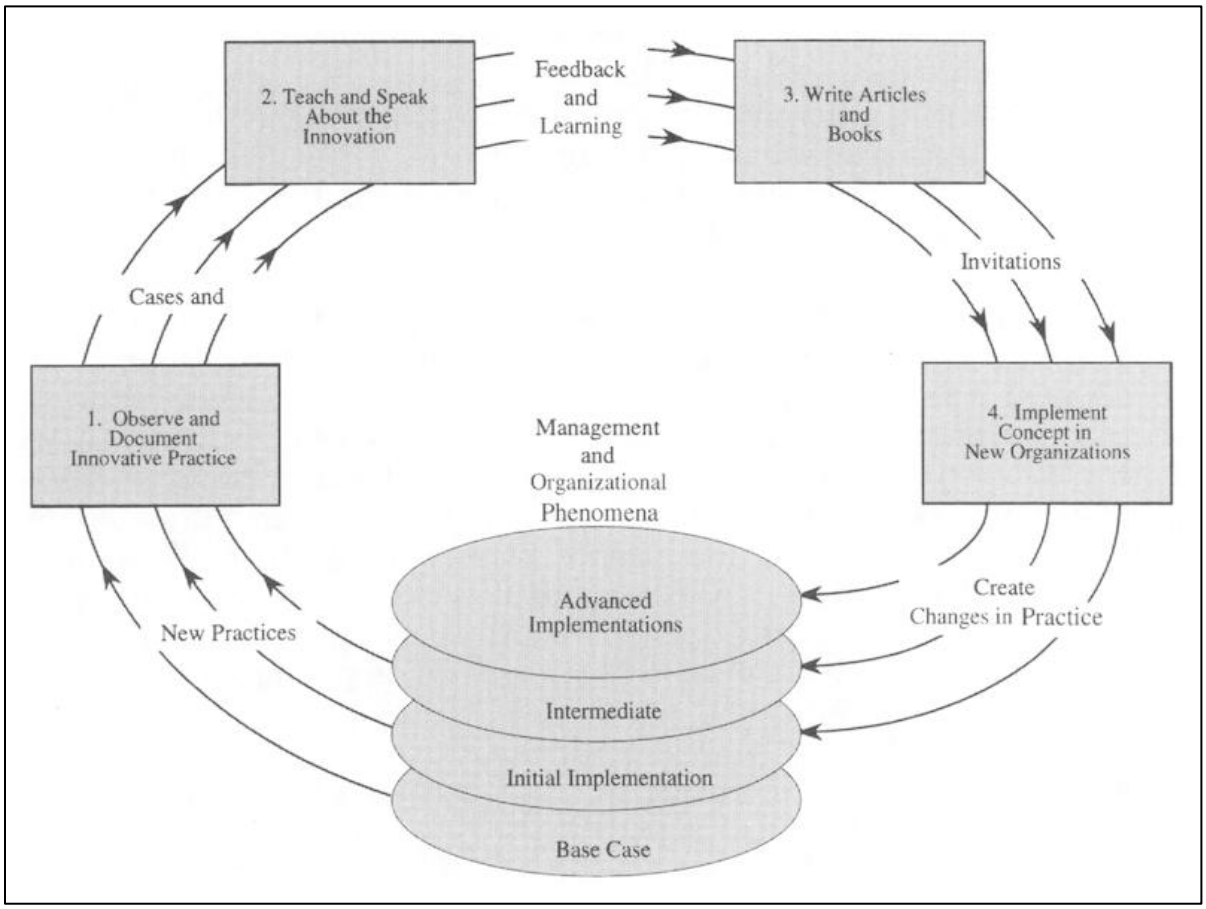
As a relatively novel concept, the transient collaboration model is not a widely known research topic in supply chain management. Scholars in the field only begin to observe transient-type collaborations among certain companies in recent years (Dekkers, 2009b; Noori & Lee, 2006). The inspiration for this thesis came from the study by Noori and Lee (2009) that describes how small companies make use of transient collaborations among themselves to design and manufacture innovative products. Though field observations show that transient collaborations is an effective operations strategy among some companies, there was no theoretical explanation or model at that time to account for the success of such performance. The conduct of research in this thesis follows in the spirit and belief that academic research and practitioner operations are connected, and that advancement in one area will and should enrich the other. Kaplan (1998) put forward the Innovation Action Research Cycle that describes how academic research can best progress through iterating loops of empirical observations, followed by academic analysis, then subsequent active implementation of new research findings to organizations, and back to new observations again.

Figure 1-1 shows how the Innovation Action Research Cycle begins with a base case, and then repeatedly loops through academic analysis and practitioner enactments to arrive finally at the advanced implementations stage.

With regard to the research effort in transient collaboration meta-organizations, it begins Stage 1 of the Kaplan's Cycle with case studies and field observations of Asian and North American companies. The research then moved into Stage 2 with presentations to academics and practitioners at seminars and conferences. These include presentations made at the Brown Bag talks at Wilfird Laurier University, at MIN Waterloo, the International Supply Chain Management symposiums, the Global Manufacturing Research Group meetings, and the POMS, INFORMS, AOM, DSI, ICLTIM and EuROMA conferences. These efforts paid off in terms of the valuable comments and feedback received on the subject from the audiences of these meetings and conferences. The research is currently at Stage 3 in the first loop. This thesis seeks to advance this research and to consolidate the foundation for it to advance into the future stages of the Cycle to benefit both academic and practitioner audiences.

Figure 1-1: Innovation Action Research Cycle

(Reproduced from Kaplan (1998))



The transient collaboration concept has antecedents in earlier theoretical ideas found in the Network Dependence concept, the Virtual Factory concept, and the Open Innovation concept. The Network Dependence concept, also referred to as the Resource Dependence Theory, describes how companies as a necessity rely on resources drawn from other companies around them (Pfeffer & Salancik, 1978). The theory views companies as having a high level of mutual inter-dependence for their viabilities and competitiveness. The Virtual Factory concept by Upton and McAfee (1996) describes a virtual factory as a set of companies that engaged in joint

production by using advanced technology to integrate and coordinate collaborative efforts. In this concept, modern technology serves to mitigate geographical distance and unstandardized company-specific routines that have often acted as hurdles in the past for companies to connect with potential collaborators. Intercompany coordination for collaborative purposes is more achievable together because of the widespread availability of cheap, standardized and effective communicative technology (Noori & Lee, 2006). Similarities in technology across companies serve to reduce the cost of switching partners, and therefore make fast supply chain re-configurations possible within collaboration groups (Kuhnle, 2009).

Finally, Chesbrough's (2007) concept of Open Innovation suggests that companies should look both inside and beyond their organizational boundaries to seek ideas and innovations that can be used to achieve organizational goals. The transient perspective emerges as a synthesis of ideas from all three viewpoints by considering how effective but low-cost communicative technology could enable companies to make transient use of external resources and ideas to provide themselves with flexible and adaptive competitive advantages. To provide more information on the topic, the basic questions such as what is a transient collaboration, how does it work, what motivates it, why is it effective, and where it is efficient will be further addressed in the literature review section.

1.3. Research Questions

This thesis seeks to answer the following research questions:

- What are the theoretical principles to explain the operation of transient collaborations meta-organizations? How does operating through transient collaborations change or affect the performance of companies?
- Why do companies participate in transient collaboration meta-organizations?
- How do companies establish or maintain transient collaboration meta-organizations?
- What is the empirical evidence for transient collaborations meta-organizations in the field?

1.4. Thesis proposal Statement / Purpose of the Study

The purpose of this thesis is to create an original contribution to the understanding of inter-organizational networks within the context of the creation of transient competitive advantage through collaborations. It sets the foundation for future study in how companies may interact, cooperate or compete through transient collaboration meta-organizations for performance advantages. This research is also to describe new collaboration-based methods that can achieve objectives under different environments, so that these may become best practices to benefit companies across industries. This thesis seeks to investigate, analyze and explain the model through three essays. The intent is that each of these essays provides a substantially differentiated research focus and has sufficient contributions so that all three may develop into distinct publications.

The first essay, in Section 0, is to lay the fundamental foundation for future research by developing the theoretical principles of the model. We develop these principles from a preliminary set of case studies and literature review. The principles describe and link the model's motivations, constructs, and moderators to explain the why it can result in more efficient and effective business performance, and the conditions that give rise to superior performance. The second essay, in Section 5, uses a case study to develop an empirical understanding of the model as it operates in the field. The essay seeks to examine the theoretical principles of the model against transient collaborations in operation among companies. The third essay, in Section 6, investigates how collaboration network structural formations may evolve over time under different environmental factors. The investigation uses the simulation method to examine how structural formations may change as entities simultaneously coordinate and compete with one another for access to resources given different conditions of market volatility.

The remainder of the thesis follows this outline; Section 2 describes the groundwork for this thesis in the form of earlier studies conducted to investigate the topic. Section 3 provides the overview of the study's constructs and concepts. Sections 0, 5 and 6 are the three essays of the thesis. Finally, Section 7 contains the expected contributions and potential future research directions for the topic.

2. PRELIMINARY STUDIES

2.1. Shanzhai Companies Study

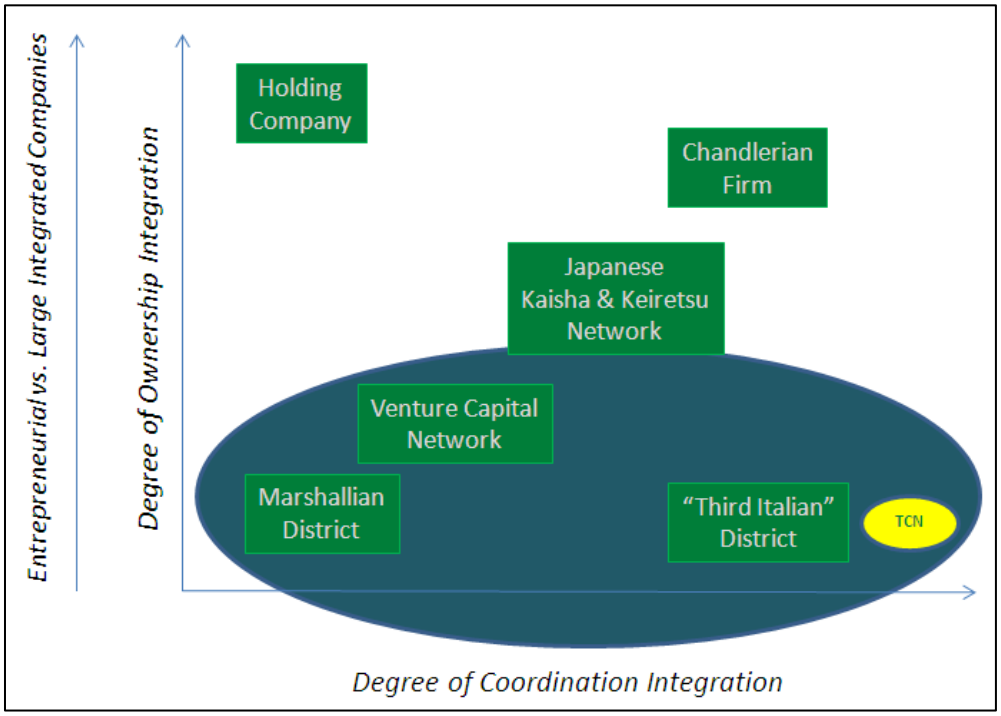
In 2009, Noori and Lee conducted a case study in South China where they observe how these small-sized Shanzhai companies, each an independent business, collectively possess an emergent ability to create different capabilities rapidly through short-term collaborations with partners with the right mix of resources. For instance, a Shanzhai company that seeks cost minimization as a competitive goal will seek out low-cost manufacturing partners to produce or assemble its product modules. Similarly, a Shanzhai company that seeks innovativeness as a business priority will work with the relevant partners to co-develop new features for its products (Noori, 2009; Tan & Noori, 2011b). The ability of Shanzhai companies to rapidly effect new capabilities creation have resulted in them becoming competitive even against established companies (Shi, 2009; Tse et al., 2009).

Noori and Lee (2009) observed that inter-organizational coordination is critical for a transient collaboration group. Operational processes conducted across separate and independent companies may jointly succeed only with efficient and effective coordination. They observe that a range of transient collaboration associations exists based on the different types of coordination style. On one end of the range, Shanzhai companies, as described earlier, operate in emergent networks where any company may take the lead for coordination (Noori, 2009; Tan & Noori, 2011b). On the other end of the range, a major company such as Li & Fung of Hong Kong acts as the sole coordinator to manage the multiple collaboration groups throughout its extensive supplier network. To achieve this, Li & Fung relies on its extensive knowledge of their partners'

resources, and on how to match these to their customers' requirements (Magretta & Fung, 1998). These different coordination styles may be due to different industry conditions or stages. For instance, coordination styles may evolve in a transient collaboration meta-organization over time as certain companies become more specialized as coordinators, while others become specialized as productive agents. In summary, though companies operating in a transient collaboration meta-organization have a high degree of individual autonomy, at the same time they allow themselves to be closely coordinated to attain a group purpose. Figure 2-1 shows how transient collaboration meta-organizations compare with other types of collaboration networks in relation to their degrees of ownership integration versus coordination integration.

Figure 2-1: Transient Collaboration Meta-Organizations as Compare with Other Networks

(Adapted from Noori (2009), and Robertson and Langlois (1995))



2.2. Pilot Study

As part of the pilot process to build theory in the topic, we interviewed selected management informants in 2011 to estimate the extent of transitory collaborations in different industries. The purpose of the interviews was to gauge the extant of transitory collaborations across industries, to determine the main characteristics of these collaborations, and their possible theoretical relationships. The convenience sample consisted of nine informants obtained through referrals from Professor Hamid Noori, the study advisor, and from other professional and personal contacts.

The study refers to these as cases C1 to C9. The informants included representatives from the telecommunications, aerospace, airline, IT, manufacturing and service industries. The employment locations of C1, C2, C3, C4 and C5 were in North America, while the employment locations of C6, C7, C8 and C9 were in Singapore. Appendix A contains the details of the informants and their organizations.

2.3. Findings from Shanzhai Companies and Pilot Studies

These studies show that given the nature of these companies as autonomous or independent entities operating in self-selected groups, a critical issue to understanding collaborations within these groups will be to explain their governance and coordination methods. For instance, the interacting roles of the coordinating companies and productive companies show that transient collaboration meta-organizations can be internally complex in terms of their value flows. Also,

the presence of different styles of coordination suggests that different structures are possible for the given different environments of these companies (Noori, 2009).

The studies show that organizations agree that informal linkages are more critical than formal linkages with regard to collaborations. This is because informal links, rather than formal links, are more useful for assessing the potential for good or bad faith in partners. Companies can use informal means to inform each other about bad experiences in relation to a third company without worrying about litigation issues. Similarly, an informal assertion that a third company is worthy of partnering carries more weight than a formal recommendation, because such informal communications tend to be more confidential in nature, and are also seen as being relatively unbiased by considerations of fear or favour (C2, 2011; C3, 2011; C4, 2011; C5, 2011; C6, 2011; C7, 2011).

The studies' informants stated that collaborations could take place not just for efficiency or effectiveness reasons alone, but also for the experience of learning from a partner. This is especially true when a company is venturing into a new area of business. Such a company can learn the ropes by collaborating with partners with more experience in that area (C6, 2011). Other motivations for companies to engage in collaborations include the desire to qualify for entry or to reduce risk in a new market, to gain kudos by way of the halo effect through collaboration with well-known industry players, or even to build a reputation in the industry for being a sound collaboration partner (C6, 2011; C9, 2011).

In the organizations studied, repeated interactions with previous partners are common because of the better familiarity and security of a company working with such partners. Past partners are often relied upon to assess, recommend or introduce new partners into a collaborative association (C2, 2011; C6, 2011). Internal corporate pressure exists to push the operation teams to collaborate with certain partners rather than more optimal partners. This includes internal corporate preference for collaboration with subsidiary companies or long-term allied companies, rather than with more suitable but more distantly-related companies (C6, 2011).

The informants mentioned that customers sometimes suddenly change their requirements, including their competitive priorities, at any time. Organizations expect customers to change requirements, and will generally strive to meet any sudden change, no matter how unexpected these may be. A company will need to be able to quickly adjust its resources or capabilities mix to match any such change at the customers' end (C6, 2011; C7, 2011). The ability to adjust collaborative partners to meet shifting customers' requirements is also often necessary.

The informants stated that companies can buy “off the shelf” for commodity services or products, and therefore has less motivation to create customized collaborative meta-organizations to deliver those items. Companies also tend to deliver according to specifications for commodity services or products, and do not view commodity items as viable for further innovative efforts (C4, 2011; C6, 2011; C8, 2011). Transitory collaborative behavior is less apparent in commoditized businesses, and is more apparent in innovative, specialized or novel

businesses. If companies need to respond quickly to events due to time pressure, they turn to collaborations, and if they are not required to respond quickly, they tend to make standard buyer-supplier contractor arrangements. This is because companies will normally have to provide better terms to collaborative partners rather than to suppliers (C6, 2011). This thesis uses the above findings from these studies to guide the lines of inquiry in analyzing transient collaboration meta-organizations in the remaining sections.

3. OVERVIEW

3.1. Definition of a transient collaboration meta-organization

The importance of networks in supply chain research is recognized in the form of special issues published on inter-organizational networks in major journals such as Production and Operations Management (Balakrishnan & Geunes, 2004), Academy of Management Executive (Tung, 2003), and Strategic Management Journal (Hitt, Ireland, Camp, & Sexton, 2001). Operating in networks confers advantages in resource complementarity and flexibility not always found in market or hierarchical forms of operation (Parkhe, 1991; Powell, 1990). In particular, one view of collaboration networks is that they are specific inter-organizational spaces where companies can come together to access, pool or combine diverse assets to support their joint efforts. Such a network consists of independent firms that have mutually agreed to work with one another in dynamic and adaptive goal-based collaboration groups. These groups are re-configurable as they can add or drop partners from within the meta-organization as needed due to changing requirements. All firms operating in a transient collaboration meta-organization are potential partners bounded by shared business values and commitments (Dekkers, 2009b).

By way of contrast, traditionally, firms that require access to certain resources will have to develop these resources internally, purchase them from external suppliers, or else negotiate specific one-to-one collaboration deals with external partners. It is likely that these various options impose additional time and cost barriers that impede companies' abilities to access resources easily to meet fast-changing requirements. Companies that operate within a transient meta-organization can quickly pull together the right set of resources by leveraging across an

already established array of trusted collaborative partners. A transient collaboration meta-organization can thereby improve companies' abilities to exploit changing circumstances or explore innovative ideas, and thereby result in their higher performances.

3.2. Entities in a transient collaboration meta-organization

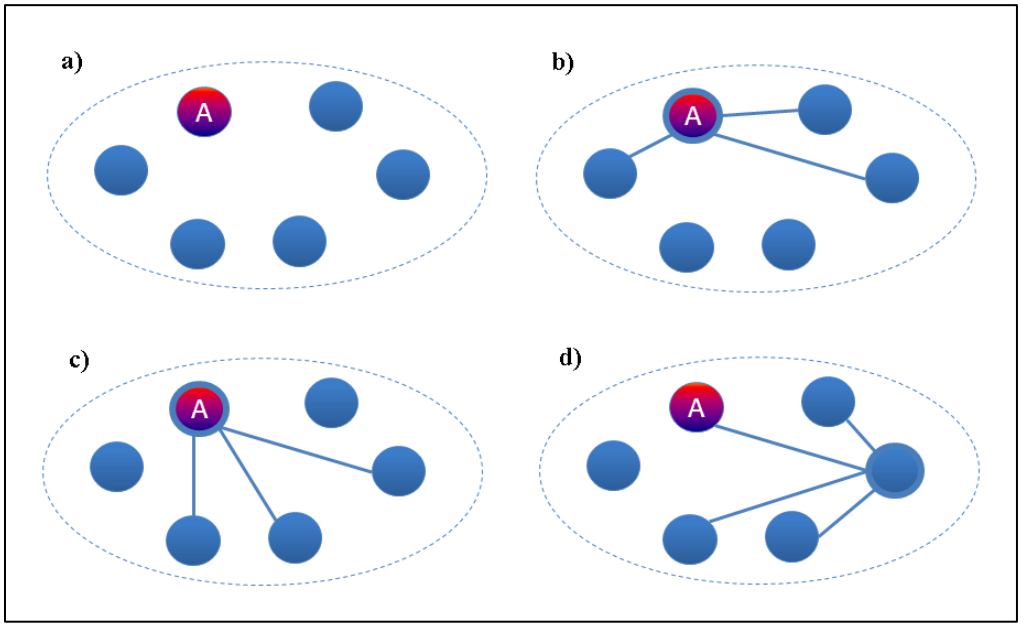
A typical meta-organization has three types of entities by functional role. The first entity is the network facilitator. It can be a designated company or team that hosts the meta-organization, provides and enforces the governance rules, and settle disputes among meta-organization's members. The dominating company in the meta-organization, or a group of dominating companies, typically appoints and empowers the network facilitator. The second entity, referred to as an agent, is a company in the meta-organization that possesses and operates the productive resources. These resources are available for potential collaborations in the meta-organization. The last entity, referred to as a hub, is a company that possesses the coordination ability to manage inter-organizational collaborations. A given company in a meta-organization may be able to perform more than one of these functional roles. The essay in Section 0 provides additional details and explanations for these entities.

Figure 3-1 illustrates the collaboration process that takes place within a transient meta-organization. Part (a) illustrates a group of companies, including a focal company A, which together constitutes a meta-organization. Parts (b) and (c) show how company A acts as a Hub to initiate and activate transient collaboration groups within the meta-organization for some

purpose. Part (d) shows how company A may also become an agent, or production member, of a collaborative group initiated by another Hub company.

Figure 3-1: Examples of Transient Collaboration within a Meta-Organization

(Reproduced from Noori and Tan (2014))



3.3. Motivations to participate in a transient collaboration meta-organization

Companies need to balance their need to access critical resources against their desire to avoid encumbering themselves with no-longer needed resources once the need for those is past. The motivation for transient collaboration operations is apparent for companies when their business and market environments are dynamic, and time-based competition is intense (C6, 2011; C7, 2011). As a form of flexible and adaptable networking, transient collaborations provide companies with the means to access resources that can handle volatility and unpredictability from unexpected innovations, competition, regulations, fads or demand peaks in

their environments. Contributing factors to dynamism in business and market environments include the trends of increasing economic globalization (Beinhocker, Davis, & Mendonca, 2009; Levitt, 1983), and emphasis on differentiation and innovativeness in companies (Chesbrough, 2007; Birkinshaw & Hood, 2001).

Companies enter into collaborations to seek gain, but at the same time, collaborations can create risks to them. Collaborations require the establishment of multiple interconnected links between companies, and unscrupulous partners can find opportunities to make use of these links to underhandedly appropriate propriety ideas, intellectual property rights or assets of other companies (Lavie, 2007). Inter-organizational trust is a safeguard that can allow fruitful yet secure collaborations among companies. However, inter-organizational trust, defined as the mutual belief among companies that their partners will not seek to take advantage of their vulnerabilities, does not emerge at the first interaction among companies that are previously unknown to one another (Barney & Hansen, 1994). Trust takes time to develop through recommendations, observed efforts and repeated interactions (Häusler, Hohn, & Lütz, 1994).

Thereby, a critical component in the governance of a transient meta-organization is the issue of inter-organizational trust. The nature of transient collaborations means that companies expect to collaborate repeatedly with one another. Without a certain level of trust in operation among these companies, a transient meta-organization cannot even begin to function as intended. Therefore, an important role of the facilitator of a transient meta-organization is to vet and assess all incoming companies for their trustworthiness, based on recommendations or their reputations,

prior to their admission as members of the meta-organization. While the bar to enter such a meta-organization is high, once a company is in it, the presence of trust allows it to reap the benefits of collaboration while avoiding the risks of unfair appropriations from unethical partners (Bouncken & Kraus, 2013). The governance of the meta-organization should include the provision for network facilitators to excise the membership of companies that choose to violate these rules.

Similarly, the pressures of time-based competition has also motivates companies to enter into transient collaboration operations (C6, 2011). Time-based competition, as conceptualized by Stalk and Hout (1990), has become the norm in many industries. Competitive strategies now include time-saving processes and faster to market innovations. Technological progress has also served to increase the clock-speed for many industries (Fine, 2000). Because time is an increasing important competitive factor, companies cannot afford the time compression opportunity cost penalties that will fall on them if they seek to develop all needed resources in-house (Dierickx & Cool, 1989). Rather, companies may seek to link up with diverse partners so that they may have potential access to sets of resources that are as wide and heterogeneous as possible (Jiang, Tao, & Santoro, 2010; Noori & Georgescu, 2008; Parkhe, 1991). The possibility of linking up with more diverse partners is higher when companies operate in transient collaboration meta-organizations (Noori & Lee, 2009).

3.4. Establishment of a transient collaboration meta-organization

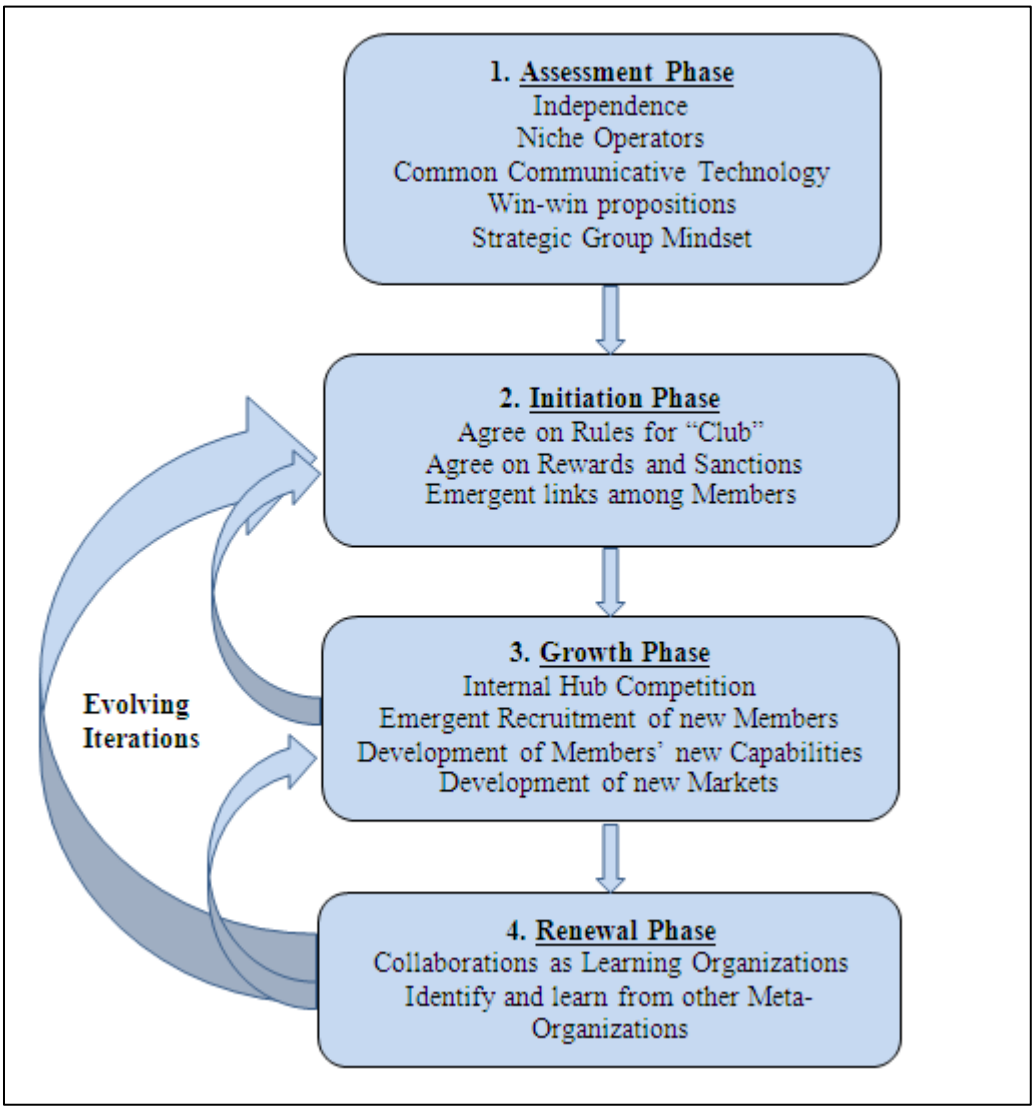
A company that seeks to participate in a transient collaboration meta-organization may not always have the option to enter into an existing meta-organization. For instance, the company may be in an industry or sector where such meta-organizations may not yet exist. If a company decides to establish a transient collaboration meta-organization, previous research shows that such an establishment requires the assessment of certain necessary conditions (Tan & Noori, 2013). The company seeking the establishment will need to recruit a core group of other companies to start a meta-organization. Among the group of companies, in the first phase they should assess if they meet the necessary condition that they are independent companies, or at least be autonomous companies in their operational decision-making. This is to allow unbiased decisions in their future collaborations. Next, these companies should individually possess niche operator characteristics within the group. This is to ensure that the meta-organization possesses resources diversity among the members. Another necessary condition is that the companies should have a common communication technology at their operational levels. Each member in the new meta-organization should also be able to derive individual performance benefits from their participation. Lastly, the companies must possess a strategic group mindset and consider themselves as a self-defined group that members chose to work with one another. With these necessary conditions at hand, the group of companies will be in a better position to proceed to the next phases to develop a transient collaboration meta-organization.

In the next phase of initiating the meta-organization, these companies need to set-up and agree on the governance rules for the new meta-organization. These rules will determine how

member companies collaborate with one another, admit new members, share rewards or resolve conflicts. The informal authority of the leading companies in the meta-organization enforces these governance rules. The next phases depend on the success of the meta-organization at attracting new businesses, developing new capabilities and recruiting new members. If the meta-organization continues to grow, it has the options to evolve and renew its structural and governance structures over time to meet the new needs of its members and markets. Figure 3-2 shows the different phases for the establishment and development of such a meta-organization.

Figure 3-2: Establishment and Development of a Transient Collaboration Meta-Organization

(Adapted from Tan and Noori (2013))



4. TRANSIENT COLLABORATION MODEL: THEORETICAL DEVELOPMENT

The purpose of this essay is to identify and describe the theoretical principles that explain the operation of transient collaboration among companies, and how the process affects the performance of the companies in transient meta-organizations. In particular, we draw from the areas of new product development (NPD) and innovation research to illustrate how companies engaged in these activities can make the use of their networks to meet performance challenges. Companies engaged in new product development or innovation research efforts are particularly susceptible to environmental uncertainties. NPD activities start with responding to a market opportunity and end with the delivery of a differentiated product or service. Its multiple stages include opportunity generation or identification, idea selection, requirements assessment and specifications, detailed development, market and manufacturing launch, lifecycle changes and support or maintenance (Krishnan & Loch, 2005). Similarly, innovation is a multi-stage process whereby organizations transform ideas into new or improved products, service or processes to advance, compete and differentiate themselves successfully in their marketplaces (Baregheh, Rowley, & Sambrook, 2009). All such efforts are explorative to an extent, as companies cannot tell in advance all the resources or capabilities that are eventually required in future stages of new product development or innovation research. The challenges from these areas are therefore particularly appropriate to illustrate the effects of the goal-based transient collaboration process to companies' performances.

We adopt the lens of Structural Contingency theory to analyze the topic. The Structural Contingency theory perspective holds that there is no one best way to structure an organization. Rather, organizations can perform effectively only if their structures are fitted to the contingency factors of their respective environments (Donaldson, 1995). In the strategic supply management literature, Structural Contingency Theory provides successful explanations on how companies can organize their internal functions to achieve overall performances for given external contingencies. From these explanations, we infer that by extending Structural Contingency theory to the network level, we can use its concepts to analyze how to organize companies in transient collaboration meta-organizations to achieve improved overall performance. The use of this lens in this thesis does not preclude the possibility of using other theories to explain or analyze different aspects of transient collaborations in future works. For instance, Transaction Cost Theory or Agency Theory may provide the appropriate lenses to examine opportunism or moral hazard issues among companies in collaborative relationships.

This thesis draws on concepts from Structural Contingency Theory to develop guiding principles in the form of propositions on how internal structures and contingencies in meta-organizations interact to affect performances. Structures refer to the enduring roles, positions and procedures that govern the performance-related interactions of multiple entities in an organization (Ranson, Hinings, & Greenwood, 1980). Examples of structures include the types of roles set for the entities, the types of links among them, the means by which these entities are coordinated for organizational purposes, the boundaries of organizations and others (Donaldson, 1995; Lawrence & Lorsch, 1967). The fundamental contingencies described in the theory include

the task uncertainty, size and environment contingencies (Priem & Rosenstein, 2000; Donaldson, 1995). In general, contingencies serve to moderate the link between organizational structure and organizational performance (Donaldson, 2001).

We argue that it is possible to design collaborations structures in meta-organizations to support the creation of transient competitive advantages. To achieve such designs, we develop a set of propositions to explain how structures and contingencies interact within transient collaboration methods to maximize performance. The interactions of companies in networks involve multiple variables, and include the effects of feedback dynamics. This will give rise to dynamically complex and non-linear processes, and as such, we need to make use of system dynamics principles to explain and illustrate to illustrate the flows and interactions between these variables (Sterman, 2000). The organization of the essay is as follows. Section 4.1 provides a review of the theoretical concepts and constructs that describe our topic. Next Section 4.2 develops and illustrates the propositions of the essay. In Section 4.3, we discuss some practical implications of these propositions. Section 4.4 contains a discussion of future research directions of the topic. Finally, Section 4.5 summarizes and concludes the essay.

4.1. Literature Review

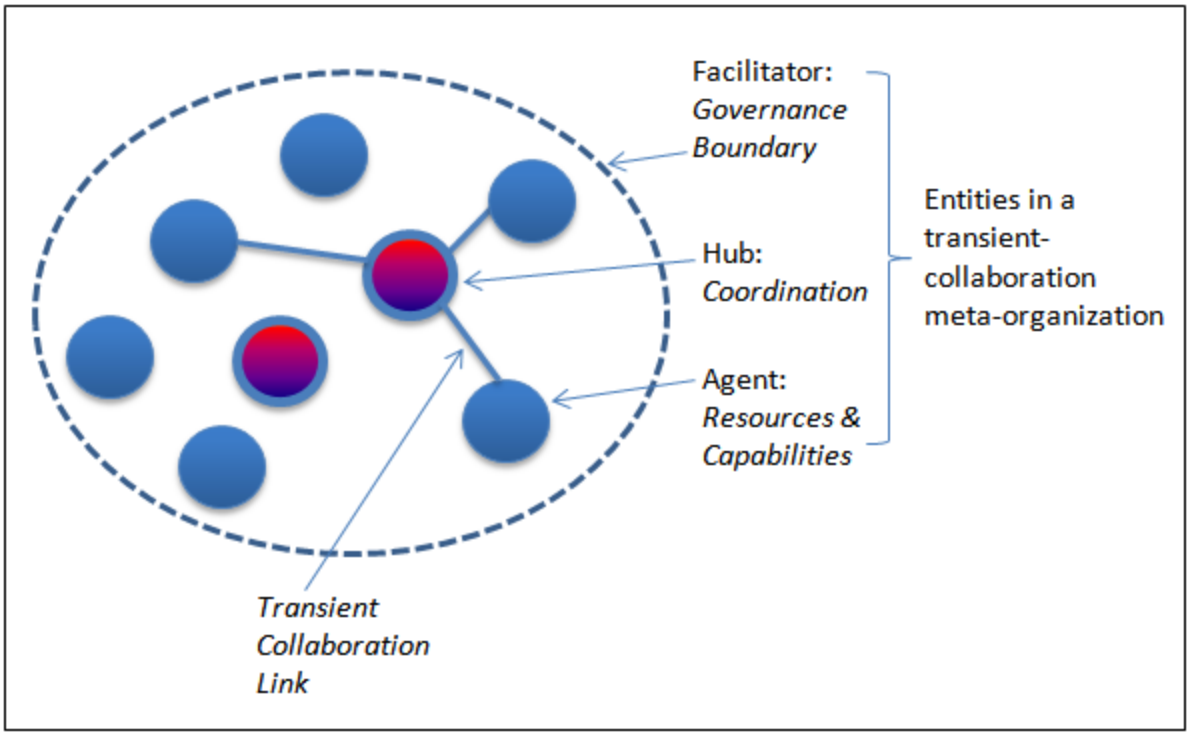
The uncertainty of future resource or capability requirements makes it very costly, if not impossible, for individual companies to internally develop and hold all possible assets to meet their future needs. As such, one view of collaboration meta-organizations is that they are organizational spaces where independent companies can come together to access, pool or

combine diverse assets to support their joint efforts (Subramanian, Lim, & Soh, 2013; Gulati et al., 2012; Daniels & Perez, 2007). We adopt structural contingency theory as the appropriate lens to analyze a meta-organization given our view of it as a collective network entity. Organizations require the execution of three basic functions for effective performance, i.e. the management, production and coordination functions (Provan & Kenis, 2008; Jones, Hesterly, & Borgatti, 1997; Lawrence & Lorsch, 1967). In our conception, these functional roles reflect and describe the three basic functional entities as found in a typical meta-organization. We interpret the management function in a network as the provision and enforcement of the governance rules, norms and expectations to coordinate and safeguard collaboration exchanges among network members (Jones et al., 1997). A dominating company, or group of dominant companies, possess both the motivation and informal authority to host, facilitate and manage such a meta-organization of companies (Gulati et al., 2012). In this study, we use the term "facilitator" to describe a company or companies that provide this function of managing their meta-organizations (Provan & Kenis, 2008). Facilitator entities are critical in meta-organizations because in addition to hosting and managing facilities, they also serve to arbitrate and resolve conflicts among member companies. Next, we interpret the production function in a meta-organization as the operation of the productive resources or capabilities of member companies within the meta-organization. These member companies are thereby the production entities within a meta-organization. The joint operation of their differentiated resources or capabilities builds competitive priorities through co-specialized collaborations. These production assets of a meta-organization are conceptually similar to the differentiated internal resources or capabilities

that exist in a typical organization (Lawrence & Lorsch, 1967). We use the term “agent” to refer to companies that contribute productive resources or capabilities for collaboration.

Finally, the coordination function in a meta-organization serves to order and integrate selected resources or capabilities across different companies. This is in line with Amit and Schoemaker’s (1993) distinction between resources and capabilities. They define resources as the direct production factors in a company such as tradable knowledge, financial or physical assets and human capital. They define capabilities as the information-based, tangible or intangible processes found in a company that are used for deploying resources (Amit & Schoemaker, 1993; Barney, Ketchen, & Wright, 2011). Adapting these definitions and integrating the concept to the earlier studies, some companies in a meta-organization must take up the role of coordinator entities to manage the productive functions of other companies. In this essay, we use the term 'hubs' to refer to member companies that undertake these coordination or integration roles in a meta-organization (Dhanaraj & Parkhe, 2006; Lawrence & Lorsch, 1967). These functional roles are not necessary mutually exclusive for a given company in a meta-organization. For instance, it may happen that a single company performs all three functional roles of “facilitator”, “agent” or “hub” at different times within a meta-organization. However, in this essay, for explanatory clarity, we will treat and describe each functional role as performed by separate entities. Figure 4-1 illustrates the functional entities and their primary roles in a meta-organization.

Figure 4-1: Functional Entities in a Transient Collaboration Meta-organization



A meta-organization may take its start when an existing core group of leading companies seeks to formalize their collaborative practices, and to extend membership in the meta-organization to other companies (Williamson & De Meyer, 2012). These founding members can negotiate together to determine the ground rules or governance structures of the new meta-organization. These may include requirements of membership, terms of payment, or means of conflict resolution. Though compliance with these ground rules are voluntary, companies that flout these rules can face exclusion from the meta-organization through the informal authority of the leading companies or the mutual consensus of other member companies (Gulati et al., 2012). These companies can designate or appoint a management team to perform the role of the

network facilitator for the meta-organization. A critical component to governance is the expected terms of the member companies' collaborative engagements with one another. Companies that adopt the goal-based transient collaboration perspective have the mindset that resources or capabilities within meta-organizations are completely mobile and are re-configurable via different collaboration groups to match with different requirements. This perspective aligns with the higher exploration component found in many NPD or innovation research efforts. It also implies that the terms of collaborations under this perspective will emphasize transiency and that the duration of collaborations will depend on the completion time of an agreed research goal. These groups will dissolve after achieving these goals so that the member companies can be free to participate in other collaborative groups within the meta-organization. Over time, some companies may collaborate repeatedly, but each time the decision of a company is always to pick only the most appropriate partners (Dekkers, 2009a; Noori & Lee, 2009). In our argument, goal-based transient collaborations are the type of activities necessary for establishing the improved performances of meta-organizations. Structural Contingency Theory states that the structures and contingency factors of a meta-organization will largely determine how effectively its members could bring together and organize relevant resources. The contingencies we explore further in this paper are: (a) task uncertainty, (b) size, and (c) environment (Donaldson, 1995).

Task uncertainty in an organization has two interpretations. The first refers to the degree in which an organization is undecided in its choice of a final objective in some endeavor. The objective may still be undecided upon, or there may be multiple objectives possible. The second refers to the situation when an organization may be clear in its choice of a final objective, but it

has a degree of ambiguity with regard to the exact methods or options required to achieve that objective (Sobrero & Roberts, 2002). In this work, we only consider task uncertainty in term of the ambiguity that a collaboration group within a meta-organization may has with regard to the methods or options to achieve some objective. Task uncertainty may benefit joint efforts by enabling more choice or options to collaborations. In this sense, we study task uncertainty in reference to the task environment of a meta-organization[1].

The contingency of *size* reflects the scope or responsibilities and number of companies in an organization. In general, there is a positive correlation between increases in size and the internal specialization and formalization of an organization. For instance, an organization that increases in size will also encounter the parallel emergence of increased hierarchical differentiation and coordination functions (Blau, 1972; Lawrence & Lorsch, 1967). For a given meta-organization, two size contingencies are relevant. The first is the number of member companies within a meta-organization, and the second is the mission scope of the meta-organization. The number of member companies can increase in relation to the search to increase the availability of resources or capabilities. All else being equal, a larger meta-organization will possess correspondingly larger numbers and more diversity of available assets. The mission scope of a meta-organization can also increase due to the motivation for constant growth and

[1] Dess and Beard (1984) define the task environment of an organization as the influences from all parties that an organization has to take into account in its strategic decisions. They describe the three dimensions of the task environment as the munificence, dynamism and complexity of environments.

expansion among companies. Both increases to member numbers and scope in a meta-organization will increase functional differentiation, and thereby lead to the requirement for more integrative coordination among the member companies (Lawrence & Lorsch, 1967).

The contingency of the *environment* refers to the type or degree of competition that an organization faces from its surrounding peers (Pfeffer, 1972). In the context of this research, a focal meta-organization will face competition in the form of other meta-organizations or companies operating in its industry. These meta-organizations can compete with one another at different levels. For instance, at the basic level, meta-organizations may compete to serve the same markets. In turn, this may lead them to compete for critical resources or capabilities either through internal development of these resources, or through recruitment of companies with highly desirable assets into their networks. As part of the competitive process, some meta-organizations may merge to maximize their joint access to resources (Donaldson, 2001). However, we believe that such meta-organizations will still need to balance the maximization of resources available for all member firms in the network against the preference of member firms to maximize the individual utilization rates for their own resources.

We have referred in a number of places to the performance of a meta-organization. A meta-organization's performance is grounded to the requirement that to be viable over the long term, a collaborative meta-organization has to present an overall win-win proposition for all its member companies (Whipple & Frankel, 2000). As an independent agent, a member company that could not derive a net positive benefit over time from its participation in a meta-organization

will exit from it. However, each member company may have its own unique determination of what constitutes net positive benefit. For instance, companies may enter into collaborations for financial gain, reputation, to break into new markets, or to learn from its partners (Beamon, 1999). Similarly, each company may also uniquely determine what constitutes its collaboration costs. For instance, a company may not only consider capital costs, but may also consider that its wider reputation is on the line when it enters into a collaboration effort. The balance between benefits and costs depends also on the time spreads for both as considered by the respective companies, which again is likely to be different for each company. In summary, the overall performance of a meta-organization is effectively a summation of the respective benefits minus costs of each member company. A corollary to the above equation is that each company should have an expectation of positive utility from its membership over a required span of time as respectively determined by each company. A meta-organization's performance is thereby a complex and multidimensional construct obtained as a function of each company's performance. The literature suggests that the measurement of meta-organization performance is correspondingly complex and should include financial, goal-objective attainment, flexibility, growth, and competitiveness dimensions (Beamon, 1999; Dess & Robinson, 1984).

4.2. Propositions

In the proposition section, we make use of system dynamics charts to illustrate and analyze the dynamic effects of feedback on performance and the different contingencies under discussion. The advantage of using system dynamic charts is that it allows us to explain the simultaneous effects of different variables on the state of a system as a whole. System dynamic

charts show how change from one variable may flow to another variable to increase or to diminish it. A flow path that ends with a plus sign indicates a positively increasing effect, while a flow path that ends with a minus sign shows a diminishing effect. In these charts, the symbol "R" inside a looped arrow indicating the feedback direction shows a self-reinforcing feedback loop, i.e., a positive feedback loop. The symbol "B" within a looped arrow indicating the feedback direction shows a self-balancing feedback loop, i.e., a negative feedback loop. In general, positive feedback loops' effects will grow exponentially, while negative feedback loop effects will bring the state of the system to some balanced point. Multiple feedback loops can interact to create augmenting or braking effects to the overall system state depending on the respective dominance of these loops (Sterman, 2000). Due to the preliminary nature of this theoretical work, we do not consider the imposition of delays to feedback loops in the propositions, though delays are an integral part of any real world system.

4.2.1. Task Uncertainty Contingencies

We interpret the three dimensions of task uncertainty in meta-organizations as follows. We define munificence as the situation when the resources needed by the members in a meta-organization are relatively available outside the meta-organization. The opposite of munificence is when such resources are difficult to locate in relative to the demand for them (Koka, Madhavan, & Prescott, 2006). Munificence affects a meta-organization's task uncertainty by increasing the number of possible partners for all collaborations. Dynamism describes the situation when the rate of change to the resources required for use by the member companies is unpredictable. For instance, the rate of technology change of certain resources may speed up or

slow down without any pattern over time. Dynamism affects task uncertainty by introducing variance to the expectations of stability in the resources of collaboration partners. Complexity describes the situation when an increased number of combinations or increased types of combinations of resources or capabilities become necessary for effective performance. For instance, some types of NPD research efforts may require the involvement of increased number of external parties with widely different expertise such as government regulators, legal experts, or environmental stakeholders. Similarly, international agreements that allow cross-border research links may create access to new collaboration opportunities. Complexity affects task uncertainty by increasing the number of connections or factors that companies have to take into account for their collaborations.

4.2.1.1. Task Uncertainty Contingency - Munificent Task Environment

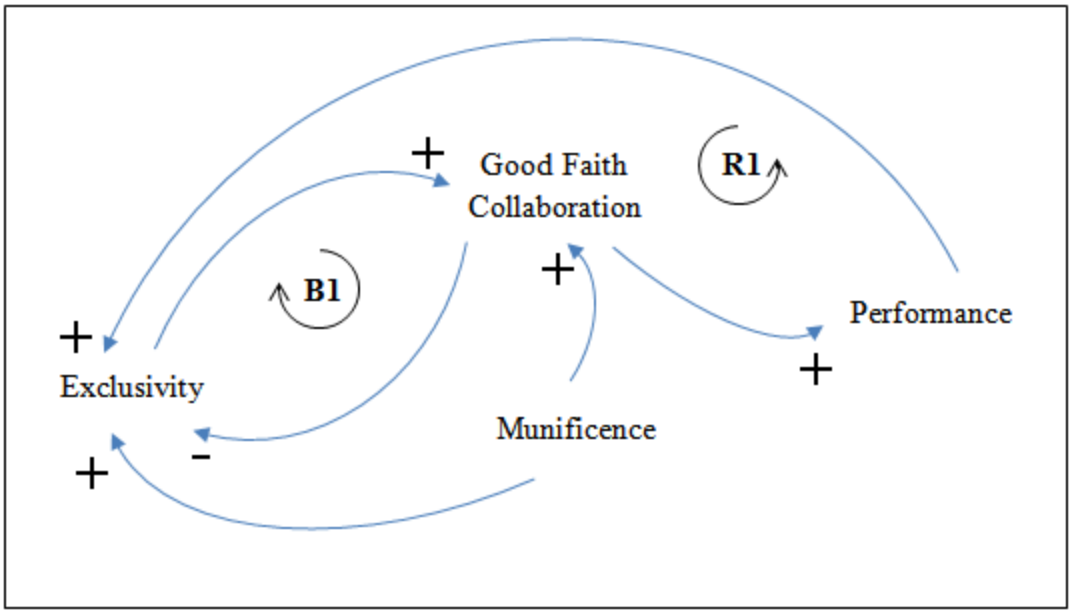
A meta-organization resembles a traditional organization in that there exists an organizational boundary whereby decisions have to be made on whether to include or to exclude the participation of independent market agents (Coase, 1937). An important criterion for membership within the meta-organizational boundary will be the relative desirability of the resources or capabilities held by a prospective company. Another important criterion for membership is the likelihood that a prospective company will be willing to abide by the terms and conditions for collaboration within a meta-organization. While the possession of vital resources is an important criterion, agreeability to good-faith collaborations should also be an equally important consideration to support performance. The existence of inter-organizational trust enables good-faith collaborations among companies. Inter-organizational trust is present

when companies believe that their partners will not take undue advantage of their vulnerabilities during the course of their interactions (Barney & Hansen, 1994). Trust can arise in various ways through repeated positive interactions, recommendations from other trusted parties or considerations of future expectations among collaborating companies (Häusler et al., 1994; Heide & Miner, 1992). Once established, the presence of good-faith collaborations will increase task uncertainty in a meta-organization as member companies will have more potential partners with whom they can work. This improves performance because it increases the number of possible options for partners under the goal-based transient collaboration process. Setting a more exclusive boundary will allow a meta-organization to admit only carefully vetted companies that are amenable to good-faith collaborations.

Given an environment that is munificent in terms of resources, an exclusive meta-organization can more easily find suitable replacements for renegade member companies that do not operate by acceptable rules of collaboration. Given an increased ease of replacement, a munificent environment can itself help to motivate member companies to work together based on good faith. An increase to the presence of good-faith collaborations may in turn reduce the need for exclusivity to a meta-organizational boundary. The system dynamics chart in the

Figure 4-2 shows these feedback relationships. The self-reinforcing R1 loop suggests that an exclusive boundary leads to good-faith collaborations that will increase performance, which will in turn increase the exclusivity of the boundary. The self-balancing B1 loop signifies that while an exclusive boundary leads to good-faith collaborations, an increase to good-faith collaborations will reduce the need to maintain an exclusive boundary.

Figure 4-2: The exclusive boundary, good-faith collaboration and munificence loops



Munificence thereby increases a meta-organization's task uncertainty by enabling the inclusive of more good-faith companies to replace the exclusion of bad-faith companies. In a contrary situation, i.e., if the environment is not munificent, a meta-organization that exercises exclusivity cannot as easily locate suitable replacements as substitutes for defaulting member companies. As such, the performance of an exclusive meta-organization where munificence is lacking can degrade due to lack of appropriate resources or capabilities. The following proposition reflects the above arguments as framed in structural contingency terms;

Proposition 1: *Exclusivity to a meta-organization's boundary increases good-faith collaborations and will increase task uncertainty to improve performance, positively moderated by the task environment munificence.*

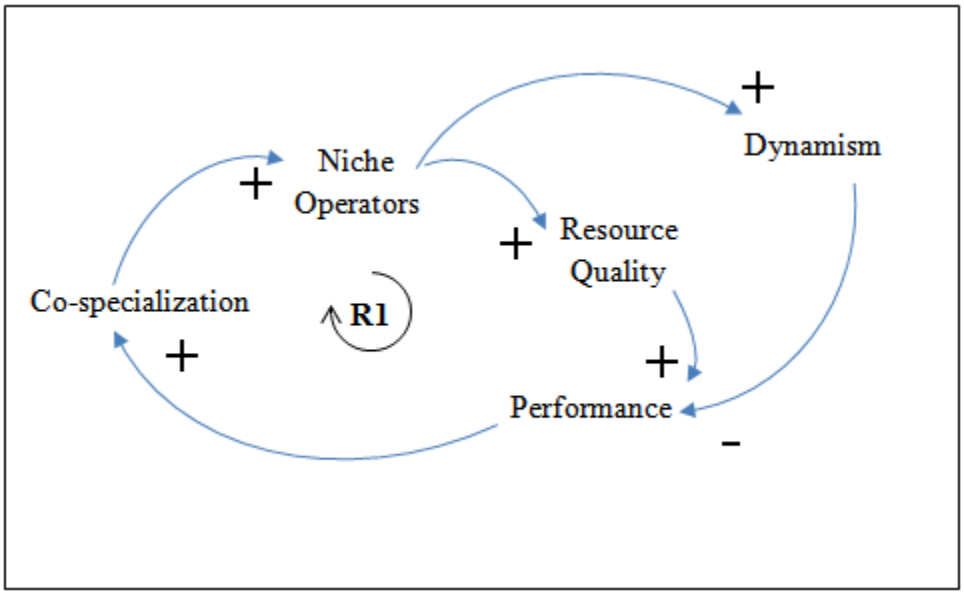
4.2.1.2. Task Uncertainty Contingency - Dynamic Task Environment

Co-specialization refers to the extent in which partners develop interdependence on each other to function more effectively together (Gimeno, 2004; Teece, 1986). In the co-specialization process, member companies in a meta-organization will continually refine or adapt their resources to improve fit to their partners' resources through repeated collaborations. This process will lead companies to favour moves toward the adoption of niche specialist roles for themselves, where each company will focus efforts to fine-tune each different kind of internal expertise for the purpose of collaboration. This does not imply that each company becomes a specialist in a single niche. Rather, companies always have the option to develop multiple specializations in parallel. The closer focus, care and attention that such companies can bring to their various areas of specialization can greatly improve the overall quality of their particular resources. Niche specialization as a structural role of companies in a meta-organization will reduce task uncertainty as it effectively limits the number of potential collaborations to fixed sets of collaborators, even within the goal-based transient collaboration process. At the same time, the improvement to the quality of resources from specialization can act to improve performance to a degree. This may result in a cycle where improved performance will in turn promote increased co-specialization efforts among the member companies.

However, the fly in the ointment to niche specializations is that unexpected breakthroughs, discoveries or applications from different fields can often introduce sudden and unexpected changes to some focal technology (Jauch & Kraft, 1986). The level of

unpredictability, or dynamism, of the technological viability of resources can have a negative effect on niche specialists as this can make their areas of specializations more vulnerable to being outmoded. Under dynamic conditions, niche specialists thereby run higher risks of obsolescence of their products or processes, which will severely affect overall performance. The system dynamics chart in Figure 4-3 illustrates the feedback loops among these concepts. The self-reinforcing R1 loop indicates that co-specialization, niche specialization, resource quality and performance will act to augment each other's effect. However, the risk of resource obsolescence that comes from specialization under dynamic conditions can act as a brake to the overall system state.

Figure 4-3: The co-specialization, niche operators and dynamism loops



Organizations that face dynamic task environments are less able to predict the future states of their environment, to estimate the possible effects on their organizations, or to assess

their potential responses to these changes (Milliken, 1987). Dynamism acts to increase task uncertainty as companies will be less assured about the viability of the resources available to them. To cope, companies may engage in uncertainty reduction strategies. For instance, these companies will invest in increased scanning and forecasting efforts, seek to buffer their technical cores, permit more internal slack for flexibility, or accept less structured decision-making processes (Milliken, 1987; Jauch & Kraft, 1986; Thompson, 1967). Though uncertainty reduction strategies are a necessity in dynamic environments, we argue that they do not necessarily create new value from dynamic situations. Rather, these strategies come at a net cost to companies in terms of management attention, financial resources and opportunity costs, and thereby reduce performance. The above discussion suggests the following proposition framed in structural contingency terms;

Proposition 2: *Niche characteristic roles resulting from co-specialization in a meta-organization increases resources quality and reduces task uncertainty to improve performance, negatively moderated by task environmental dynamism.*

4.2.1.3. Task Uncertainty Contingency - Complex Task Environment

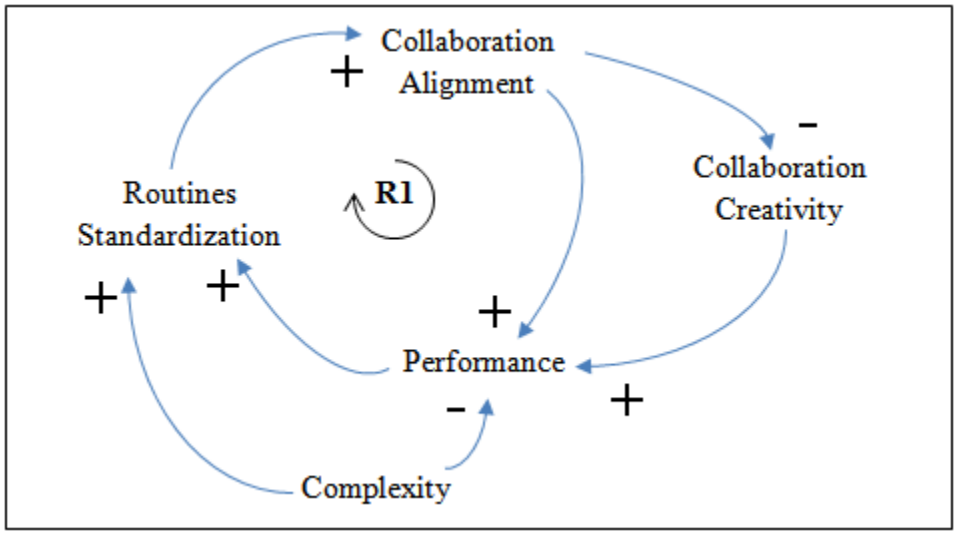
The standardization of routines is a strategy to reduce the variance of outcomes in organizations. The standardization process creates formal sets of procedures, fixes quality attainment targets, and establishes and monitors measures for compliance (Gilson, Mathieu, Shalley, & Ruddy, 2005). Companies experience more complex task environments when greater

interdependency of resources is required for effective performance. Complexity serves to increase coordination costs as the deployment of such resources will require major re-adjustments to meet each new requirement (Zhou, 2011). Standardizations to collaboration routines in a meta-organization can confer benefits to the members. The initial standardization process allows member companies to share best practices and to align their internal innovation development processes with those of potential future collaborators (Evans & Jukes, 2000). Successful standardizations to these routines allow all member companies to make use of established processes to build smoother working relationships within the meta-organization and to minimize collaboration setup costs. If a given task environment is complex, performance may suffer due to an increase risks of unforeseen complications and errors. By way of response, standardized routines may arise in a meta-organization to cope with the more convoluted or intricate collaboration operations needed due to complexity. Standardized routines will lead to collaboration routines alignment across a wider group of potential collaborators under the goal-based transient collaboration meta-organizational process. This wider pool of potential collaborators will permit the potential formation of more solutions, and will thereby increase task uncertainty to contribute positively to performance. Increased performance will in turn justify and reinforce routines standardizations.

However, collaboration alignment may also act to suppress instances of processes creativity by effectively limiting the consideration of alternative processes (Gilson et al., 2005). For instance, companies that adhere to rigidly standardized collaboration routines may not be as flexible at engaging in new ways with their partners that could unlock previously inaccessible

resources. Such a decrease to collaboration creativity can in turn have a negative impact to performance. This leads to the following system dynamics chart in Figure 4-4 that outlines these feedback relationships. The self-reinforcing R1 loop suggests that routines standardization increases collaboration alignment, which in turn improves performance. However, the negative effect of alignment to creativity may then act to impose a brake to the overall state of the system.

Figure 4-4: The routines standardization, collaboration alignment and complexity loops



Companies that face complex task environments may find that they need to seek a balance between standardized routines and collaboration creativity to improve performance. This leads us to the next proposition;

Proposition 3: *Standardization of collaboration routines in a meta-organization increases collaboration alignment to increase task uncertainty and improve performance, negatively moderated by task environmental complexity.*

4.2.2. Size Contingency

A meta-organization requires inter-company coordination by hubs to manage all collaborations due to an absence of a hierarchical organizational structure in such a collection of independent companies (Noori & Lee, 2009; Jarillo, 1988). The larger the number of hubs, all else being equal, the greater the corresponding amount of integrative capabilities available to a meta-organization. By definition, each hub can integrate at least one group of collaborators, and hubs that possess more coordination capabilities can simultaneously coordinate multiple groups at a time. As coordinators, the performance of hubs is visible to all partners in the collaboration group. As such, hubs need to inspect and validate the performance of their collaboration partners to maintain their reputation as a coordinator company in their meta-organizations.

A hub can obtain multiple benefits by virtue of its role. For instance, a hub occupies a more central position in terms of information links as compared with non-hub companies. These links can reveal the onset of major economic trends, and provide advance knowledge of future opportunities or threats (Bernardes, 2010; Gulati, 1999; Freeman, 1979). Hubs can use such information to benefit themselves, or by sharing them with other companies, can increase their influence in a meta-organization. These benefits can motivate many companies to develop coordinative capabilities and to attempt to become hubs. A proliferation of hubs may then seem to be a likely result for any meta-organization.

However, a meta-organization is not an actual company that will act to curb overlapping or duplicate coordination activities. Rather, hubs in a meta-organization can compete freely with each other in attempts to become the preferred integrator for member companies within the meta-organization. The goal-based transient collaboration meta-organization process that makes all collaboration groups re-configurable allows hubs to compete without constraints among themselves based on their reputations, costs and evidence of competent integrative capabilities. As such, any hub proliferation in a meta-organization will likely lead to the presence of hub competition (Gnyawali & Madhavan, 2001). Competitive pressure may cause some hubs to give up the role, and revert to being just agents that only serve to provide productive resources. Hub mortality may occur in which uncompetitive hubs may go out of business, or else exit the meta-organization to join other meta-organizations. The number of hubs in a focal meta-organization is therefore changeable and under certain circumstances, it may even be possible that a meta-organization ends up with a minimum of a single monopolistic hub.

Hubs can also become competitive by acting as change agents for the meta-organization. In this role, hubs can actively work with chosen member companies to develop these companies' capabilities to match market demand. These hubs can also seek to track demand patterns for new products or innovations, and be able to quickly identify, recruit and coordinate the most appropriate resources to satisfy such demands (Belderbos, Gilsing, & Lokshin, 2012). Hubs can also spur market demand for their meta-organization's offerings by cooperating with selected customers to open or create new markets (Prahalad & Ramaswamy, 2004). Hubs that can succeed in these actions will reap the benefit of being in the central position to coordinate both

the supply and demand side of a new collaboration group. Such competitive moves or activities by hubs can serve to expand the supply capabilities of a meta-organization as well as increase demand from the market for its outputs. The following set of propositions describes the above line of reasoning;

Proposition 4a: *Hub competition increases a meta-organization's supply capabilities.*

Proposition 4b: *Hub competition increases a meta-organization's market demand.*

An increase to a meta-organization's supply capabilities will spur an expansion to a meta-organization's membership size. This is because, all else being equal, increased capabilities will increase the potential for forming more collaboration groups in a meta-organization, which will thereby require more member companies. It gives rise to the possibility that more groups within the meta-organization can emerge to work in parallel. These groups may employ different approaches or use different resources in their attempts. These simultaneous efforts can act to spur both competition and collaboration among these groups within the meta-organization. However, the simultaneous formation of many different groups under the goal-based transient collaboration meta-organization process is only possible if additional coordination resources exist to provide all the required integrative coordination. Additional coordination resources comes about when hubs anticipate increased opportunities in the future and take the initiative to build new integrative facilities in advance. The presence of additional coordination resources means that member companies in a meta-organization can have more choices of coordination hub partners, and increase their possibilities to create different sets of collaborations to work on innovation

opportunities. Therefore, an increase to membership size should have a positive effect on a meta-organization that possesses additional coordination resources. The above statements bring us to the following proposition;

Proposition 5a: *Additional coordination resources increase meta-organizational performance, positively moderated by meta-organizational membership size.*

An increase to a meta-organization's market demand variance will expand its mission scope size. This in turn will motivate an increase to resources differentiation in the meta-organization. Resources differentiation, or resources heterogeneity, arises with the recruitment of new member companies with novel resources required for an expanded mission scope, or with current member companies' development of novel resources. Increases in resource heterogeneity will allow the creation of more novel combinations of resources, some of which may result in positive contributions to performance (Jiang et al., 2010). These novel integrative possibilities will be more likely if coordination resources are higher than that required for normal integrative purposes. As such, an increase to mission scope will have a positive effect only to a meta-organization that has additional coordination resources available. The proposition follows as below;

Proposition 5b: *Additional coordination resources increases meta-organizational performance, positively moderated by meta-organizational mission scope size.*

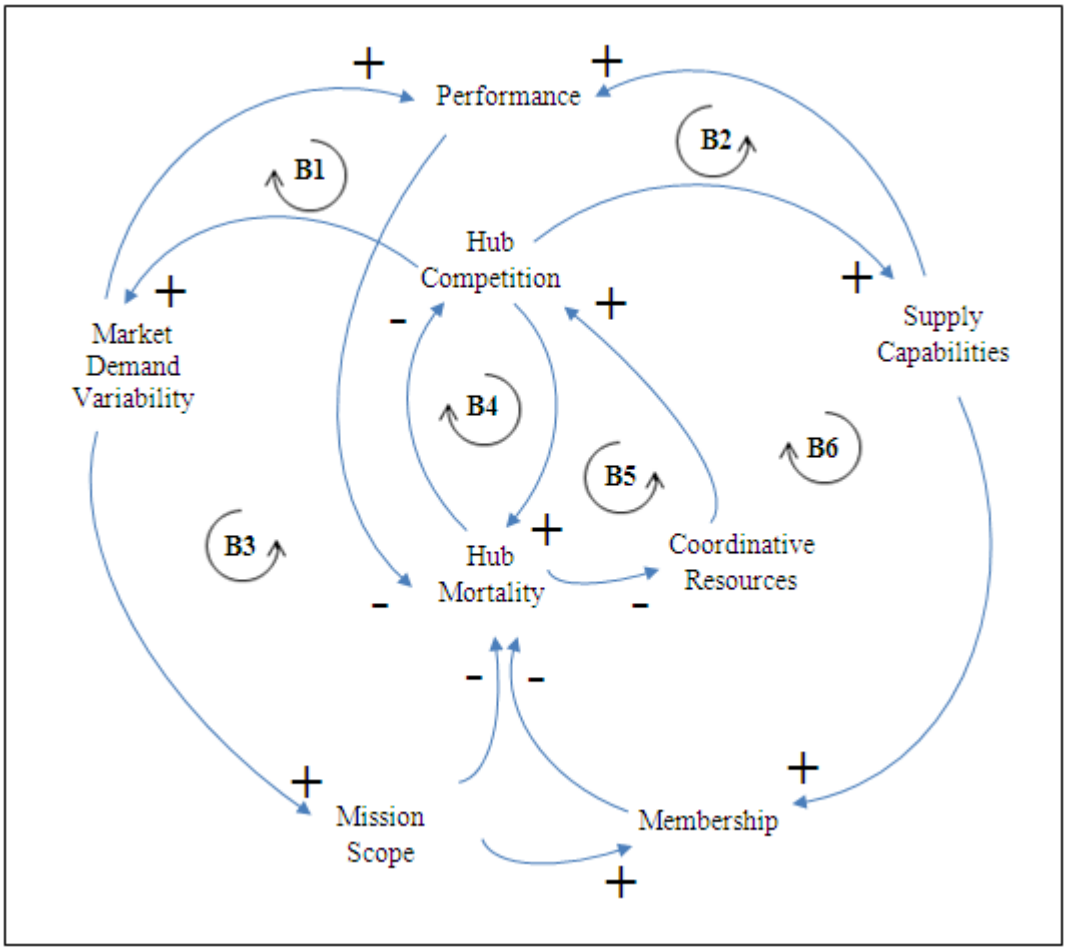
Changes to market, technology or competition can cause a meta-organization to experience reductions to both membership and mission scope. Under such a situation, even if the number of members decreases or if the scope reduces, due to the conservative nature of coordination structures (Freeman & Hannan, 1975), hubs may still maintain their original coordination capabilities within the meta-organization. This situation can lead to the initiation of hub hypercompetition. We define hub hypercompetition as the state that arises when hubs face a shrinking pool of coordinative opportunities available within their meta-organization. This is unlike the situation where hubs build up additional integrative capabilities in anticipation of future growth to collaboration opportunities. Under hypercompetitive pressure, hubs will need to undercut or undermine each other just to survive in the meta-organization. The transient process supports such hypercompetitive activities as member companies can quickly switch to other hubs to act as coordinators. The eventual outcome of hub hypercompetition will depend on the interplay of the several factors described in the above propositions. For instance, hub hypercompetition may result in the survival of only the most viable hubs. These hubs could act to revive the meta-organization to re-grow capabilities and renew market demand. Alternatively, if the factors that cause the meta-organization's decline become too dominant, the meta-organization may just dissolve. The following propositions illustrate the above discussion;

Proposition 6a: *Reduction to meta-organizational membership size increases hub hypercompetition.*

Proposition 6b: *Reductions to meta-organizational mission scope size increases hub hypercompetition.*

The system dynamic chart in Figure 4-5 shows the feedbacks among the multiple concepts from the size contingency propositions. The self-balancing B1 loop suggests that hub competition increases market demand, which increases performance. That in turn reduces hub mortality, and thereby reduces hub competition. The similar B2 loop indicates that hub competition increases supply capabilities, which increases performance. That will in turn reduce hub mortality, which will then reduce hub competition. The B3 loop shows that hub competition increases market demand to increase the mission scope size. That will in turn reduce hub mortality to reduce hub competition. The B4 loop signifies that hub competition increases hub mortality, but as the number of competing hubs decreases, hub competition will decrease. The B5 loop signifies that hub competition increases hub mortality, and that a diminishing number of hubs will lead to a decrease of coordinative resources, the presence of which will increase hub competition. Finally, the B6 loop suggests that hub competition increases supply capabilities, which will in turn increase membership size. The corresponding increase to collaboration potential will decrease hub mortality, thereby bringing down coordinative resources, the presence of which will serve to increase hub competition.

Figure 4-5: The size contingencies, hub competition and coordinative resources loops



4.2.3. Environment Contingency

As previously stated, the primary function of a meta-organization is to enable a potential space for trusted and fruitful collaborations among its member companies. This suggests that competition between meta-organizations or with other companies may take place based on the differences to their collaborative productivity or learning opportunities to their members (Tsai, 2009; Gomes-Casseres, 1994). A meta-organization that can maximize the number of successful collaborations or increase learning opportunities among its member companies will be

correspondingly more attractive and hence more competitive as compared with other meta-organizations. From the viewpoint of a member company, it maximizes its number of collaborations within a meta-organization if it can achieve effectively full and complete utilization of its resources. However, it is apparent that some types of resources found in a meta-organization will be more highly in demand than others. For instance, it is possible to deploy certain types of general resources across many different types of goals, while other types of specialized or technical resources are deployable only for specific and limited types of projects. A meta-organization will typically require both general as well as specialized resources for complete collaboration purposes. This may lead to the situation where general-type resources are insufficient, while specialized-type resources are under-utilized for collaborations within a meta-organization.

In the absence of competition in the environment, both types of inefficiencies are possibly tolerable. Member companies can be willing to forgo the occasional project due to a lack of general resources, or to accept the chance that their specialized resources are from time to time not required. Membership in a meta-organization is a privilege where member companies have the assurance of conducting trusted collaboration with their fellow-members, as against the apprehension of risky cooperation with unknown partners outside the meta-organization. However, the situation changes if other meta-organizations appear in the same industry. Member companies that join multiple meta-organizations can collaborate with companies in different meta-organizations. By doing so, member companies that own general-type resources can more likely avoid sitting out projects due to insufficient resources, while member companies that own

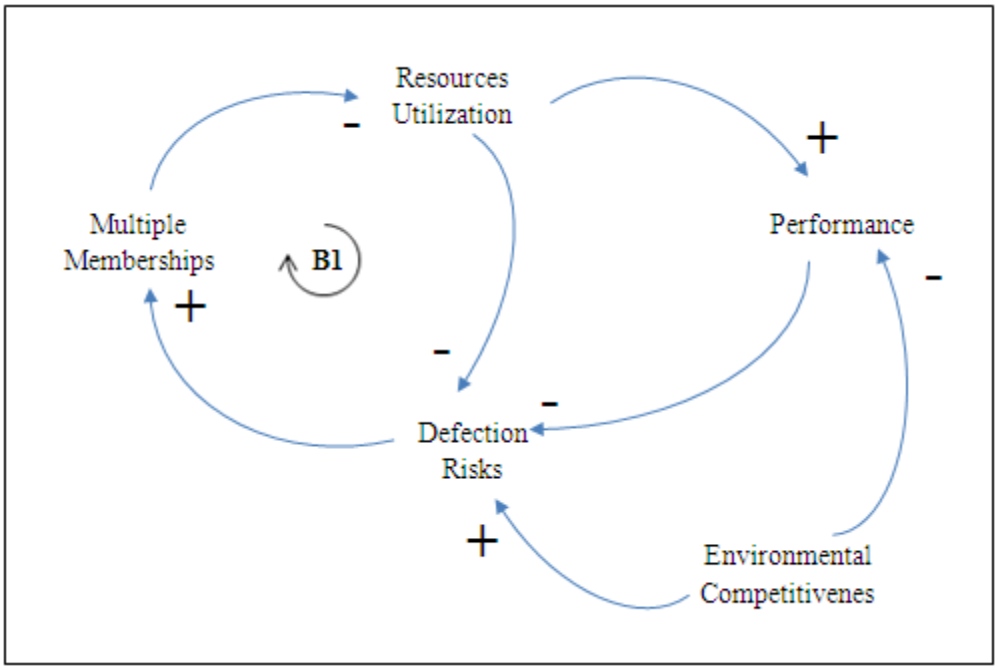
specialized-type resources can now be better able to maximize their resources utilization. While collaborations in different meta-organizations can be beneficial for some member companies, from the point of view of a focal meta-organization, the existence of multiple memberships will degrade its performance as a whole. This is because if member companies collaborate with external companies, it will reduce collaboration opportunities and resources utilization rates within the meta-organization for the other member companies. However, in the presence of competition from other meta-organizations, to avoid defections of its members, a focal meta-organization will likely have no choice but to permit its member companies to take up multiple memberships across different meta-organizations if they wish to do so. To note, any given member company should prefer to have the option to collaborate with other companies across multiple meta-organizations in order to maximize resources utilization, and to gain the opportunity to learn from new partners. By permitting multiple memberships, the focal meta-organization may salvage some collaborative opportunities from those member companies by still keeping them on its roster. This leads to the final proposition;

Proposition 7: *A multiple membership structure in a meta-organization will decrease resources utilization to reduce performance, negatively moderated by environmental competitiveness.*

The system dynamics chart in Figure 4-6 illustrates the feedback relationships among the concepts in Proposition 7. The self-balancing B1 loop suggests that allowing multiple memberships across meta-organizations will reduce the focal meta-organization's resources

utilization rates. In turn, resources utilization has a negative relationship to the risk of companies defecting from a meta-organization. The risk of defection that can arise from the presence of environmental competitiveness will increase the allowance for multiple memberships in the focal meta-organization.

Figure 4-6: The multiple memberships, resources utilization, environmental competitiveness and defection risks loops



4.3. Discussion

The goal-based transient collaboration process enables each collaborative meta-organization to reach its full theoretical potential to match its resources and capabilities to meet new requirements. In addition, the performance of a meta-organization also depends on the set-up of its structures for given contingencies as per the propositions. In this section, we discuss

how these propositions may translate in practice to companies. The propositions broadly divide into three categories of external, internal and competitive contingencies. For instance, propositions 1, 2 and 3 address the external contingencies of environmental munificence, dynamism, complexity; while propositions 4, 5 and 6 tackle internal changes to the number of hubs, membership size, mission scope size, hub competition, coordination resources, hub hypercompetition, supply capabilities and market demand of meta-organizations; and proposition 7 covers the competitive environment contingency.

Proposition 1 makes the link between meta-organization's boundaries and environmental munificence. A working meta-organization's list of required resources is changeable over time. Different resources will come into prominence or fall out of favor for a given meta-organization due to changes to demand requirements or technological progressive developments to resources (Smith & Lewis, 2011). The level of munificence need not be identical for different resources in a focal meta-organization. For instance, a new type of resource may be relatively rare, while an older type of resource may be more easily locatable in the environment of a meta-organization due to more companies having time to build it. Given the possibility that munificence is likely always a mixed state for a meta-organization, a collaborative meta-organization's structure will probably have a semi-permeable boundary that is either inclusive or exclusive depending on the respective munificence of a focal resource.

Though the future is unknown, one consensus is that business environments will become increasingly dynamic, competitive and complex, especially in new product development or

innovation research areas. Products, processes or technologies, capabilities or competencies that in the past could be counted upon to be viable over long-term periods may suddenly become obsolete overnight due to changes in globalized market preferences or through the actions of global competitors (Smith & Lewis, 2011; Sirmon, Hitt, & Ireland, 2007; Levitt, 1983). The intertwined linkages of global supply chains, and the increasing interdependencies of technological development suggest the complexity of business environments will also continue to increase (Choi, Dooley, & Rungtusanatham, 2001; Gimeno, 2004; Teece, 1986). Proposition 2 links the contingency of dynamism to niche characteristic roles in meta-organizations. To ensure high resource quality that can support performance, a meta-organization should possess member companies that are strong niche characteristic operators. However, given that the dynamism contingency is likely to be ever-present going forward, as a way to reduce the risk of resources obsolescence a working meta-organizational model should also allow multiple memberships of companies across meta-organizations to provide increased learning opportunities and alternative options for collaborations. This is in addition to allowing multiple memberships as a competitive measure against other meta-organizations as per Proposition 7. In a similar way, meta-organizations in practice should not impose overly rigid standardization routines of collaborations. Although the establishment of standardized routines can potentially permit more collaboration to take place, under the expected conditions of increased complexity, meta-organizations can perform better by allowing more flexible and creative forms of collaborations among its members.

Propositions 4, 5 and 6 show how competition motivates hubs build coordination resources, expand market shares, develop meta-organizations' resources, adjust meta-organizational membership numbers, and seek innovation synergies from novel combinations of resources. Hub competition expands the scope for collaboration opportunities, though it comes with the potential cost of increased hub mortality. Setting artificial limits to membership size or mission scope size in a meta-organization may serve to constrain long-term meta-organizational viability. Rather, a more appropriate approach in practice may be to allow membership size or mission scope size to grow based on free-market supply and demand principles. In a similar way, the number of hubs in a meta-organization should also vary in an emergent way according to internal supply or demand for integrative purposes until the appropriate number of hubs is present for the membership and mission scope sizes. The presence of a sufficient number of hubs is especially important in new product development or innovation research efforts that may require simultaneous searches for solutions in multiple directions by different collaboration groups.

4.4. Future Research Directions

A fundamental question raised in this research is whether a collection of autonomous companies working together in a goal-based transient collaboration meta-organization can be more effective than alternative forms of organization. These alternatives may include a group of companies working in fixed collaborative roles, or a single large monolithic company operating alone. We hold that the first view is more likely correct because the transient nature of goal-based collaborations can enable faster renewals of competitive advantages within a collection of

companies. The process of goal-based transient collaboration also prevents the build-up of organizational inertia. Inertia can arise due to overly embedded relations that make these entities unable to devolve or move away from some established configuration of relationships for any reason, even though that particular configuration may no longer result in efficient or effective operations from the business viewpoint. The existence of inertia serves to reduce overall organizational performances and innovation outcomes (Davis & Eisenhardt, 2011; Maurer & Ebers, 2006). The avoidance of inertia will ensure that a meta-organization is viable in both short and long-term periods. In addition, the transient nature inherent in the collaboration model also provides a very strong motivation to member companies or hubs to continually attempt to build or sustain best-in-class resources, as otherwise they could no longer be attractive to potential partners for collaboration efforts. By comparison, companies in non-transient collaboration networks, or functions located within large monolithic companies, are not easily replaceable on an individual basis. This serves as a form of protectionism for these entities, and it can result in the tolerance of lower quality resources used for productive purposes.

A related question is whether any focal company will fare better as a member in a meta-organization, or as a collaborator to a single large and monolithic company. The conclusion here not as clear because our definition of performance allows for a wide latitude in how individual focal companies may choose to consider as their relevant costs, benefits and timelines from their collaborations. For instance, a focal company may still concludes that its collaboration with a single large company as overall beneficial because of its increased learning experiences even if it suffers a financial loss from the association (Lavie, 2006). All else being equal though, it is

likely that the power imbalance inherent in such a lop-sided partnership is such that a smaller focal company may not find the relationship as beneficial over time. For instance, the larger company may have more leeway in terms of power to alter the terms of a collaboration to be more detrimental to the interests of the smaller company at any time. The smaller company will need to consider such uncertainties when entering into such relationships. To note, power issues will still likely exist even in our proposed collaboration model, as companies are rarely equal in their sizes or influences (Powell, 1990). However, the more interdependent and resource-specialized nature of a goal-based transient meta-organization provides more dispersion of power among its member companies. A focal company will thereby face less pressure due to power issues in a meta-organizational setting, and will be able to realize more collaboration benefits.

4.5. Conclusion

This research seeks to provide a novel contribution to the literature of inter-company collaboration by investigating how the structures and contingencies of networks interact to affect performance with a specific focus on NPD and innovation research networks. We extended concepts from Structural Contingency theory to understand and analyze the theoretical principles behind meta-organizational collaborations. Our analysis leads to the creation of propositions that link the contingencies of environmental munificence, dynamism, complexity, size and environmental competition to the structures of meta-organizational boundaries, niche characteristic roles, the critical roles of hubs, routines standardizations, coordination resources, hub competition and multiple membership allowances. We use system dynamics charts to clarify the complex relationships and feedbacks among these constructs. The propositions may serve to

provide a significant shift to current assumptions or current practices in managing NPD or innovation research. For instance, the design of appropriate collaboration structures can provide these companies with better potential to achieve sustained competitive advantages even in volatile environments. As such, we assert that smaller companies collectively operating as a coordinated organizational entity with flexible goal-based transient activities can out-compete either single large companies, or companies operating within more rigidly structured collaboration associations. The practical contribution of this paper is to provide understanding of how such associations may design and set up collaboration structures that can achieve sustained competitive advantages for their member companies in today's globalized business environments. The propositions in this essay will serve to set the foundation for conducting future research in related topics.

5. TRANSIENT COLLABORATION MODEL: OPERATIONAL VERIFICATION

The primary purpose of the research described in this essay is to verify a match between the transient collaboration model as practiced by companies operating in the field, and the theoretical principles of the model. We seek to find out if the empirical evidence may require us to amend or further expand the theory, with the objective of better understanding how transient collaboration processes may be carried out in businesses to aid performance (Yin, 2003; Eisenhardt, 1989). To this end, we conduct a qualitative study on example organizations using the case study method. This method allows us to perform a wide-ranging and in-depth field examination of collaborations in selected organizations to explore and explain the topic in detail (Ellram, 1996). The unit of analysis in this study is a collaboration group consisting of network entities that operates in a meta-organization.

The organization of the remainder of the essay is as follows; Section 5.1 lists the case samples in the study, while Section 5.2 describes the study methodology and validity issues. Section 5.3 describes the informants, and Section 5.4 covers the individual case studies in detail. In section 5.5, we discuss the findings and conclusions.

5.1. Case Samples

The first selected organization is a university research park called the David Johnson Research + Technology Park, located within the University of Waterloo, in Waterloo, Ontario. The core mission of the research park is to enable and foster the pursuit of radical innovations, to generate technology jobs, and enhance the business earnings of its resident companies and

surrounding communities. The research park has been in operation since 2004. It covers an area of 29 hectares and possesses 1.2 million square feet of office space in nine main buildings. The park currently hosts 20 resident tenant companies, including SAP, OpenText, Sybase, Blackberry, Cisco, Communitech and others, and has more than 30 start-up companies in its R&D incubator. It has graduated dozens of start-up companies in previous years (David Johnston Research + Technology Park, 2014). The research park is also a member of the Association of University Research Parks Canada, or AURP Canada, which consists of 26 university research parks across Canada (AURP Canada, 2014), and the AURP (USA), which consists of more than 700 research parks located worldwide (AURP, 2014). Our study analyzes the collaborative group experiences centered on those of a tenant company and two start-up companies in the research park; refer to in this essay as Company W, Company X and Company Y.

The second selected organization is a consumer mobile apps developer called Dandy Corporation, located in Kitchener, Ontario. The company's mission is to build consumer mobile apps based on the ideas, expertise and technical skills of its online community of users with arbitration by its management team. The company is a relatively new startup that has been in operation for two years (Dandy Corporation, 2014). Our study analyzes the collaboration group efforts to develop an app project from Dandy Corp refer to in this essay as Project Z.

5.2. Case Study Methodology

The aim of using a proper case study methodology is to strengthen the construct validity, external validity and reliability of the study. Aside from interviewing the informants of the

organizations, secondary data on the organizations' structures, contractual agreements, media releases, and relations with other organizations provide additional information. Multiple sources of information that can be used to cross-check against one another will reduce the chances of errors or bias in the findings (Eisenhardt, 1989; Yin, 2003).

5.2.1. External Validity

A major consideration with case studies is the generalizability, or external validity, of the findings (Ellram, 1996). A means to improve external validity is to increase samples in a study. Additional case sample flesh out the different facets of the theoretical concept that will add more clarity to the results. In this study, we use four case samples to explore the different aspects of the topic.

5.2.2. Reliability

The reliability of a case study addresses the issue on how repeatable the findings can be for an identical study on different case samples. We seek to bolster the reliability in this study with the use of a pilot study, a case study protocol and proper recording of study data. We develop the case study protocol from prior interviews performed during the preliminary pilot study and from literature review on case study practices (Yin, 2003; Ellram, 1996). The pilot study allows us to fine-tune the interview procedures, and to determine the possible extents for such a study. Appendix B contains the study protocol developed and used in the case. Encryption and backups of all data collected in the study ensure that records are available for further reference if needed.

5.2.3. Construct Validity

In a case study, construct validity refers to the accuracy in which the operational measures of the study reflects the theoretical constructs. We reinforce construct validity in the study in several ways. First, we provide upfront definitions of the constructs in non-academic terms to the informants at the preliminary stage of the study. We discuss and clarify these definitions with informants to ensure that all parties have the same understanding of the terms and concepts of the study. Next, we meet and contact informants repeatedly to counter-check our understanding of information provided. We provide figures and diagrams developed from the study to informants for their feedback and correction as necessary. Finally, where possible we check our study information against secondary data from organizational websites, media and other reports to ensure accuracy.

5.3. Data Collection

The informant at the David Johnson Research + Technology Park is Ms. Carol Steward, the park's Business Development Manager. The informant has 10 years of tenure in a management position at the park, and is closely involved with the activities of all its tenant and startup companies, and that of potential companies seeking to join the park. The informant also works with local business owners, University of Waterloo faculty, other research parks administrators and government agencies representatives to promote the research park's profile and activities. We collected data through personal interviews and emails with the informant and her assistants. Archival data includes tenants' business information, park information brochures and media releases provided by the informant or obtained from the companies' websites.

The informant at Dandy Corporation is Mr. Colin Calvert, the company's Business Operations manager. The informant has been with the company since its founding, and has an in-depth knowledge of the interaction among the company's user base, and the app products under development. We collected data from the informant through face-to-face interviews and email communications. Archival data collected from the informant and the company website includes the company's evaluations of apps, user lists, and user interactions in different app projects.

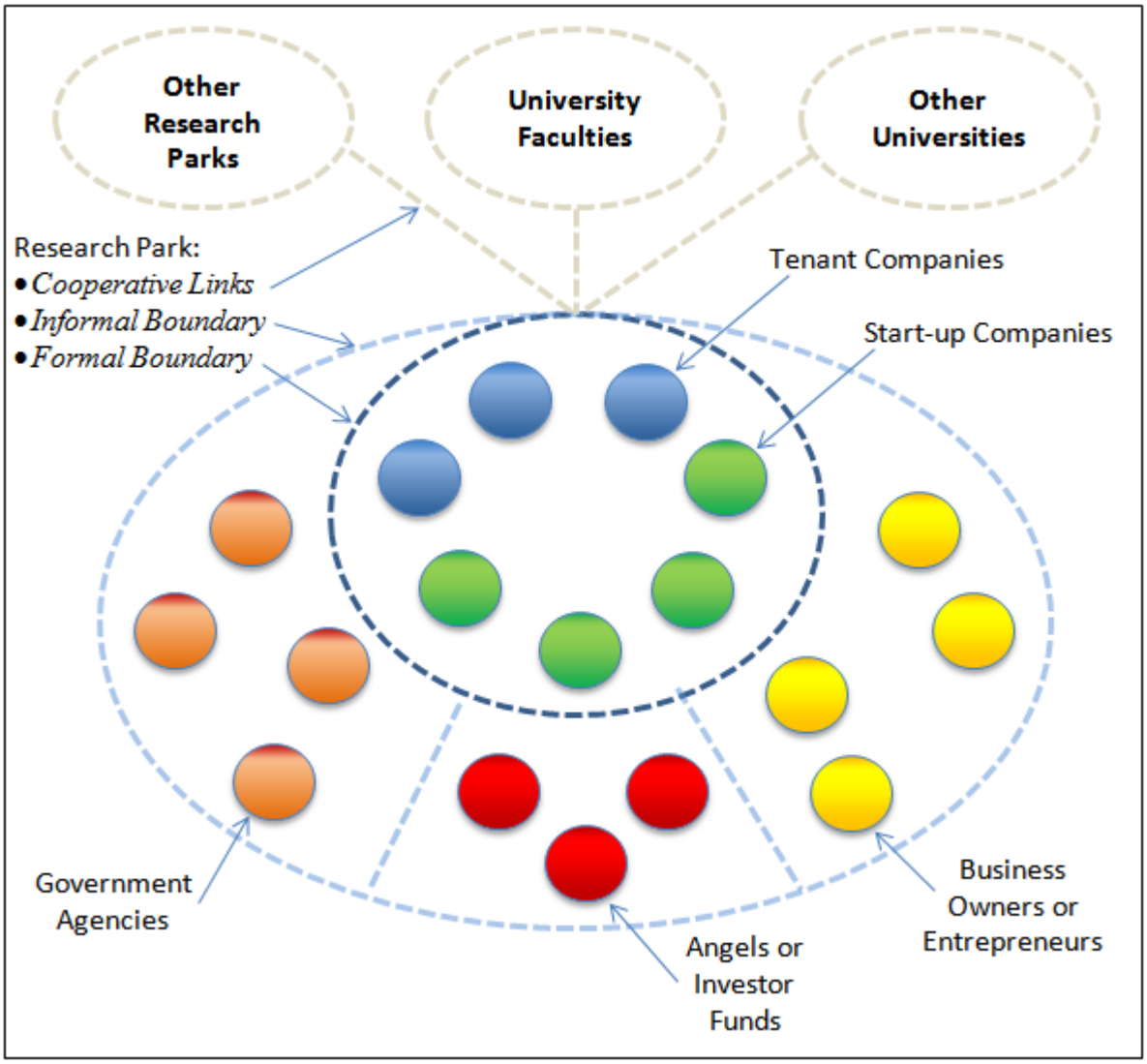
5.4. Data Analysis

5.4.1. David Johnson Research + Technology Park Meta-Organization

The description obtained in our study of the David Johnson Research + Technology Park shows that its management team primary role is that of a facilitator for a collaborative meta-organization. The management team provides the initial governance structure at the founding of the research park, and continues to manage and execute this governance role. Our study suggests that the research park team exercises its network facilitator function through both formal and informal means. Formally, the research park team serves as the guardian to manage the entry of new entities into its meta-organization, such as tenants and start-up companies. The team also cultivates and manages formal understandings and cooperation with other research parks, research consortiums, and universities. Informally and just as importantly, the team builds and maintains an extensive contact list of business owners, entrepreneurs, investors and government agencies as potential partners or supporters for the research park's companies. The crucial point is that, whether linked by formal or informal ties, these entities all equally lie within exclusive boundary spaces managed and controlled by the network facilitator that enable them to

collaborate on a transient basis for specific objectives. Figure 5-1 lists the entities in the research park's meta-organization and their placements within either formal or informal boundaries.

Figure 5-1: Entities in Research Park's Meta-Organization



The stated objectives for the tenant or start-up companies to seek entry into the research park is to get resources to enable them to increase innovativeness, faster time-to-market, create more learning opportunities, build reputations and expand networking. These companies

consider their membership in the research park as a crucial means to develop the ability to create deep collaboration partnerships with other companies within exclusive and well-trusted boundaries to attain these objectives. These companies view the research park as a safe space where they can freely share or learn information across companies, and where such potentially vulnerable openness will not end up harming their individual interests. Tenant and start-up companies also gain reputational advantages within their industries from their membership in the research park. The thorough vetting process that these companies undergo prior to their admission into the park provides a level of assurance that these park member companies are well-grounded organizations with sound business plans, financing and legitimate management practices.

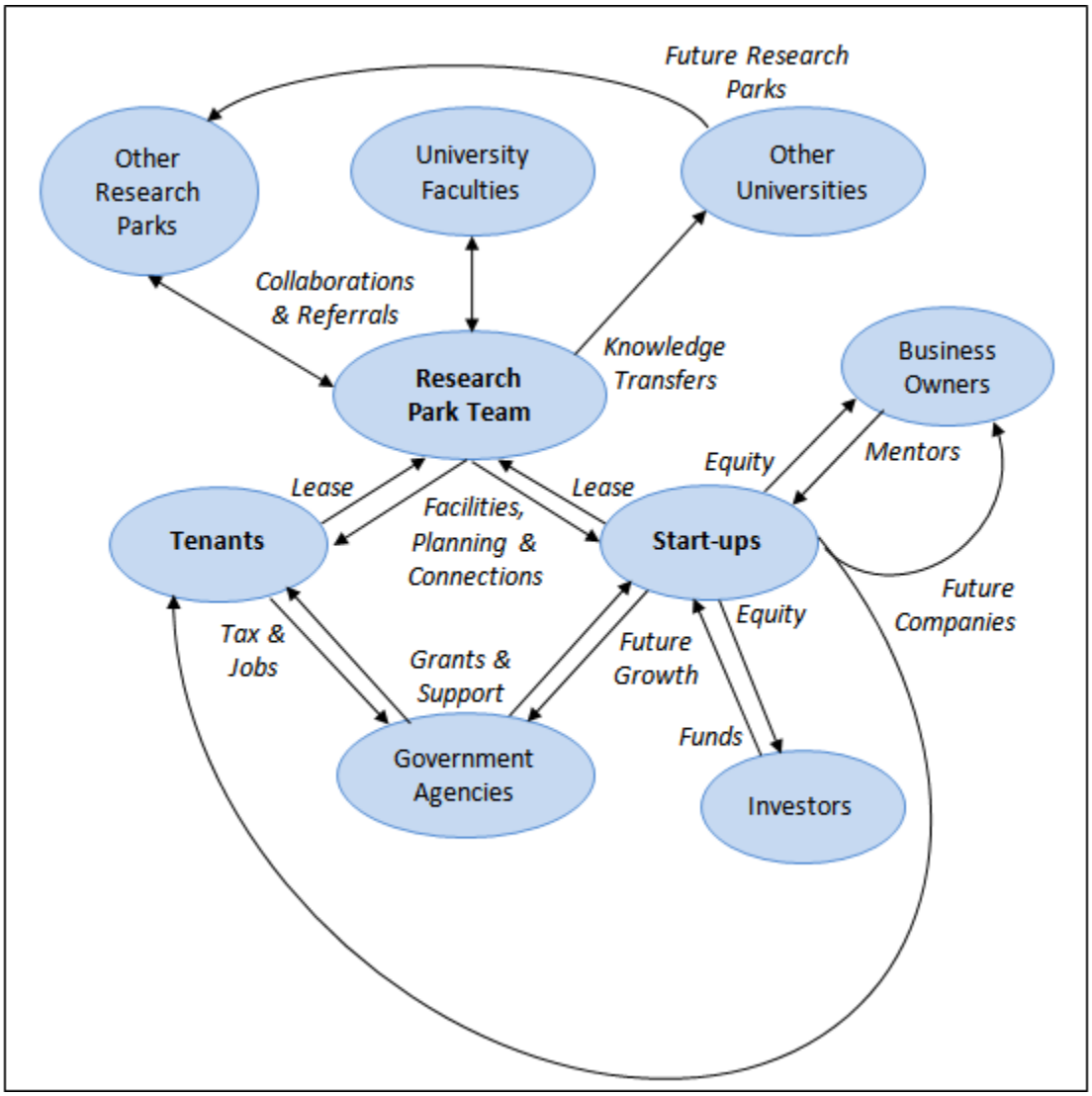
Our informant reveals that multiple types of direct and indirect value-flows exist within the research park's meta-organization. The most obvious and direct value-flows take place within the park's formal boundary among the park's team, the tenant and start-up companies. The tenant and start-up companies lease office space and pay rent to the research park. In return, the research park team provides the facilities, management planning aid, and connections to other parties in the meta-organization. All start-up companies that seek to enter the research park first undergo a thorough screening process by the park's management team to ensure that the start-ups are in feasible businesses, have business plans, have well-defined markets, and have potential growth trajectories. Those start-up companies approved to enter into the park will then work with park team to design a development plan that can grow and mature their companies within a limited timeframe of between three to twenty-eight months. The plan includes meeting

various milestones that will eventually allow the start-up company to exit the park as a graduate, and to enter the community as a full-fledge and successful business. As part of the plan, the research park team will link each start-up company with a select voluntary group of business owners or entrepreneurs who will provide business mentorship and consultancy to the start-up. The park team has a contact list of approximately a hundred such mentors who come from the surrounding business community, and who are willing to invest their own time to be mentors. The mentors teach the start-up companies how to report achievements or problems to a board of directors, and connect with them to access new skills such as marketing or financing as needed. An example of such a mentor at the park is Mr. Mike Lazaridis, formerly of Blackberry Corporation. The park team can continually adjust the composition of the mentor group to suit the changing needs of a start-up company. In return, the mentors derive reputational gains and satisfaction from their mentorship contributions. The mentors also have excellent chances to obtain early investment opportunities in start-up companies that become successful. In this regard, the research park team also maintains a list of potential investors to provide investment funds to promising start-up companies. A successful start-up company may return to the research park as a tenant, and its owner may even become a mentor to new start-up companies. Our informant makes the point that not all start-up company may graduate to become a blockbuster company. However, they may still become a perfectly viable company that contributes economic value to the community.

The research park team also works with government agencies to provide grants and other support to their tenant and start-up companies. For instance, start-up companies that seek to

expand abroad may find it difficult to find temporary hosting sites in foreign countries. For such cases, the research park team works with the Canadian Trade Commissioner Service to provide temporary hosting sites in selected cities abroad through the CTA, or Canadian Technology Accelerator, scheme (Canadian Trade Commissioner Service, 2014). The indirect value flow to government agencies that support these companies takes the form of future economic and job growth in the regional or national economy. The research park team also maintains links with other research parks and the University of Waterloo faculties that benefit their tenant and start-up companies. The tenant or start-up companies can access resources from companies in other research parks or the University's faculties through joint collaboration projects. It is also a practice for the research parks to refer new proposed start-up companies to other research parks depending on their specializations. For instance, the David Johnson research park does not possess a life science sector, and the park team will refer any proposed start-up with a life science focus either to the University of Guelph research park or to the MaRS Discovery District in Toronto (MaRS Discovery District, 2014; University of Guelph, 2014). The research park team also periodically hosts delegations from other universities that wish to learn how to set up their own research parks to promote business innovativeness. This includes universities from China, Japan, India, Mongolia, Australia, Sweden, Ireland and others. The indirect pay-off for the research park for such effort may come years in the future when these new research parks come online and become new collaborators. Figure 5-2 illustrates these value-flows among the entities of the research park's meta-organization.

Figure 5-2: Value-Flows in Research Park's Meta-Organization



5.4.1.1. Company W

Company W is a branch of a multi-national company located as a permanent tenant in the research park. Recently, a large and well-endowed foreign-based company formally applies to become a tenant in the research park. Upon learning of this application, Company W registered a very strenuous objection to the research park team about the proposed entry of the foreign company. The reason cited for the objection is that the foreign-based company has previously

violated Company W's intellectual property rights in a case that sparked a major lawsuit. According to Company W, the foreign company has also recently made an earlier unsuccessful attempt to be co-located with another of Company W's branches at another research site. In its communication, Company W registered profound distrust of the foreign-based company's intentions, implying the possibility of industrial espionage with the statement that that the foreign company is "always sniffing around" Company W's research programs. Company W also made it clear that it would withdraw from the park with immediate effect should the foreign-based company enters the park. After due consideration, the park's management team eventually disallows the application of the foreign-based company primarily because of this objection.

Company W's lack of trust in the foreign-based company apparently over-shadows any short-term benefit the entry of such a connected and resource-rich company into the research park might bring for it. This case shows that the importance of inter-organizational trust dominates an entity company's valuation of a meta-organization, above that of collaboration opportunities, no matter how attractive these may be.

5.4.1.2. Company X

In 2009, two entrepreneurs, then undergraduates at the University of Waterloo, founded Company X as a software innovation company. After undergoing and passing the vetting process, Company X entered the research park as a start-up company. Within a year, the company's flagship product, an app that allows smart devices users to text through Wi-Fi without a calling plan, went viral and attracted both consumer and industry attention. At that time, a

mentor at the research park provided critical advice to the two entrepreneurs to revisit and revise their financial accounting system to take into account their increased earnings. In 2011, the company received a large infusion of funds from two major venture capital firms. Later in that year, the company graduated from its start-up status, became a tenant company in the research park, and opened a branch in the United States.

While the market popularity for Company X's software product obviously plays an important role to ensure their eventual success, it is noteworthy that Company X's status as a start-up in the research park was just as important. For instance, throughout its time in the research park, Company X also received continued exposure in the print and online media as an up-and-coming success story that will have materially contributed to the further promotion of its brand and products. Similarly, the advice of their mentor on managing sudden financial growth put them on the path to ensure internal accountability and to prevent future mismanagement issues. In addition, the company's membership in the park provides it with a level of stature and good repute that can assure investors of its sound standing and future prospects. This is borne out by Company X's ability to raise funds with major investors for its next stage of expansion into other products and locations. As such, Company X presents an almost textbook example of the success of the research park's method of concentrating diverse collaborative resources to locate, develop and graduate start-up companies to become full-fledged companies.

5.4.1.3. Company Y

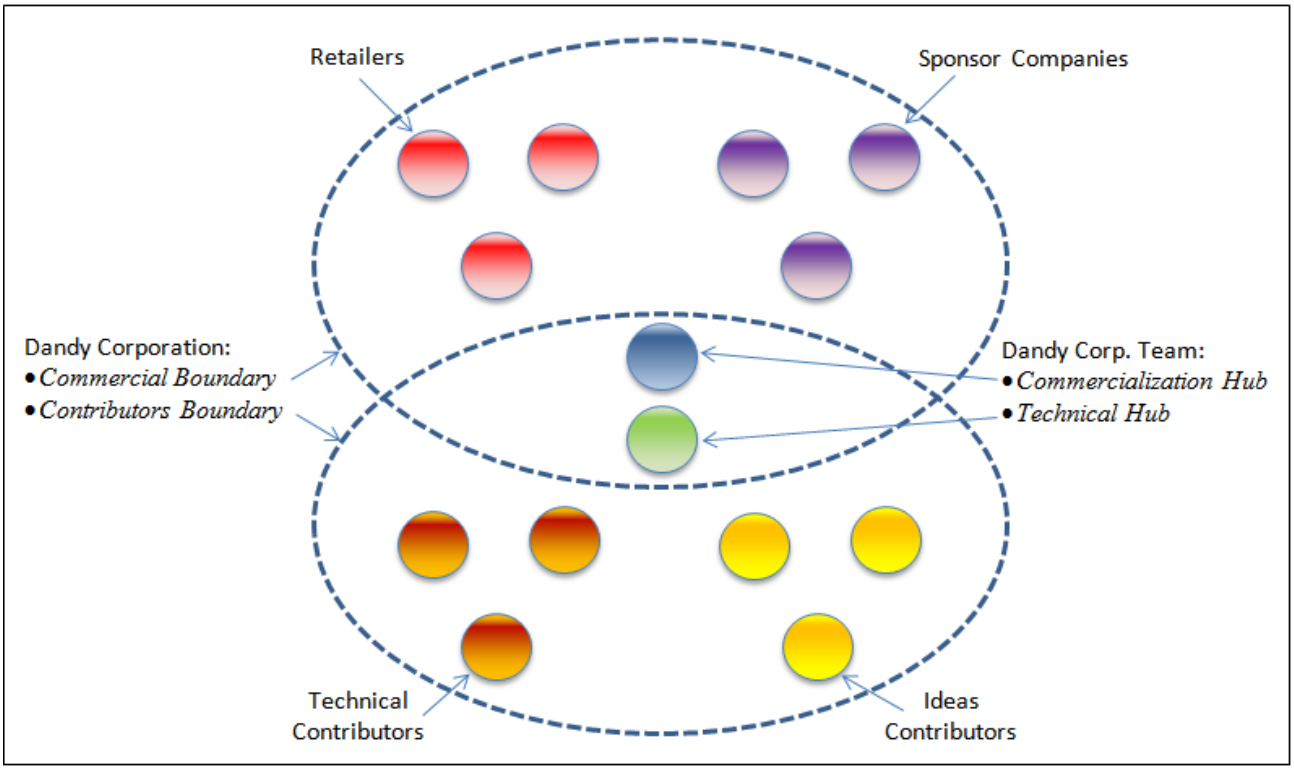
A number of years ago, an entrepreneur began Company Y as a digital media gaming company. Company Y also undergo the vetting process, and entered the research as a start-up company. The company developed within the park and achieved a number of successful milestones over a period of two years. However, as the company grew, it reached limitations to what the park can offer. Notably, the company found that it lacks sufficient support, advisors and publishers pertinent to its particular industry niche. After a period of reflection, Company Y took the unusual step of exiting from the research park before the graduation process. The company relocates to Toronto, and based on the interviews, has done well since.

The departure of Company Y precipitated considerable internal discussion among the research park team and the University of Waterloo that leads to a subsequent re-assessment of their existing support setup. Their conclusion is that the research park lacks a digital media cluster of sufficient concentration to support start-up companies in that area. They also determine that digital media will become more in demand in the future, and that there is a major need to build such a cluster. This initiative leads to the establishment of the Games Institute at the University of Waterloo Stratford campus in 2011, and the resulting entry of digital media start-up companies into the new establishment (Stratford Campus, 2014). Although Company Y failed to graduate as a start-up in the research park, the failure provides important lessons to the park, and alerts the team to a critical lack of specific resources in their collaborative setup. The research park is then able to work with existing partners to create new resources to support future start-ups in the digital media industry.

5.4.2. Dandy Corporation Meta-Organization

Our study of Dandy Corporation shows that its management team performs two functional roles in its collaborative meta-organization. In their first role, the team acts as the overall network facilitator to establish and govern the meta-organization. In their second role, the team acts as the technical and commercialization hubs within the meta-organization. As a technical hub, the Dandy team assesses and manages the technical direction of the app projects with regard to their technological feasibility and marketability. After an app project enters the market, the team as a technical hub continues to coordinate and approve technical direction and support. As a commercialization hub, the Dandy team assesses and selects app projects, and invites contributors to collaborate with ideas or skills to improve on the projects. As the app projects mature and become ready for market, the team approaches and draws in sponsors and retailers such as Apple, Google or Blackberry to become collaborators to promote and commercialize the app product. Figure 5-3 lists these entities, and shows their placements within either the contributor or commercial boundaries of the app developer meta-organization. The technical and ideas contributors located within the Contributors Boundary are individual persons, as oppose to being companies. These contributors operate within the Dandy online portal, and they create emergent collaboration groups among themselves to work on apps projects.

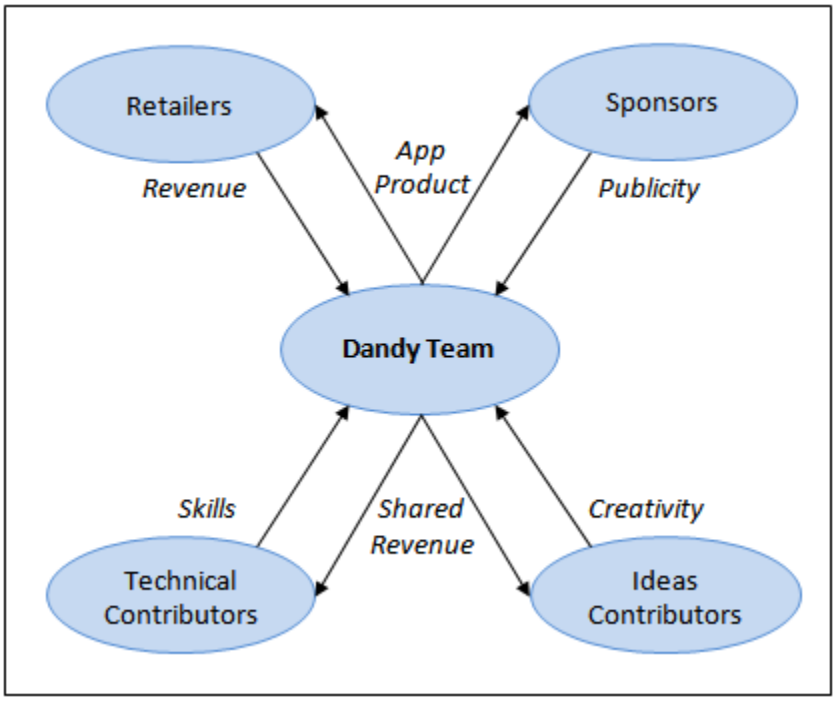
Figure 5-3: Entities in Apps Developer's Meta-Organization



The motivation for the technical or ideas contributors is to gain credit from Dandy Corporation for contributing efforts during the creation and development stages of an app product. The contributors may gain credit by providing ideas, feedbacks, discussions, technical and testing support at different stages of the app development. Upon commercialization of the product, after a cut to Dandy Corporation, sponsors and retailers, the team uses the credit distribution as the basis to divide financial returns by app products to the contributors. As the network facilitator, the Dandy team sets up and governs the online portal where the technical and ideas contributors virtually meet and interact. In theory, any person online may become a contributor. This is by deliberate design, as Dandy team intends for the boundary for contributors

to be open and inclusive to maximize new ideas and skills. However, the team does reserve the right to exclude abusive contributors who do not abide by their portal's terms and conditions. The Dandy team also works with sponsors and retailers to market completed app products. These sponsors and retailers work directly with the Dandy team in its role as a commercialization hub. Thereby, the respective boundaries for contributors and commercialization parties only overlap within Dandy itself. The value-flows found among the entities in the meta-organization are relatively straightforward. The ideas contributors provide conceptual creativity during the apps development stages, while the technical contributors provide the programming skills to create and debug the app for different platforms. In return, these contributors will have a share of the future revenue once the app reaches the market. During the commercialization stage, the Dandy team links up with sponsors to use the apps in creative ways to raise market awareness for both the app products as well as the sponsors among the public. Finally, Dandy works with the retailers so that the consumers may download the app across different platforms, and pay for advance features in the app products. Figure 5-4 illustrates the value-flows among the entities in the meta-organization.

Figure 5-4: Value-Flow in the App Developer's Meta-Organization



5.4.2.1. Project Z

In early 2013, Dandy Corporation launches its online portal to attract ideas and concepts from the online community for new apps. Multiple contributions came in, and from these, the Dandy team shortlisted nine app ideas based on their respective feasibilities, innovativeness and market potential. We name these nine app ideas as projects A, B, C, D, E, F, G, H and Z. The Dandy website prominently displays the nine app ideas for their technical and ideas contributors to post development ideas and suggestions for the respective apps. Throughout this stage, Dandy team performs the role of a technical moderator to assess and guide the apps development process.

The technical and ideas contributors are individual online users who are independent from one another. It is only necessary for users to provide a valid email address to register as a contributor in the Dandy website. Each contributor decides on how much time, effort and creativity to devote to a particular app project at any period. It is unlikely that every app project will succeed, so not every effort will receive a final pay-off. All contributions to the projects are visible as individual posts attached to the respective app projects.

Archival data collected from the Dandy website shows that 94 individual contributors, labelled 001 to 094, provide 548 posts for these nine app projects over 10 months. Unfortunately, about 70% of these posts are in sub-areas that do not have time-stamp information available. Time-stamps are not critical to show the presence of collaboration links. However, as our interest is in the area of transient collaborations, time-stamps are necessary for indicating the periods during which contributors participate in different app projects. We mapped only the 171 posts that have time-stamp information. To illustrate their collaboration patterns, we show in detail a data subset for an 11 days period with particularly busy interactions. During this time, 23 contributors posted 47 times across five projects (B, C, E, H and Z). Figure 5-5 shows the snapshots of their interaction pattern for each day (Periods I to XI), where the final snapshot shows the cumulative pattern of all interactions. Table 5-1 lists the interaction data in table form with each post by project shown by periods. For instance, the column for Period I shows one entry, where contributor 032 posted to project C. This entry corresponds to the snapshot for Period I in Figure 5-5.

Focusing on Project Z, we see that in this data subset the first posts to the project came from contributors 038 and 081 in Period IV. In that same period, contributor 081 also posted to project B. The next series of posts to Project Z came from Contributors 058 and 059 in Period 5. Contributor 058 has also previously posted to Project C during Period IV. Essentially, the pattern of postings shows that the contributors shift their attention across different projects over time. This is because the contributors constantly react to each other's posts in their online interactions to comment, clarify or expand on ideas. The rapidity of their cross-interactions ensures that new ideas or concepts that emerge in one project are quickly transferable to another. The contributors also communicate among themselves to request information or help on various issues. Through such activities, the contributors emergently create transient collaboration groups that come together to tackle specific issues for any app project.

After this initial stage of development, the Dandy Team selected Project Z to advance to the next stage of coding and commercialization. At that time, due to insufficient availability of technical contributors in their pool, the Dandy team hired technical programmers to complete Project Z. The team continues in their role of a technical hub to direct the development of Project Z to be in line with the latest advances in smart devices platforms. The team also screens and enlists a team of beta-testers from among their contributors to field-test the different technical stages for Project Z. The time to complete the app development to market is 2 months. The industry considers this time as fast for the given app complexity.

Next, the Dandy team takes on the commercial hub role to market and promote the app by seeking sponsors and working with app retailers. For instance, Dandy works with the "Living Colour" marathon event in Waterloo, Ontario, to co-promote the app (Waterloo Running Series, 2014). The app receives publicity through the collaboration, and because members of the public take pictures of the race through the app for entry into a contest, the marathon event gain in publicity as well. The app became available to the market in early 2014. The development of Project Z shows how the Dandy team draws on different expertise from a wide pool of independent contributors to achieve market-focused innovativeness and faster time to market. The transient collaboration process allows the development of Project Z to benefit from work done on the other eight projects, as the process allows the contributors to freely transfers ideas and knowledge within a trusted environment for collaboration.

Figure 5-5: Snapshots of Collaboration Patterns – Periods I to XI

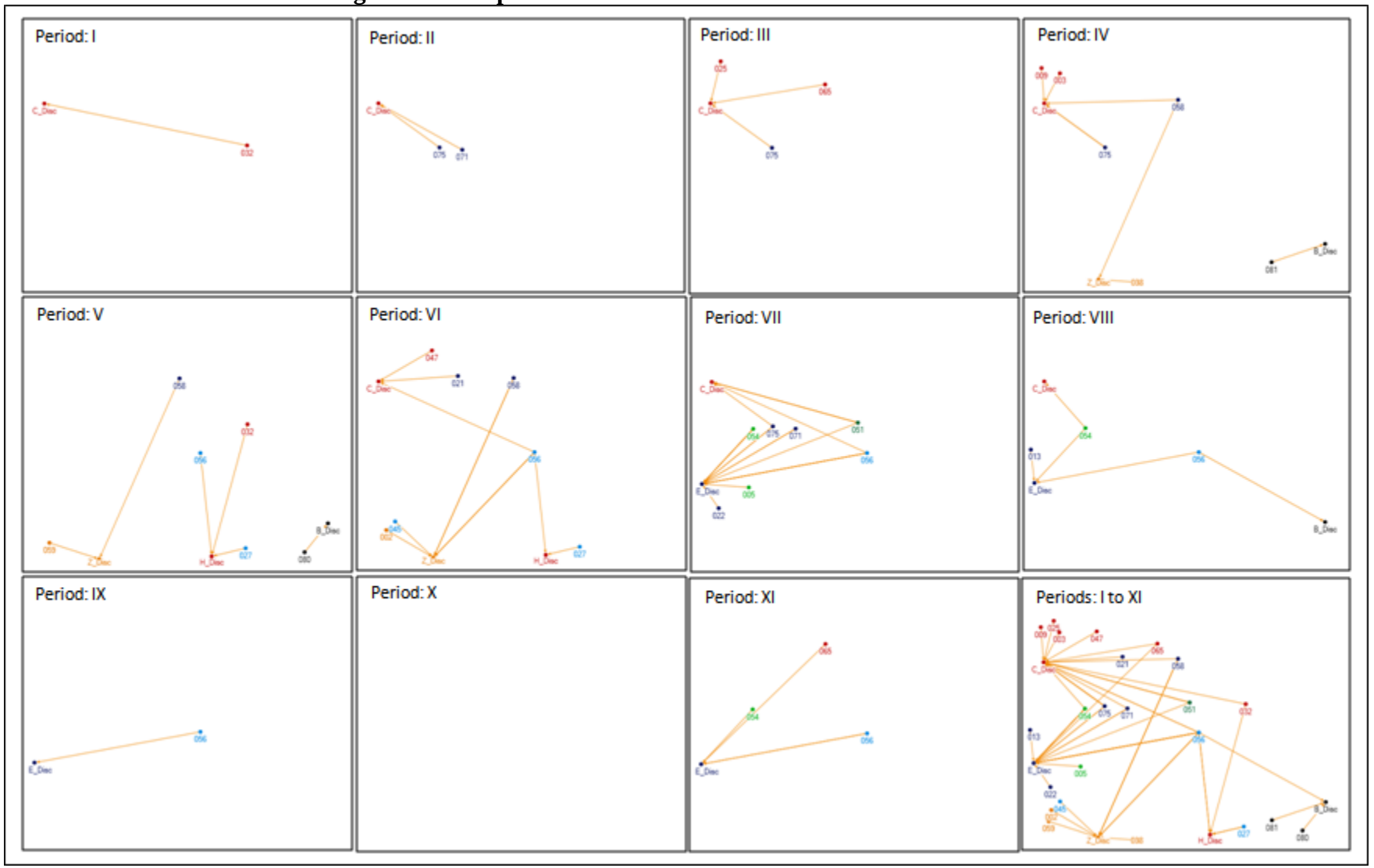


Table 5-1: Contributors' Posts by Projects from Periods I to XI

Period / Contributor	I	II	III	IV	V	VI	VII	VIII	IX	X	XI
002						Z					
003				C							
005						E					
009				C							
013								E			
021						C					
022						E					
025			C								
027					H	H					
032	C				H						
038				Z							
045						Z					
047						C					
051							C, E				
054							E	C, E			E
056					H	C, H, Z	C, E	B, E	E		E
058				C	Z	Z					
059					Z						
065			C								E
071		C					E				
075		C	C	C			C, E				
080					B						
081				B, Z							

Note: Projects listed in Table includes B, C, E, H and Z.

5.5. Conclusion

Our case study provides field data to assess the theoretical principles developed for transient collaborations. The findings provide partial validation to a number of propositions. The case of Company W illustrates how the presence of exclusive boundaries enables trust and good

faith collaborations within meta-organizations. This partially validates Proposition 1 from the first essay, though we are not able to link boundary exclusivity directly to the contingency of environmental munificence. In turn, the case of Company X shows how niche specialization and standardizations of collaboration routines enable successful performances in a meta-organization. The availability of links to multiple types of specialists, ranging from business planners, mentors to investors, aided Company X throughout the different stages of its development. This supports the validation of the co-specialization aspect of Proposition 2, though we were not able to link this aspect to environmental dynamism.

The success of Company X also illustrates the advantages to standardize collaboration routines for meta-organizations. The research park team provides the start-up company with a well-established path of collaborations with different parties that is able to foster its rapid development in the research park. At the same time, the failure of Company Y also illustrates the disadvantages of standardizing collaboration routines under a different context. Although Company Y has access to the same paths of collaborations, it did not succeed mainly because the research park team did not understand the unexpected environmental complexity of the new industry for Company Y. The joint observations of Companies X and Y together serve to validate Proposition 3 that links successes to the standardization of collaboration routines to the contingency of environmental complexity. The organizational changes to the research park in the aftermath of Company Y's departure also illustrate the links between coordination resources and meta-organizational mission scope. The tie-up and establishment of the Gaming Institute increases coordination resources and mission scope for the meta-organization, and provides new

start-ups in digital media with improved performance potential. This finding validates Proposition 5b from the first essay. Finally, the case of Project Z provides limited but clear empirical observations of transient collaboration groups in operation. The interaction of different types of collaborators to improve overall performance in the Dandy's meta-organization also supports the validation of the co-specialization aspect of Proposition 2.

The study also provides consideration for new research areas in the transient collaboration topic. The study uncovers the existence of multiple types of boundaries within a meta-organization, and the types of collaborations that take place across these boundaries. This suggests that boundary structures in meta-organizations can be more complex and multi-dimensional than previously thought. The case study also validates the critical role of the network facilitator to manage governance in a meta-organization. In particular, the case shows that the role of the network facilitator to direct the long-term growth and development of a meta-organization requires more investigation. Validation for the remaining propositions in the theoretical essay requires additional empirical study and methods.

6. TRANSIENT COLLABORATION MODEL: NETWORK COLLABORATION STRUCTURES

6.1. Introduction

The purpose of this essay is to examine how different structures within transient collaboration meta-organizations may perform for given environmental factors. Companies may seek to mitigate uncertainty and volatility in their environments through collaboration efforts with their partners. However, different meta-organizational structures for collaboration are possible, and it is not clear if certain structures are more efficient in different environments. Prior observations have shown a range of transient meta-organizational structures. For instance, the Li & Fung example exhibits a highly centralized structure where both suppliers and customers are coordinated by a single hub company (Magretta & Fung, 1998). In contrast, the Shanzhai example shows a loosely decentralized structure of multiple emergent networks that are not dominated by any one company (Noori, 2009; Tse et al., 2009). It is important to understand the effects of such differences, especially with regard how these may relate to the performance of individual companies as well as to the overall performance of the meta-organization as a whole. By understanding and designing their collaboration structures appropriately, organizations could build dynamic capabilities that will create new competitive advantages for them over time (Teece et al., 1997).

The nature of collaborations gives rise to complex interaction links that are often difficult to observe and quantify. This is more so in the case of transient collaborations with links that can change from project to project even within a same overall group of partners. It is not easy or

even possible to obtain complete empirical data that can capture all possible combinations of network structures and market environments. Given the above constraints, a simulation will be a suitable method to investigate transient collaboration structures by replicating the performances of companies collaborating under different environments, and to obtain data for analysis. The simulation method is in line with other research efforts to simulate the decision-making process in company networks (Renna, 2013; Persson & Olhager, 2002). The simulation program develops a game of life scenario whereby individual companies make decisions to compete or collaborate with one another to service market demands. In this essay, we focus on the different entity types that constitute meta-organizations, and the task environment contingency of dynamism.

The organization of the remainder of the essay is as follows; Section 6.2 describes the simulation details and assumptions, while Section 6.4 describes the observations. Section 6.5 discusses the findings, and Section 6.5 covers limitations. Section 6.7 provides the conclusion to the study.

6.2. Simulation Model

6.2.1. Setup and Assumptions

The simulation consists of a market that periodically generates demands at random intervals that require particular types and volume of resources for fulfillment, and companies that act to fulfill these demands in return for capital. Each company may hold different types and numbers of resources, and each company continuously consumes capital to maintain these

resources. Depending on their company type, companies can seek to serve market demands by using internal resources, by using external resources by collaborating with other companies. A company can scan past market demands for the most popular resources, or spent capital to build and add these resources into its portfolio. A company can also choose to divest itself of underutilized resources to reduce its resource maintenance costs. Companies also scan and evaluate the resource base of other companies to decide on their offer price to service demands. For each demand, the market will evaluate the price quote and offering company, and award the demand to a winner. A company can scan the assets and performances records of other companies to decide if they will make desirable collaboration partners. All companies possess memories of past collaborative interactions with other companies, and whether these result in either successful or unsuccessful collaborations, and that can be use to weight their decision-making process. Each company makes a go or no-go collaboration decision for each new demand requirement.

The simulation model ran each model for different rates of environmental stability, ranging from 99% to 0% stability. The stability parameter operates on changes to the resource requirements for each demand in the following period. Initially, the market generates a new demand with random resource requirements. The simulation then uses the stability factor to weight the previous demand resource requirements, uses the converse of the stability factor to weight the new demand resource requirements, and then takes the average as the new demand's final resource requirements. Therefore, the probability of each resource appearing as a part of a demand requirement is set to range from being completely random in each period to reflect

complete instability, to completely following the prior demand requirement in one period earlier to reflect complete stability, with values in between for intermediate states of volatility. A setting of 0% stability ensures that each new demand is completely random in terms of resource requirements, while a setting of 99% stability means very minor change to any demand's resource requirements from one period to the next.

6.2.2. Resource Types

The simulation uses two types of resources throughout a run. Companies will deploy production resources to fulfill demands that arise from the market. There are five unique types of production resources, and a production company may possess a variable number or none of each type of production resource. There are no special meaning attributed to the five types of production resource, but they could be considered as similar to assets such as labour, capital assets, facilities, patents etc. that companies deploy to meet various customer requirements. The reason to have different types of production resources is to simulate resource variance by both number and type among companies, as a company that possesses many units of one production resource type may still lack sufficient number of another production resource type. The existence of different types and different volumes of resources among companies also reflect real-world conditions.

Aside from production resources, some companies possess the coordination resource used to coordinate a collaboration group. The coordination resource is similar in concept to a management resource needed for the supervision and coordination of production. The

coordination resource is not a productive resource by itself, as there is no customer demand for it. However, in the simulation, at least one coordination resource must be present to deploy production resources to meet demand, even if a company serves the market directly and does not collaborate with any other companies. Each additional company added into a collaboration group will need to have an additional coordinate resource deployed. Both production and coordination resources require maintenance upkeep costs in each period. Companies may also build or dispose of both production and management resources depending on their assessment of projected demand patterns and availability of capital. The resources exist in different phases in the simulation. A company may hold ownership of certain resources, but not all its owned resources are equally available for deployment at all times. Resources are sometimes not currently available because they are already committed for a demand bid, or are committed to an existing collaboration group, or are committed to serve an on-going demand. In addition, new resources on order are not available until the delivery time. A company may own many resources, but if all these resources are committed as above, and if the past demand pattern suggests the requirement to have more available resources, then the company will build additional resources.

6.2.3. Company Types

Section 4 describes how three entities in a meta-organization perform different functional roles. The three entities are the network facilitator, the hub company and the production agent company. The current simulation did not cover the role of the network facilitator, as the focus is not on meta-organizational governance. As for the hub and agent entities, because it is possible for individual companies to combine both roles simultaneously in different ways, the simulation

creates five types of companies. Figure 6-1 lists the characteristics of the different company types.

- **Hub** – A Hub company possesses only coordination resources, and does not possess any production resources of its own. This type of company only has the ability to coordinate other agent companies in a collaboration group.
- **Agent** - An Agent company possesses only production resources, and does not possess any coordination resources. It can offer its production resources for deployment to a collaboration group, but cannot coordinate itself or other agent companies to fulfill demands.
- **Internal** - This type of company own both production and coordination resources. It can internally coordinate its own resources to fulfill demands, and can offer productive resources to a Hub company for deployment in a collaboration group. However, an Internal company cannot coordinate the production resources of other agent companies to fulfill demands.
- **Hybrid** - This type of company is a Hub and Agent company combined. It owns both production and coordination resources. It can coordinate its own resources to fulfill demands, and to offer production resources to a Hub company for deployment in a collaboration group. A Hybrid company can also act as a Hub to coordinate other agent companies to fulfill demands.
- **Standalone** – This type of company does not participate in any collaboration. It possesses both production and coordination resources, but it can only coordinate its own resources to fulfill demands. Standalone companies are not a part of a meta-organization.

Their role in the simulation is to act as the baseline group to compare the performance of other types of companies operating in identical environments.

Figure 6-1: Characteristics of the Entity Types

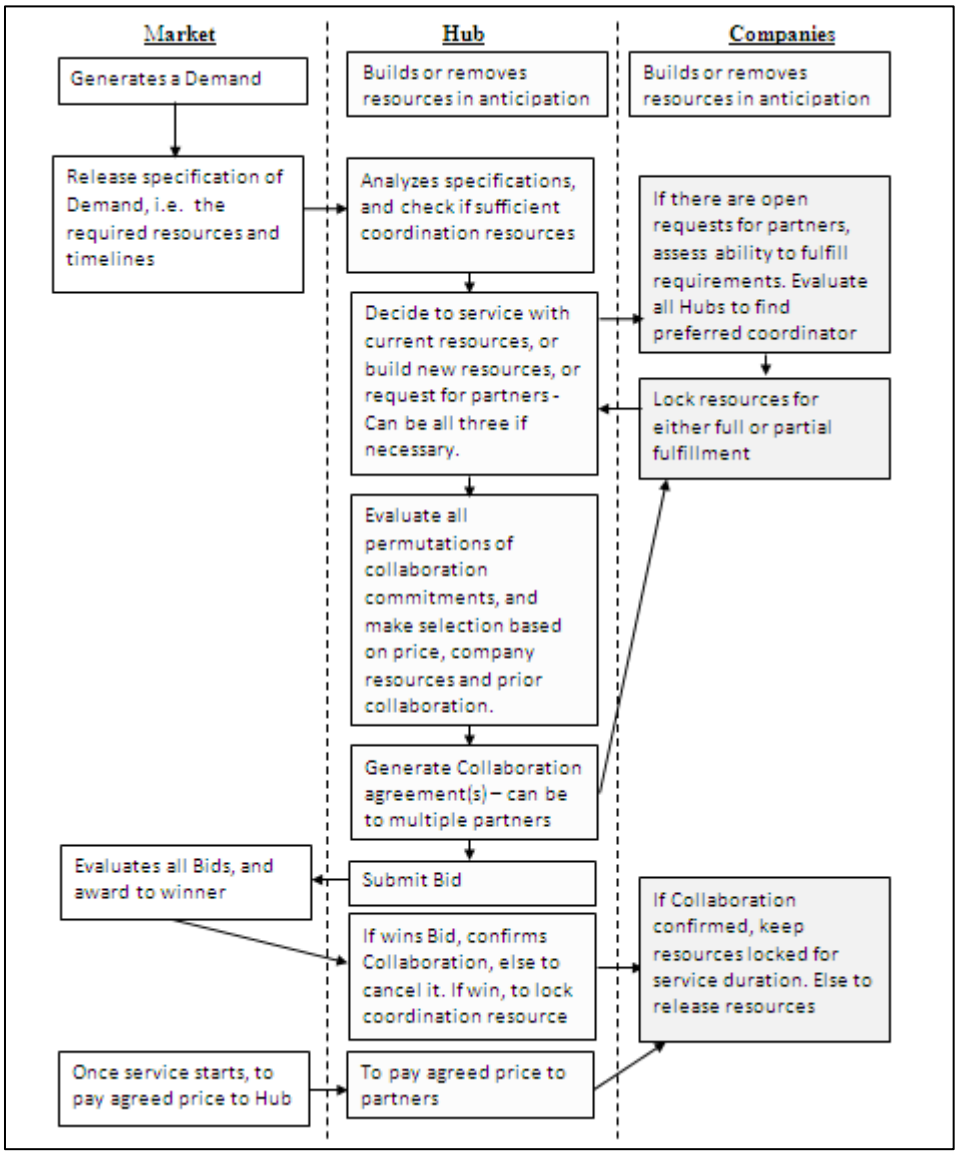
Characteristics / Entity Type	**Coordination Resources**	**Production Resources**	**Be Coordinated** (Act as Production company for another Hub)	**Coordinate Others** (Act as Hub)	**Coordinate Itself** (As Self-Hub and Self-Production)
Hub	Yes	No	No	Yes	No
Agent	No	Yes	Yes	No	No
Internal	Yes	Yes	Yes	No	Yes
Hybrid	Yes	Yes	Yes	Yes	Yes
Standalone	Yes	Yes	No	No	Yes

6.2.4. Events Flow

The simulation is cyclic, with all entities going through decision routines in each period. The fundamental task for the companies is to fulfill demands by generating matching sets of resources with through internal or external means. Figure 6-2 illustrates the main flow of events of how a hub company may respond to a demand, draw in collaborators, and bid to serve the demand. The market awards the winner of a bid with a contract to service the demand. Other routines in the simulation flow allow companies scan past demand patterns to determine what type of resources, and the number of resources, they should build in anticipation. Based on the same scan, companies can also remove long unused resources to save on maintenance costs.

Companies also compare their resources with the resources of their fellow companies, and set sale prices depending on the number of identical resources in the field. The simulation also keeps track of when companies order the building of new resources, and delivers the new resources to these companies at the end of their respective build time.

Figure 6-2: Flow to show Links among Market Demand, Hubs and Collaboration Companies



6.2.5. Models

The simulation runs five basic models to examine how various company types with different collaboration structures perform as the environment vary from static to dynamic states. Each model runs by itself and consists of a group of ten companies operating in a repeated

market environment. At the beginning of the run, every company is identical with any difference due only to its particular type characteristic. Every run lasts 200 periods, with convergence by 100 iterations. The reason for setting 200 periods is that the longer the number of periods, the more the differences will grow among the companies and meta-organizations. Due to random change for early advantage, some companies grew to become much larger over time, while other companies dropped out from the simulation when they ran out of capital. These are normal outcomes from any game of life simulation, and represent interesting results. However, in this essay, the focus is on the performance effects from the structural setup of a meta-organization. Setting a fixed common run of 200 periods allows the trends operating across different models to be observable, but before these trends alter the nature of the models. The simulation runs five initial models as described below. Figure 6-3 lists the respective numbers of entity types for each model.

1. **"Standalone"** – All the companies in this model are of the Standalone type. They operate within the same market environment, but never enter into collaborations with one another. This is the base case of a model where no members engage in collaborations.
2. **"Hybrid" –** All the companies in this model are of the Hybrid type companies. This model represents the earlier stages of a Shanzhai network, when all members are equally able to coordinate themselves and other companies.
3. **"Hub & Agent"** – In this test model, there are two Hub type companies, and eight Agent type companies. This model represents the case where there exists a clear line of division

between the coordinative and productive functional roles in a meta-organization such as the Li & Fung network.

4. **"Hub & Internal"** – There are two Hub type, and eight Internal type companies for this model. This model is a variation on the third model. It represents the case when some members in a meta-organization are performing just all-coordination roles, but at the same time, the other members are also able to coordinate themselves in the later stage of a Shanzhai network.
5. **"Mixed"** – The entities in this composite model consist of two Hub type, three Agent type, three Internal type, and two Hybrid type companies. This is a test case to assess the situation when multiple types of companies exist within a single meta-organization.

Figure 6-3: Numbers of Entity Types in each Model

Entity Type / Models	Hub	Agent	Internal	Hybrid	Standalone	Analog
"Standalone"	0	0	0	0	10	Non-Collaborators
"Hybrid"	0	0	0	10	0	Shanzhai
"Hub & Agent"	2	8	0	0	0	Li & Fung
"Hub & Internal"	2	0	8	0	0	Later Shanzhai
"Mixed"	2	3	3	2	0	Composite of above

6.2.6. Measures

Performance measures typically have multi-dimensional aspects as different organizations possess different yardsticks by which to measure success. The simulation tracks

meta-organizational-level and company-level indices to evaluate performance success. At the meta-organizational level, the assessment is on the joint ability of the group of companies to fulfill demand from the market. The first measure is on the total number of demands served versus those not served. The second measure compares the value of the total number of demands served versus those unserved. Both of these measures are ratios that are comparable across the different models.

At the company-level, the assessment is on the possession of capital by a given company type. Every company starts with the same level of capital, and the level of capital at hand provides an indication of their performance level over time. The measure is an average of current capital divided by original capital by company type. In this simulation, because the rate of return is set to an arbitrary low value for all companies, the ratio is generally less than one. The evaluation of all these measures is only possible through comparison with other companies in the simulation. The measure of coefficient of variance of current capital shows individual company differences in capital level within each company type. Finally, the success rate of collaborations measure shows the ratio of collaborations that succeed against attempted collaborations that did not end in a contract.

6.2.7. Simulation Program

No software programs or packages found and evaluated could simulate the decision-making processes of companies engaged in transient collaborations. As such, this requires the coding of a new simulation program to suit the purpose. The language is Python 3.3, the editor is

Wing-IDE101 and the compiler is Cython via MINGW. Appendix C lists the main routines of the simulation program together with a description of their functions and activation occurrences.

6.3. Simulation Validation

Validation is an important part for any simulation to ensure that the results can reflect real-world experiences. A major difficulty in this study is the lack of sufficient secondary empirical data in transient collaboration operations with operational and performance data that can provide direct comparisons for validation purposes. To overcome this difficulty, the study follows a three-stage means of validation. In the first stage, consultations with academic experts ensure that the premise of the simulation has face validity. This includes presentations to academic audiences to gather feedback on critical points to address in the study. In the second stage, earlier theoretical work on the subject, the field observations and case study provide guidance to establish the entities, relationships and parameters to strengthen internal validation of the simulation. This includes the identification of the functional roles of the relevant companies and resources types.

In the third stage, the program design adopts a minimalist approach to create a simple simulation setting stripped of all other elements except for a set of companies and demand requirements. The only study factors built into this setting are the ability or inability of companies to act to collaborate or to coordinate collaborations, and the variance rate of demand requirements. The idea behind this design approach is that although the actual operations of real-world transient collaborations are not sufficiently visible for complete replication through

simulation, the purpose of this study does not require complete replication. The study aims only to assess the different performance outcomes of alternate structures of transient collaborations under environmental dynamism. By simulating the elementary setting as a base case, the study can then obtain useful data of any differences to performance through direct comparison of other settings with the study factors included or excluded as per the models. Though perhaps not ideal, this approach can still serve to provide useful data and insights about transient collaboration performances otherwise not available.

6.4. Results

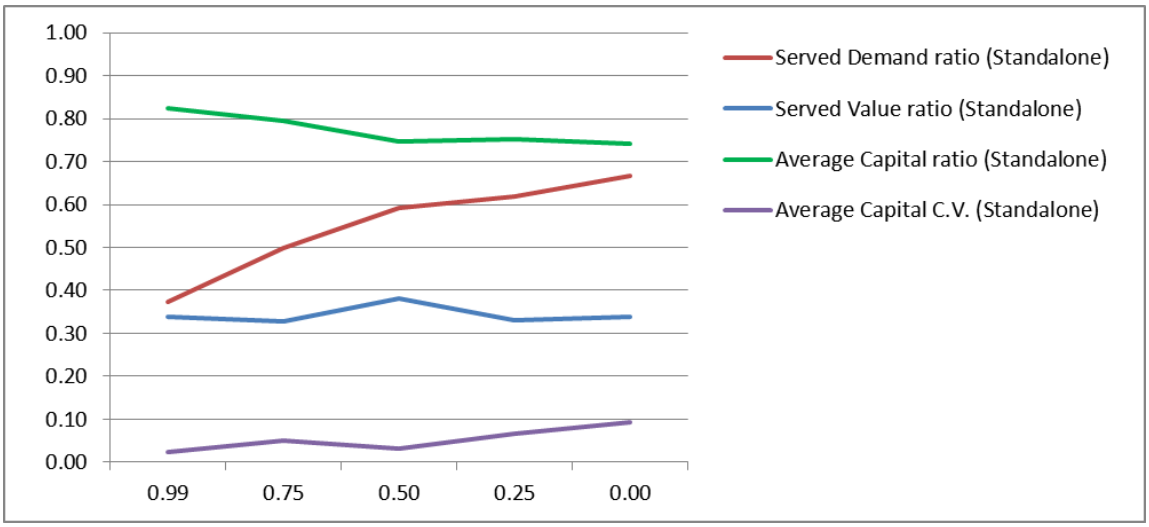
6.4.1. Standalone Model

The Standalone model run shows an unexpected result in that the Served Demand ratio has an inverse relation to the stability factor. Please refer to Table 6-1 and Figure 6-4. The ratio rises from 0.37 to 0.67 across the board as stability decreases from 99% to 0%. The Served Demand ratio refers to the number of successful contracts awarded to companies in the group as compared with the number of Demands generated from the market. If market requirements are stable and predictable, the expectation is that companies will be able to easily predict demand patterns and thereby increase the demand fulfillment rate. This is true even in the simulation because the routine allows companies to build new resources or remove unused ones to match the prevailing market demand pattern.

Table 6-1: "Standalone" Model Results

Stability Rate	99%	75%	50%	25%	0%
Served Demand ratio	0.37	0.50	0.59	0.62	0.67
Served Value ratio	0.34	0.33	0.38	0.33	0.34
Average Capital ratio	0.82	0.80	0.75	0.75	0.74
Average Capital C.V.	2.36%	5.04%	3.06%	6.59%	9.28%

Figure 6-4: "Standalone" Model Results in Graphs



An analysis shows that the underlying reason for the low fulfillment rate in a stable environment is that the simulated companies each behave in exactly the same way after they observe a stable demand pattern. Each company now builds the same sets of resources in advance to serve a predictable market. When the market generates a demand, every company is now equipped to bid, and does bid, for the right to service that demand. The simulation rules require that a company that issue a formal bid for a demand to set aside a set of resources

necessary for handling that bid if awarded. Every time a demand appears, every company that can do so issues a bid, and thereby locks that part of its resources. During the waiting duration before that demand's award time, which is a random number of periods, other demands could appear but now these will go unbid for because no company now has sufficient resources left unlocked. In the real world, companies may not immediately lock-in all required resources while bidding for a potential project. However, many companies do have a practice of setting aside assets in anticipation of some potential project. If that said project did not materialize in the end, the assets might have missed the opportunity for deployment to another project. The consistent execution of routines in the simulation, and the identical behavior of each company in the model serve to make this effect more obvious.

As stability decreases, the Served Demand ratio increases because the companies in the Standalone model respond to demand variance by expanding their resources mix to build more types and volumes of resources. This directly serves to improve their ability to fulfill variable market demands. An aspect of decreased stability is that fewer companies will bid for the same demand, as not all companies may possess the right mix of resources at that time. This has the consequence that when another demand came randomly, those uncommitted companies now have the opportunity to bid and win the new demand, and so increase the Served Demand ratio for the whole group. However, standalone companies incur higher costs to build and maintain all the new resources. Their overall average capital ratio decreased from 0.82 to 0.74 with decreasing stability. At the same time, the C.V rate also increased from 2.36% to 9.28%, showing more variation to the individual companies' relative performances from their increasing

differentiated success at capturing the more variable demands. The Standalone model illustrates the thoroughly competition nature of this group of companies, where each company strives alone to serve the entire market. Though not directly illustrative of a meta-organization, the Standalone Model generates useful insights into some of the possible challenges and costs for companies that do not engage in collaborations, and provides a performance baseline to measure the other models.

6.4.2. Hybrid Model

The Hybrid model represents a collaborative meta-organization where every member has the ability to perform both Hub and Agent roles. The model results as per Table 6-2 and Figure 6-5 show a higher Served Demand ratio at all levels of stability as compared with the Standalone model. In a stable environment, Hybrid companies still exercise the same fundamental behaviour pattern as the Standalone companies in that they will all build identical resource sets and bid for the same demands. However, the Hybrid companies can now also pool together even small units of unlocked resources to serve any other demand that arises randomly. This ability increased the overall Served Demand ratio, and the Served Value ratio for the Hybrid Model compared with the Standalone Model as shown in Figure 6-6. As stability decreases, the effect increases for the Served Demand ratio because the more differentiated demands provide more opportunities for the companies, through engagement in collaboration groups, to deploy every available resource. However, the Served Value ratio decreased from 0.61 to 0.43 as stability decreases. In a more unstable environment, it is easier for companies to capture demands with lower rather than higher resource volumes. This is because in a stable environment, the type of resource is

predictable regardless of resource volume, but in an unstable environment, variation is across both type and volume of resources. This result in the decrease to the Served Value ratio, though the Hybrid model still outperforms the Standalone model at the 0% stability rate because of their ability to collaborate.

Table 6-2: "Hybrid" Model Results

Stability Rate	99%	75%	50%	25%	0%
Served Demand ratio	0.65	0.63	0.69	0.68	0.74
Served Value ratio	0.61	0.49	0.48	0.42	0.43
Average Capital ratio	0.44	0.43	0.38	0.33	0.41
Average Capital C.V.	9.71%	12.81%	15.45%	21.85%	14.53%
Collaboration Success ratio	0.22	0.21	0.19	0.17	0.14

Figure 6-5: "Hybrid" Model Results in Graphs

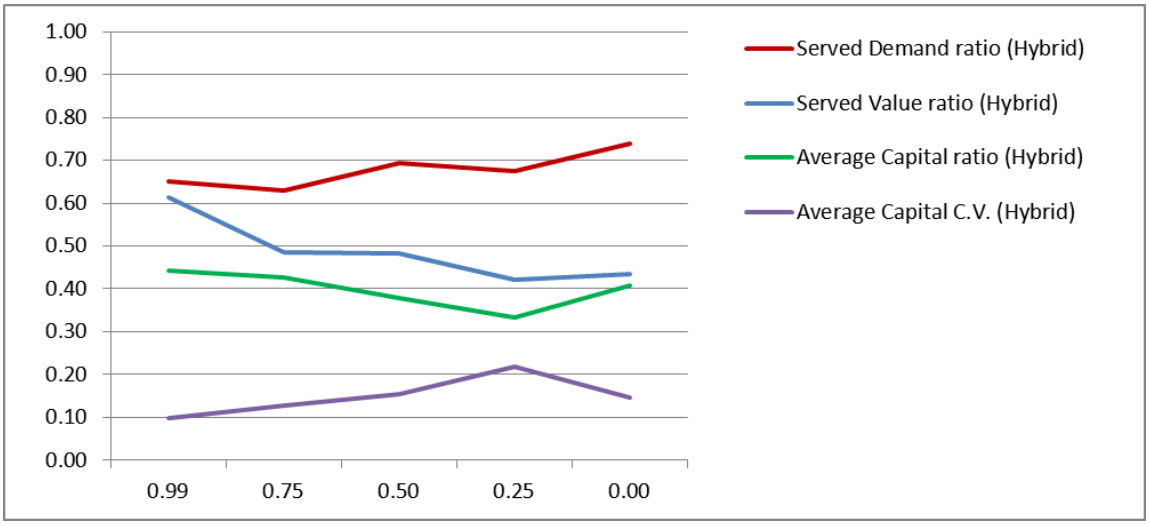
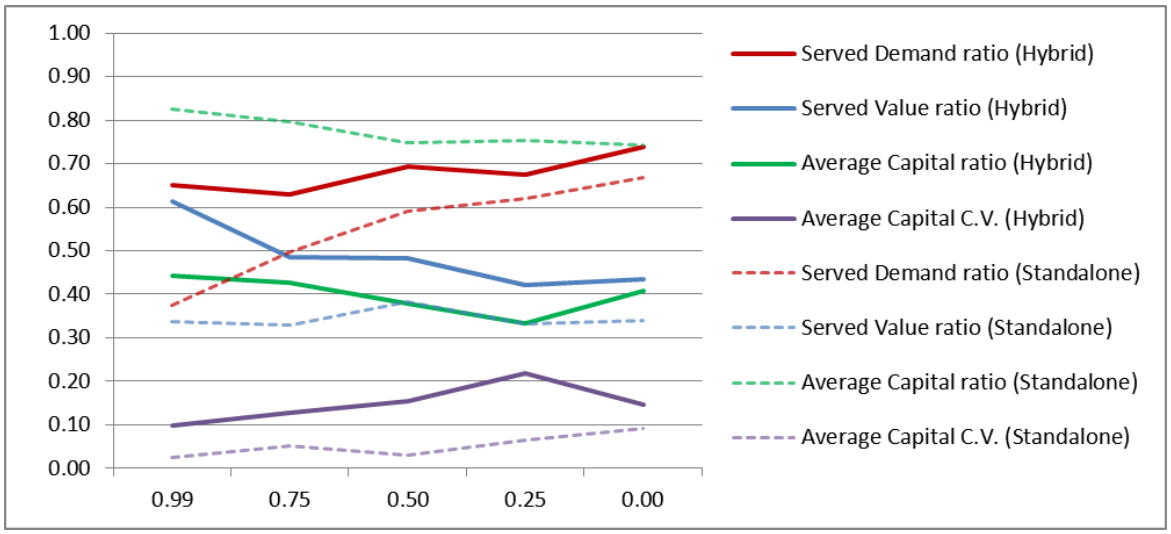


Figure 6-6: "Hybrid" and "Standalone" Models Results in Graphs



The increased ability of the Hybrid companies to fulfill demands also means additional investments of capital to build and maintain resources. Their average Capital ratio is consistently low at all levels of stability. It is also striking that their C.V rate is also relatively higher throughout. The individual differences to their capital levels arise because repeated collaborations among some companies provide more advantage to them over their peers. As stability decreases, the number of opportunities for collaborations increases which will result in more collaboration attempts. However, the rate of collaboration success does not increase because the total number of successful collaborations did not increase as fast as the number of collaboration opportunities. The Hybrid model shows that group collaborations do not always equate to equal successes for all members. It also illustrates how transient collaboration can create more opportunities for companies to fulfill market requirements and thereby maximize their resource utilization. For instance, even companies with a single unused resource can now have a chance to deploy that resource for fulfillment by sending it to a Hub company. This model shows only the results from engaging in transient collaborative behavior but does not show if it is

necessarily profitable or beneficial for companies to do so. The assumption is that real-world companies will only engage in transient collaborations to achieve beneficial transactions, and will avoid unbeneficial ones.

6.4.3. Hub & Agent Model

The Hub & Agent model results as per Table 6-3 and Figure 6-7 show unexpectedly low Served Demand and Served Value ratios across all levels of stability. The reason for this low performance is partially an artifact of the simulation, and partially reflective of actual companies interactions.

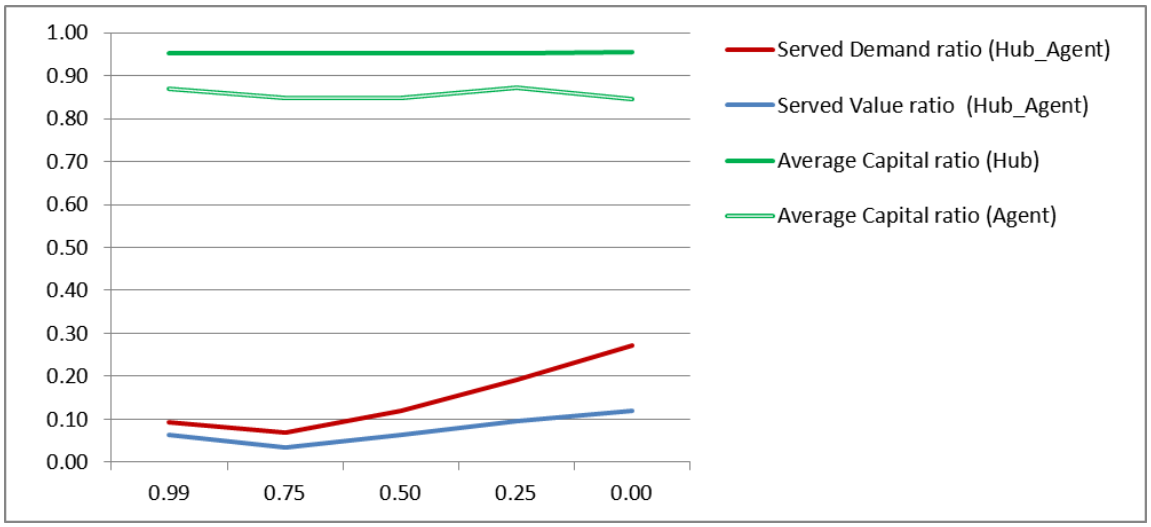
In this model, both Hub and Agent companies cannot fulfill demand unless they do so through collaboration with at least one other company of a different type. This introduces a constant inefficiency to the ability for both types of companies to conduct resources search and match. Though both Hub and Agent companies seek mutual collaborations, the right match to meet a demand requirement may not always occur. An Agent company may have its resources already locked up by a Hub company, or a Hub company may have its coordination resource locked up by its Agent companies because of a prior bid when a fresh demand appears. This inefficiency is particularly marked when the environment is stable because all resources ended up locked in the same queues to bid for the same demands. When the environment becomes less stable, as with the other models, variance to demand requirements and to the Agent resource bases makes it less likely for all companies to attempt to bid for all the same demands. This

serves to increase the Served Demand and Served Value ratios, though these are still much lower than the ratios in the earlier models.

Table 6-3: "Hub & Agent" Model Results

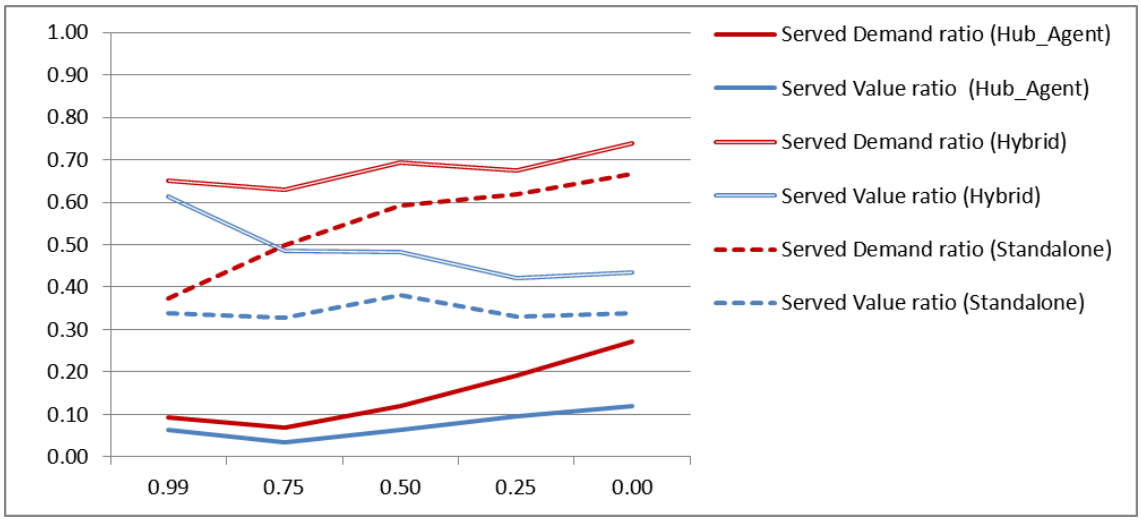
Stability Rate	**99%**	**75%**	**50%**	**25%**	**0%**
Served Demand ratio	0.09	0.07	0.12	0.19	0.27
Served Value ratio	0.06	0.03	0.06	0.10	0.12
Average Capital ratio *(Hub)*	0.95	0.95	0.95	0.95	0.95
Average Capital C.V. *(Hub)*	0.15%	0.10%	0.17%	0.19%	0.29%
Average Capital ratio *(Agent)*	0.87	0.85	0.85	0.87	0.84
Average Capital C.V. *(Agent)*	1.18%	0.78%	1.51%	1.14%	2.42%
Collaboration Success ratio	0.71	0.75	0.80	0.75	0.78

Figure 6-7: "Hub & Agent" Model Results in Graphs



The higher average capital ratios for the Hub and Agent companies are simply a reflection of this inefficiency, and do not denote performance success. These companies have a high average capital ratio because they have unused resources available, and therefore did not expend capital to build new resources. In this respect, the Standalone and Hybrid companies more aggressive abilities to build new resources and deploy them to increase the demand fulfillment rates are better reflective of expected entrepreneurial behavior as shown for comparison with the Hub & Agent model in Figure 6-8. The Hub & Agent model also suggests that a meta-organization with clearly divided coordination and production roles will require additional strategic oversight and coordination to prevent inefficient resource allocation. This is the indeed the case of some such meta-organizations observed in the field where a dominant hub strategically manages a whole network of independent supplier companies (Magretta & Fung, 1998).

Figure 6-8: "Hub & Agent", "Hybrid" and "Standalone" Models Results in Graphs



6.4.4. Hub & Internal Model

The Hub & Internal model modifies the Hub & Agent model by substituting the Agent companies with Internal companies that could self-coordinate to fulfill demand, but that could not serve as hubs to coordinate other companies. The results as listed in Figure 6-4, Figure 6-9 and Figure 6-10 show that the Served Demand ratios compare well against the Hub & Agent model, and are similar to those found in the Standalone model.

Table 6-4: "Hub & Internal " Model Results

Stability Rate	**99%**	**75%**	**50%**	**25%**	**0%**
Served Demand ratio	0.40	0.45	0.58	0.62	0.66
Served Demand Ratio (Hub)	*0.05*	*0.05*	*0.07*	*0.11*	*0.12*
Served Demand Ratio (Internal)	*0.35*	*0.40*	*0.51*	*0.52*	*0.54*
Served Value ratio	0.36	0.33	0.36	0.32	0.32
Average Capital ratio *(Hub)*	0.95	0.95	0.95	0.95	0.95
Average Capital C.V. *(Hub)*	0.11%	0.11%	0.14%	0.15%	0.17%
Average Capital ratio *(Internal)*	0.83	0.81	0.78	0.75	0.74
Average Capital C.V. *(Internal)*	4.19%	6.36%	7.15%	11.03%	10.93%
Collaboration Success ratio	0.83	0.81	0.80	0.72	0.59

Figure 6-9: "Hub & Internal" Model Results in Graphs

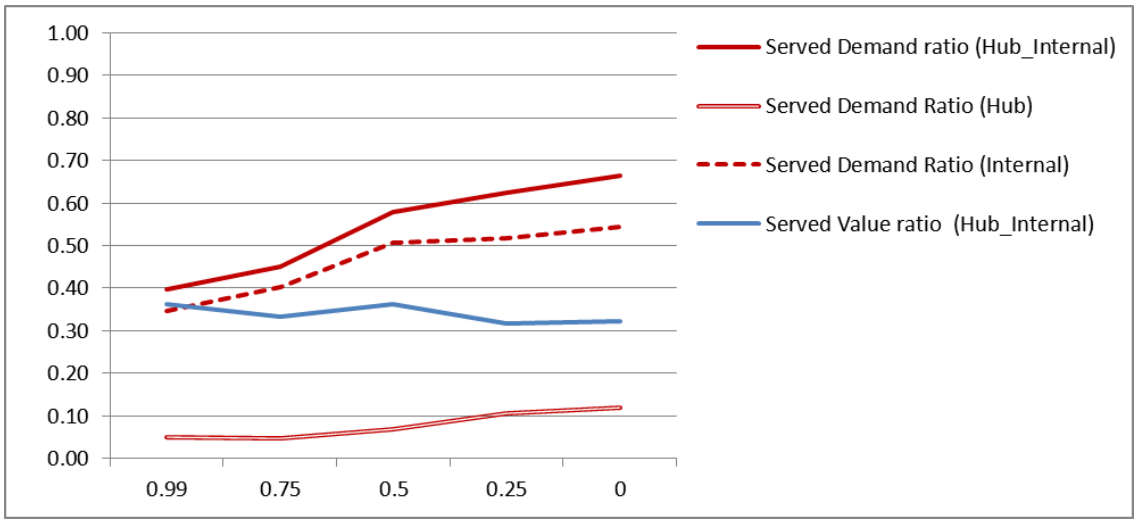
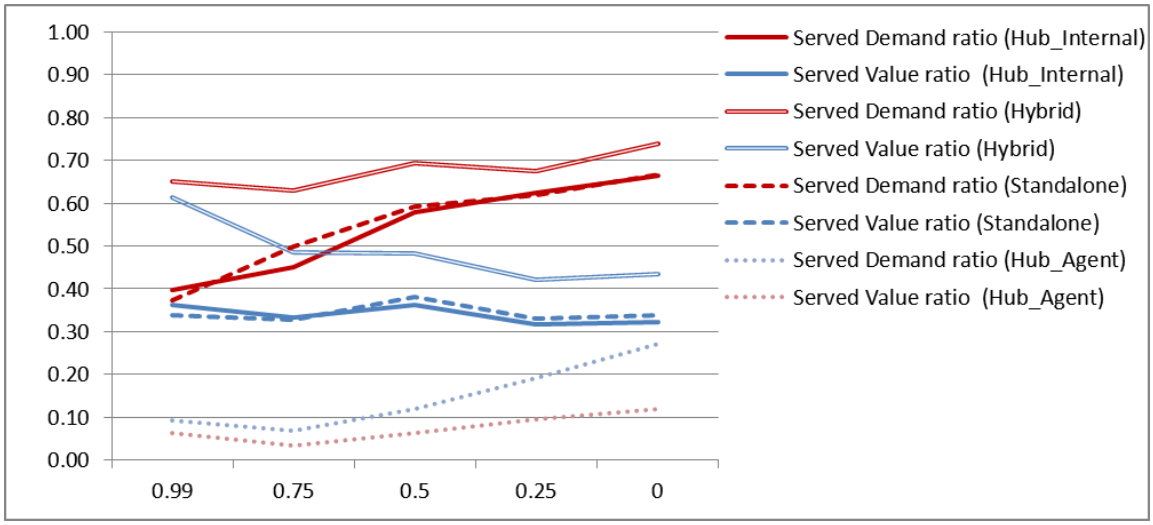


Figure 6-10: "Hub & Internal", "Hybrid", "Standalone" and "Hub & Agent" Models Results in Graphs



The main difference to the Hub & Internal model is that it achieves these comparable results even though the meta-organization starts with 20% less productive resources and capital than the Standalone model, and continues with 20% less productive agent companies throughout the simulation. The reason for the more efficient utilization of resources is the added presence of

the Hub companies. Randomly, the situation might arise when a demand appears in the market that none of Internal companies could serve by itself. For instance, each Internal company may have available only a part of the complete resource requirements. Though the Internal companies do not collaborate directly with one another, if such a demand appears, a Hub company could detect it and issues a collaboration invite to the companies. Therefore, these different Internal companies can still come together through indirect collaborations via a Hub to service the demand. This maintains or increases the Served Demand ratio, and increases the efficient utilization of the Internal companies' resources. Table 6-4 and Figure 6-9 show the Served Demand ratio sub-divided into Hub and Internal components by the number of contracts held by company type. These ratios show that as stability decreases the Internal companies are able to maintain the demand fulfillment rates by increasing their reliance on the Hub companies to combine and deploy unused and available resources. This model suggests that with the appropriate collaboration structure within a meta-organization, transient collaborations can provide more efficiency than non-collaboration operations, and that such performance may not require the establishment of an overall strategic management of the meta-organization.

6.4.5. Mixed Model

The Mixed Model puts together different collaborative company types into the same meta-organization to test their interactions in terms of performances. The results in Table 6-5, Figure 6-11 and Figure 6-12 show that the overall Served Demand and Served Value ratios are high across different levels of stability and are comparable with those in the Hybrid model. In effect, the Mixed Model is more efficient than the Hybrid model because it can produce comparable results with a start of 20% less production resources and 20% less capital, and continues with 20% fewer companies with productive resources. Table 6-5 and Figure 6-11 show the Served Demand ratio sub-divided by company type into Hub, Internal and Hybrid components. The Hub component shows that Hub companies only take the lead to be the hub to coordinate a minority of the successful projects. The more interesting result shows that when the environment is stable, the Hybrid companies have more success at taking the lead to be the hub to coordinate contracts, but as the environment becomes less stable, their performance declined, and the Internal companies become more successful.

Table 6-5: "Mixed" Model Results

Stability Rate	**99%**	**75%**	**50%**	**25%**	**0%**
Served Demand ratio	0.62	0.59	0.69	0.70	0.78
Served Demand Ratio (Hub)	*0.04*	*0.03*	*0.05*	*0.07*	*0.09*
Served Demand Ratio (Internal)	*0.15*	*0.20*	*0.27*	*0.34*	*0.44*
Served Demand Ratio (Hybrid)	*0.43*	*0.37*	*0.37*	*0.30*	*0.26*
Served Value ratio	0.58	0.45	0.47	0.42	0.46
Average Capital ratio *(Hub)*	0.95	0.95	0.95	0.95	0.95
Average Capital C.V. *(Hub)*	0.08%	0.07%	0.08%	0.13%	0.18%
Average Capital ratio *(Agent)*	0.85	0.84	0.85	0.85	0.83
Average Capital C.V. *(Agent)*	1.05%	1.06%	0.87%	0.78%	0.79%
Average Capital ratio *(Internal)*	0.83	0.81	0.83	0.80	0.78
Average Capital C.V. *(Internal)*	3.47%	3.64%	4.98%	8.38%	7.33%
Average Capital ratio *(Hybrid)*	0.49	0.44	0.44	0.40	0.38
Average Capital C.V. *(Hybrid)*	7.59%	12.83%	13.23%	15.78%	16.52%

Figure 6-11: "Mixed" Model Results in Graphs

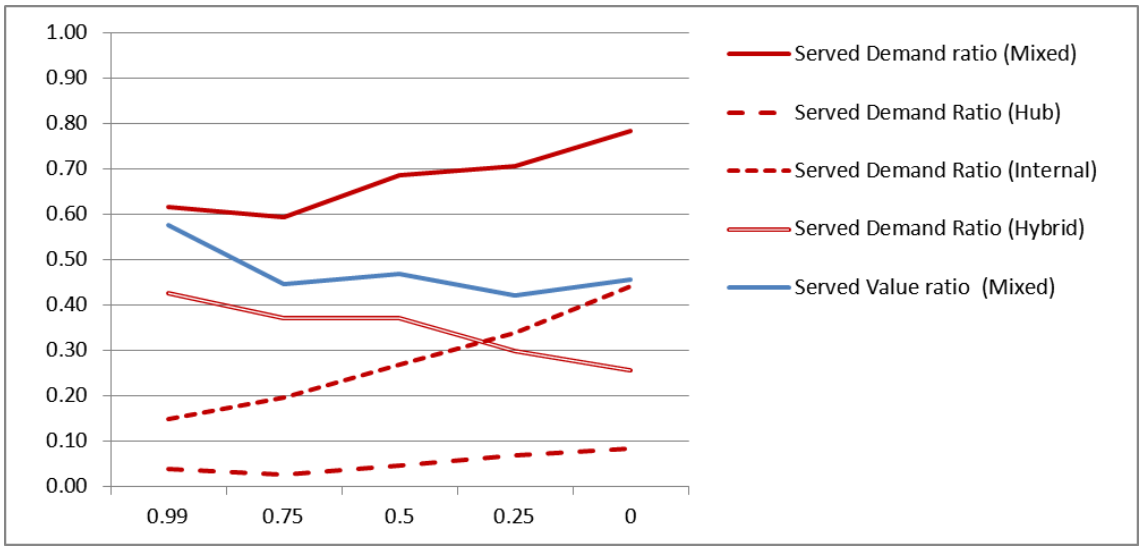
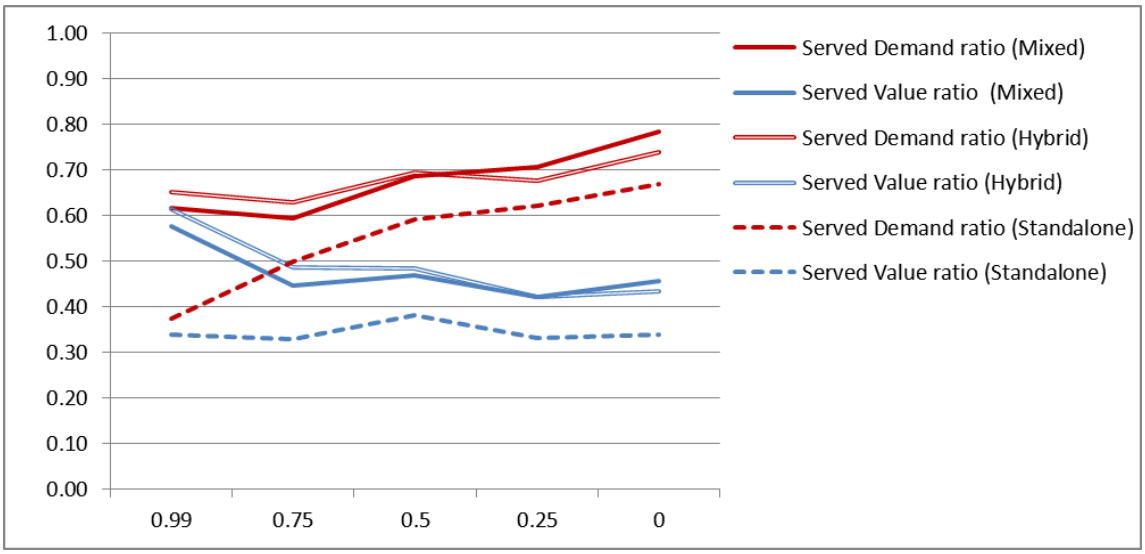


Figure 6-12: "Mixed" Model, "Hybrid" Model and "Standalone" Model Results in Graphs.



The explanation for this contrasting performance lies in the respective approaches that these companies take to bid for demands. Where possible, both types of companies will bid to serve any available demand, but because the Hybrid companies can act as Hubs, they can seek for additional resources through collaborations, and thereby bid for relatively more demands.

This is not the case for the Internal companies as they can only bid to serve demands for which they already have resources available. The Internal companies can only provide spare unused resources to Hub type companies, including the Hybrid companies in this model. The ability of the Hybrid companies to attempt bids across relatively more demands is a double-edged sword. In a stable environment, it is advantageous because the Hybrid companies can simply build large numbers of the appropriate resource types to help support their multiple bids for demands. However, as stability decreases, Hybrid companies will no longer have internal resources that are always appropriate to serve newly arriving demands. The Hybrid companies will still attempt to bid for all demands, and will still seek collaborators. However, this also means that the Hybrid companies are locking in their now limited internal resources, and this will in turn limit their abilities to bid for new changeable demands. Internal companies avoided this situation simply because they cannot act as a Hub. In stable environments, this is a disadvantage because they can only place a limited number of bids for demands. When stability decreases, this built-in forbearance becomes advantageous because the Internal companies do not deploy out all their resources to every demand in sight. This indirectly provides them with the reserved ability to bid and win a new demand that arrives later.

6.4.6. Additional Models

The results from the interaction of these two company types in the Mixed Model suggest that they can complement each other to raise overall performance in the same meta-organization across different levels of stability. To test this possibility, the simulation runs two other models described below, and with their numbers of entity types shown in Figure 6-13 below;

1. **"4x4"** – This model has four Hybrid type companies, and four Internal type companies. This model has eight companies with production resources so that the results may be comparable to the Mixed model, which also has only eight companies with production resources.
2. **"2x6" –** This model has two Hybrid type companies, and six Internal type companies. This model tests if varying the proportion of company types may result in performance changes.

Figure 6-13: Numbers of Entity Types in each of the additional Models

Entity Type / Models	Hub	Agent	Internal	Hybrid	Standalone
"4x4"	0	0	4	4	0
"2x6"	0	0	6	2	0

Table 6-6, Figure 6-14, Table 6-7 and Figure 6-15 show the results for the two above models. The results for both models show the complementary ability of the two company types to win contracts at different levels of environmental stability. The 4x4 Model outperforms the 2x6 Model when the environment is stable. This reflects the reduction to the number of Hybrid companies in the 2x6 Model. The model further confirms the complementary nature of the performances of the two company types, and that both types have to be present in roughly equal numbers to provide consistent performance for any level of environmental stability. To note, Internal companies require the presence of some Hub-type company, either Hub or Hybrid types,

to take advantage of their collaborative abilities. Minus the presence of any Hub-type company, a set of Internal companies will not perform any better than a set of Standalone companies. A separate simulation run of a set of Internal-only companies, results not shown here, confirms this performance equivalence.

Table 6-6: "4x4" Model Results

Stability Rate	**99%**	**75%**	**50%**	**25%**	**0%**
Served Demand ratio	0.64	0.64	0.72	0.72	0.79
Served Demand Ratio (Internal)	0.19	0.25	0.37	0.41	0.50
Served Demand Ratio (Hybrid)	0.45	0.39	0.35	0.31	0.29
Served Value ratio	0.60	0.49	0.50	0.47	0.46
Average Capital ratio *(Internal)*	0.81	0.79	0.79	0.78	0.76
Average Capital C.V. *(Internal)*	1.76%	4.94%	7.11%	6.81%	10.55%
Average Capital ratio *(Hybrid)*	0.40	0.40	0.39	0.36	0.32
Average Capital C.V. *(Hybrid)*	14.38%	11.95%	15.02%	17.87%	19.99%
Collaboration Success ratio	0.40	0.36	0.29	0.25	0.20

Figure 6-14: "4x4" Model Results in Graphs

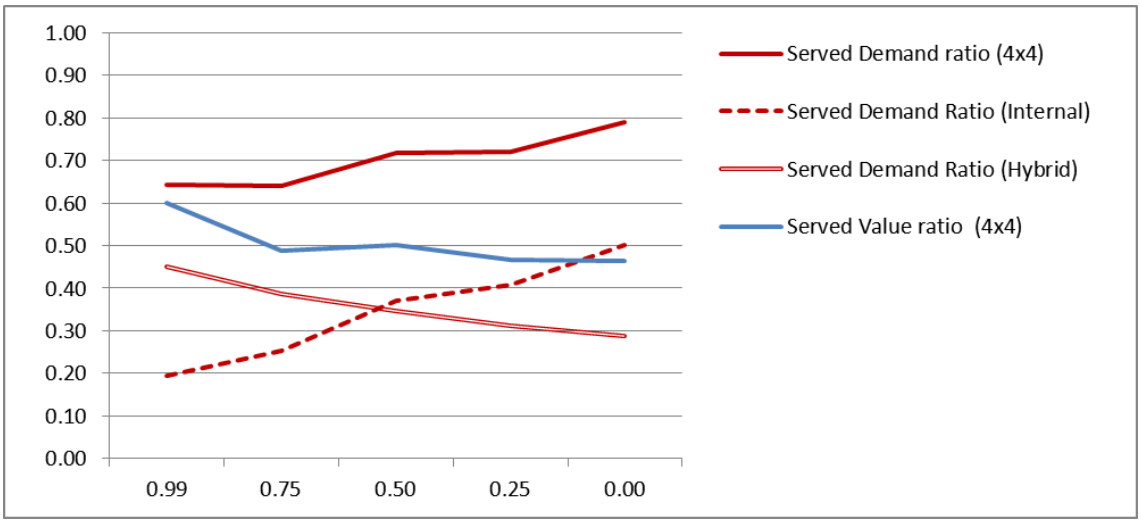
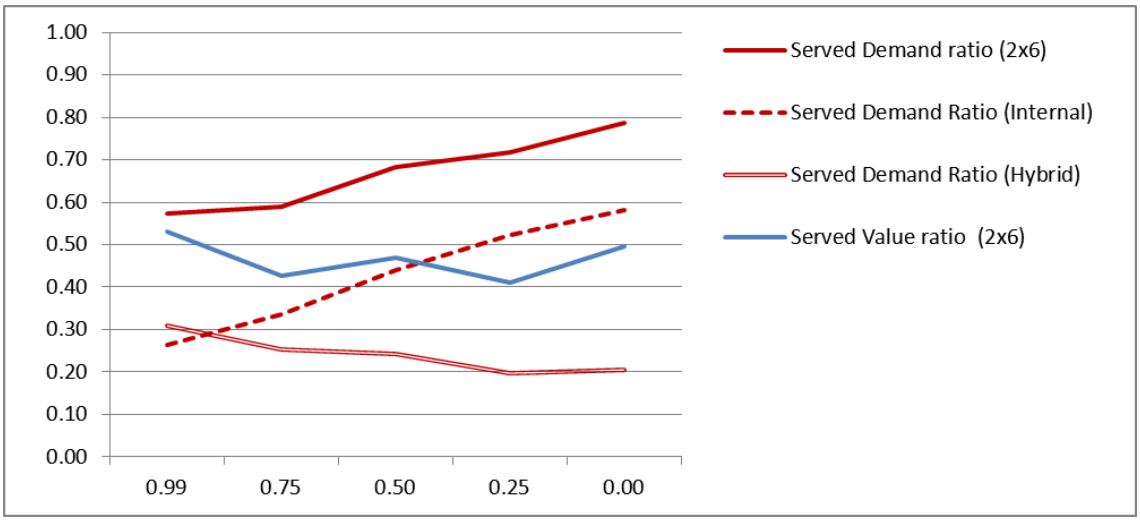


Table 6-7: "2x6" Model Results

Stability Rate	**99%**	**75%**	**50%**	**25%**	**0%**
Served Demand ratio	0.57	0.59	0.68	0.72	0.79
Served Demand Ratio (Internal)	0.26	0.33	0.44	0.52	0.58
Served Demand Ratio (Hybrid)	0.31	0.25	0.24	0.20	0.20
Served Value ratio	0.53	0.43	0.47	0.41	0.50
Average Capital ratio *(Internal)*	0.81	0.78	0.78	0.76	0.76
Average Capital C.V. *(Internal)*	4.62%	5.97%	7.40%	8.91%	10.27%
Average Capital ratio *(Hybrid)*	0.46	0.38	0.38	0.36	0.35
Average Capital C.V. *(Hybrid)*	8.20%	7.51%	10.84%	15.31%	15.15%
Collaboration Success ratio	0.50	0.41	0.37	0.29	0.30

Figure 6-15: "2x6" Model Results in Graphs



6.5. Discussion

The key finding to this study is that collaboration structures in a transient collaboration meta-organization play a critical role to determine its effectiveness to fulfill demand requirements, to locate and deploy resources, and to mitigate environmental volatility. In the simulation, the Hub & Agent model shows the least promise to deliver on performance. The implication from the model is that a transient meta-organization requires coordination of resources allocation not only at the inter-company level, but also at the meta-organizational level to prevent inefficiency. The 4x4 model shows the most promise in performance, and suggests that a mixture of different collaboration types can make a meta-organization more robust at fulfilling demand requirements even in volatile environments.

6.6. Limitations

The simulation does not include certain aspects of transient collaborations in meta-organizations. Among these is the lack of a network facilitator to govern and manage collaborations among the companies. The earlier case study essay shows that the role of the network facilitator is critical to help develop and grow the culture of collaboration among companies. The network facilitator also provides strategic direction and guidance at the meta-organizational level that can aid the long-term development of the meta-organization. The simulation excludes the role of a network facilitator because it is not clear how to program such a role, and because the presence of a facilitator is not directly relevant to serve the intent of this study. However, to note, all interactions in the simulation takes place in the absence of the facilitator role.

In the simulation, any collaboration group has a maximum setting of only a Hub and three companies. Therefore, the only possible collaboration groups are a Hub and a company, a Hub and two companies, or a Hub and three companies regardless of the number of potential companies seeking to join a collaboration group. The simulation does evaluates a complete permutation set of all potential companies seeking to join a particular group, up to a maximum set of a Hub and three companies, before selecting the final members of any collaboration group. For instance, if a Hub has five potential partners for collaborations, then the program evaluates and selects from 85 different collaboration sets i.e. 5 "Hub and a company" groups, 20 "Hub and two companies" groups, and 60 "Hub and three companies" groups. Computational complexity required to evaluate larger numbers of collaboration groups sets this limitation. The effect of this

limitation is to make collaborative versus non-collaborative comparisons to be more robust in favour of collaborative operations. This is because the program excludes the more numerous collaboration groups, which if included, will have increase the performance measures of collaboration setups.

The simulation also excludes the measure of interorganizational trust among the entities. All collaborations assume the presence of complete trust, and all activities take place at the promised time. A major simplification to the simulation is to reduce the types and complexity of resources. The model assumes all resources are identical and mutually interchangeable across companies engaged in collaborations.

6.7. Conclusion

The simulation shows that environmental stability is an important contingency to affect the performance of meta-organizations and helps validate collaboration structures in meta-organizations, in terms of entity types and numbers, can mitigate the volatility of environmental stability and reduce the impact to company-level as well as network-level performances. The simulation provides insights into the dependencies among the coordination and production roles in meta-organizations, and shows how to manage these to maximize demand fulfillment and resources utilization. The simulation results suggest that the transient collaboration model can allow companies to work more efficiently together to fulfill demand requirements when correctly structured.

Future work in this area includes expanding the program to simulate other scenarios. One scenario is to allow the introduction of new sources of dynamism into the simulation. For instance, varying the rates of demand arrival from high to low can demonstrate the robustness of different structural types of meta-organizations to handle these feast or famine conditions. The program may also include different types of competition to existing meta-organizations. For instance, a simulation of two or more meta-organizations competing in the same marketplace could offer insights into how to design a meta-organization to cope with network-level competition. Such a simulation could further test if meta-organizations that allow multiple memberships could perform more effectively than those with exclusive membership requirements could. Another scenario is to set up equivalent companies with fixed collaboration partners and test their performances for comparison. One more scenario could introduce new resources halfway into a simulation run to assess the impact to companies facing new types of market demand. A further area to explore will be to provide the companies with a profit assessment routine and assess if transient collaborations can help companies to better balance revenues and costs. The evaluation of these new scenarios will improve understanding of the potential impact of transient collaboration practices to companies' performances.

7. IMPLICATIONS OF THE RESEARCH

This thesis contributes to the literature of collaborative networks by introducing the transient collaboration meta-organization model as an emerging perspective in supply chain management. The first essay in the thesis extends concepts from Structural Contingency Theory to the network level, and builds propositions to explain the links between structures, contingencies and performance of goal-based transient collaboration meta-organizations. The theoretical development of the transient collaboration meta-organization model shows that the interactions of meta-organizational structures with environmental contingencies of dynamism, munificence and complexity, size and competition will result in significant performance implications for companies. Companies seeking to operate in transient collaboration meta-organizations need to understand how to design their meta-organizations to take into account, and balance their structures with different contingencies to enhance performance. The second essay analyzes empirical evidence for transient collaboration operations in the field, and examines if the theoretical principles are in line with the findings. The case studies presented show that empirical support exists for certain theoretical findings in Essay 1. The cases show that boundary exclusivity, co-specialization, routines standardization and change to coordination resources and mission scope are factors that affect meta-organizational performance. In addition, the cases show the presence of multiple types of boundaries that delineate different functions within meta-organizations. Organizations such as the research park, or companies like Dandy Corporation, need to understand and take into account the effects of these factors when operating in a transient collaboration meta-organization. In particular, these companies need to consider the types of internal boundaries needed in their meta-organization to support the various governance,

coordination and production structures. The final essay builds and generates collaboration data through a simulation program to assess the effects of collaboration structures and dynamism in environments on performances. The simulation results show that dynamism in the environment differently affects the performance of companies using different collaboration methods operating in transient collaboration meta-organizations. In particular, Internal and Hybrid companies encounter opposing performance effects at different levels of environmental dynamism. One implication of this study is that the design of meta-organizations can benefit by mixing companies with different types of collaboration methods within the same meta-organization to ensure performance stability robustness at all levels of environmental dynamism. Another implication is that companies in meta-organizations can consider changing their collaboration methods to suit changes to environmental dynamism.

Many of today's companies increasingly find themselves operating in dynamic environments imbued with advanced technology, constant changes, and unstoppable globalization. Companies need to consider if they should adopt or participate in new organizational forms that can take advantage of interconnectable technology, create new opportunities from innovations, and make collaborative linkages across regional or national boundaries. This research introduces and describes a new strategic organizational form - the transient collaboration meta-organization - that operates to take into account today's new business realities. Although many companies already know how to collaborate with one another via traditional collaboration networks, operating in the transient collaboration meta-organizations requires a major shift to mindsets. For instance, a key element in transient collaborations meta-

organizations is that companies need to view all collaborations as transient, emergent and goal-based, rather than as contractual or specification-based. As such, collaborations in transient collaboration meta-organizations can operate with high levels of flexibility and robustness to changeable conditions that may not be available to traditional collaboration networks. This dynamic characteristic of transient collaboration meta-organizations makes them an interorganizational form suitable for strategic adoption by companies in an increasing number of industries that face growing challenges from unpredictable innovations, competitions or globalization effects. The transient collaboration meta-organizations model is applicable across for a wide range of collaboration entities, ranging from individual persons, to companies, and to consortiums of companies. This provides the model with the versatility to enable collaborations for different business environments.

The future research work has the goals to extend academic knowledge and to provide practitioners with a business model that can inform and guide managers about the option to operate their organizations as part of transient meta-organizations. Future research opportunities include the following topics:

1. Risks and Reputations

- How could transient collaboration members manage common risks if operating across meta-organizational relationships?
- How could the practice of transient collaborations enhance the reputation and extend the competitive reach of companies?

2. Crisis Situations

- Organizations randomly encounter business disasters or crises on a random periodic basis (Nishiguchi & Beaudet, 1998). Will transient goal-based collaborations be advantageous or disadvantageous for the different parties if one of the parties has such a crisis?
- Humanitarian supply chains typically have both short-term and long-term engagement requirements (Oloruntoba & Gray, 2006; Thomas & Fritz, 2006). Could parties involve in these supply chains benefit from transient-type operations to improve their performances?

3. Competitive Dimensions

- Inter-organizational competition can occur simultaneously with meta-organizational competition within an industry (Nagarajan & Sosic, 2007; Gimeno, 2004). How do these different types of competition affect company-level and network-level performances in a transient collaboration meta-organization?
- Will meta-organizations compete among themselves to attract companies with best-in-class productive resources?
- How could meta-organizations coordinated pricing or make use of transfer pricing to ensure competitive pricing?

4. Clock-speed

- More products and industries have increased their clock-speeds over time (Dierickx & Cool, 1989). Are transient collaboration practices more effective in high versus low clock-speed industries?

5. Operations Management

- Are transient collaboration concepts applicable throughout all levels of a value chain?
- Can transient collaboration meta-organizations achieve more efficient make vs. buy decisions for the individual companies?
- Can transient collaboration meta-organizations achieve higher economies of scale due to their more flexible coordination abilities? Can meta-organizations achieve higher economies of scope due to more cross-integrated production?
- Could goal-based transient collaborations reduce inventory levels for cooperating organizations?
- How could members in a transient collaboration meta-organization maintain common quality standards?
- Could service operations benefit from goal-based transient collaborations among companies?
- How will the quality of network facilitators and hubs affect the performance of transient meta-organizations? How may researchers measure or assess such qualities?

Appendix A. Informant Details in Pilot Cases

No.	Cases	Informant Description	Organization
1	C1 (2011)	Former Manager, engaged in software development. Based in Waterloo, Ontario.	Blackberry, a North American telecommunications company.
2	C2 (2011)	Technical Manager, engaged in research and development. Based in Greenbelt, Maryland.	National Aeronautics and Space Administration (NASA), the aerospace agency of the US government.
3	C3 (2011)	Manager, engaged in business development. Based in Mexico.	Blackberry, a North American telecommunications company.
4	C4 (2011)	Manager, engaged in software development. Based in Phoenix, Arizona.	US Airways, a major North American airline.
5	C5 (2011)	Manager and self-employed owner. Based in Waterloo, Ontario.	Berkeley Garage Doors & Repairs, an installation and repairs contractor company.
6	C6 (2011)	Project Manager, engaged in project management. Based in Singapore.	Atos, a major European technology company. The interview took place at an Asian subsidiary.
7	C7 (2011)	Manager, engaged in services support. Based in Singapore.	Fujitsu Technology, a major Japanese technology company. The interview took place at an Asian subsidiary.
8	C8 (2011)	Technical Manager, engaged in internal software development. Based in Singapore.	Atos, a major European technology company. The interview took place at an Asian subsidiary.
9	C9 (2011)	Technical Manager, engaged in business development. Based in Singapore.	ASM Technology, a major European equipment manufacturer. The interview took place at an Asian subsidiary.

Appendix B. Study Protocol

No.	Headings	Topics	Details
1.	Introduction to the case study	• Overview	• The case study is to determine how organizations collaborate to obtain access to resources, how they adjust competitive priorities using these resources, and how these collaborations may affect performances.
		• The theoretical basis of the study	• Structural contingency theory considers how organizational structures, for given contingencies, affect how organizations perform. • Extension of the theory to the network-level, to explain transient collaboration processes in meta-organizations. • The transient collaboration perspective considers how the use of temporary goal-based groups allows organizations to better match capabilities to shifting market requirements. • Companies may perform different roles such as network facilitator, hub coordinator or productive agent in a meta-organization.
2.	Standard information provided to interviewees	• Information about the study	• State academic nature of study, and provide assurance of anonymity. • The research seeks to understand how companies collaborate and network together. Specifically, the study wants to find out how do companies collaborate with one another, especially with regard to innovation. The study is also interested to find out about repeated partnerships (if any), partnership durations, and why partners may change over time.
3.	Data collection procedures	• Expected steps or procedures in data collection	Interview session: • Bring identification and required documents for the study • Inform the front desk of organization (if any) of the appointment with the informant. • Provide the standard information about the study to the informant (during first meeting, and further clarifications in next meetings if needed). • Sign non-disclosure forms if needed. • Conduct the interview in a private setting if possible. • Request permission to record interview and take notes. • During the interview, obtain organizational data from

			the informant. • Label and file all documents (if any). • Make appointment for next meeting (if applicable). • Transcribe field notes within 24 hours. • Propose and justify any update to the study protocol following the interview if applicable. • File all documents and data of interview into study database within 24 hours. Archival data collection: Online - local backup into database. Hardcopy – scan and backup into database. Daily database backup with encryption. Off-site database backup after major addition.
		• Approved or appropriate sources of data (Example notations)	• Case # 01 consists of Company A. • The informants for each organization are (name, position, contact numbers, emails). • Make appointments and visit each organization in turn according to Schedule. • The annual reports for Case #01 are filed at location Z. • The website X contains the information for Case #01. • The files Y at <database site> contain the public information for Case #01.
4.	Case study questions	• Questions for the researcher to consider during the interview	• What are the primary roles of the organization? Facilitator, Hub, Agent or mixed? • Does this organization primarily seek resources from internal or external sources? • Is the organizational culture favorable towards collaboration with external parties? • How are potential partners selected? • How are potential partners evaluated? • What is the basis for the duration of a partnership? • Are partners changed before the expected end of an alliance? Why? • What are the boundaries for collaborations (if any)? • What environmental factors are important (task, size, competition)? • What is its market, and how are opportunities determined?

		• Questions to the interviewee	• Please describe the main functions of your organization. • Please describe your role in the organization. • Does your organization collaborate with other organizations? • Are these collaborations formal or informal? • Are collaborations between consortiums, organizations or between individuals? • How long do these collaborations typically last? • What is the main purpose or intent of such collaborations? • Are collaborations repeatable with the same partners for different projects? • Do existing partners ever introduce new partners to your organization? • Do existing partners ever caution against other potential partners? • Describe a collaboration project from start to finish (repeat). Success, failure or mixed? • What are the reasons for the success/failure for that collaboration?
5.	Case Study Report	• Observations or data to be reported	Information about each interview as follows; • Information about the informant, including contacts. • Information about the organization, including websites. • Types of collaboration engaged in by the organization. • Reasons provided for being in collaboration - choice of partners. • Advantages and disadvantages of collaboration. • Any recommendation from current partners. • Any cancellation/rejection of collaboration, and the reasons.
		• Attachments of documents or other data collected	• Collaboration terms and conditions with its main partners (if changed, when?) • Evaluation reports. • Cost reports. • Quality reports. • Delivery reports. • Patents reports.

Appendix C. Main Routines of Simulation Program

No.	Routines	Descriptions	Activation Occurrences
1	main()	Main routine to enter parameters, periods and iterations of a run. Creates final output file.	At the initial start of a run.
2	main_run()	Routine resets variables to run's parameters, and executes a current iteration.	At the initial start of each iteration.
3	demands()	The routine creates Demands.	Based on probability in each period. Attributes based on probabilities.
4	investors()	The routine creates Companies.	Called only once per run based on number and type of companies of run. Attributes based on probabilities and company types.
5	up_demand()	The routine updates time and status attributes of all Demands.	Once per period.
6	rpricing_decision()	Each Company evaluates and sets prices for its resources.	Once per period.
7	demand_priority()	Each Company makes initial prioritization of the available Demands to bid for.	Once per period.
8	def demand_scan()	The routine updates tracking of current Demands, and removes expired Demands from Companies' attention.	Once per period.
9	demand_choice()	Each Company finalizes prioritization of the available Demands to bid for.	Once per period.

10	collab_priority()	Each Company sets prioritization of other Companies for Collaboration.	Once per period.
11	partner_bid()	Each Company bid to be a partner in available Collaborations.	Once per period.
12	partner_decision()	Each Hub selects partner(s) for Collaboration. Sets of a Hub and one or two or three Partners are chosen from all potential Partners.	Once per period. (includes decision on earlier bids if these come due during current period).
13	demand_pricing()	Each Hub sets price to bid for an available Demand.	Once per period.
14	demand_bid()	Each Hub bid for available Demand (if bid possible).	Once per period. (only if bid time is due for Demand).
15	bid_priority()	Market sets prioritization of Companies to service Demand.	Once per period.
16	demand_decision()	Market makes award decision on Demand.	Once per period. (only if award time is due for Demand)
17	collab_reconfirm()	Each Hub confirms or cancels Collaborations, based on Demand award status.	Once per period. (only if such Collaborations exist).
18	build_check()	The routine updates status of all resources being built, and delivers completed resources.	Once per period.
19	resource_assess()	Each company decides to remove or build new resources.	Once per period.
20	capital_check()	The Market pays for Contract services, and Hubs pay to Partners.	Once per period.

21	lockr_check()	The routine updates status of all locked resources.	Each time a resource is locked or released, or built, delivered or removed.
22	resource_check()	The routine updates status of all available resources.	Each time a resource is locked or released, or built, delivered or removed.
23	partner_confirm()	The routine creates a Partnership agreement between two Companies.	Each time a Hub confirms a Partnership (can be multiple partnerships per Demand).
24	contract_confirm()	The routine creates a Contract agreement between Market and a Hub company.	Each time a Contract is awarded.
25	mgmt_confirm()	The routine creates an internal contract between a Company and its coordination resources.	Each time a Hub locks its coordination resources for a bid.
26	internal_confirm()	The routine creates an internal contract between a Company and its production resources.	Each time a Company locks its production resources for a bid.
27	rev_internal_confirm()	The routine cancels an internal contract between a Company and its internal resources.	Each time a Company releases its production resources from a bid.
28	build_mgmtresources()	The routine starts a build for a set of coordination resources.	Each time a Hub builds coordination resources.
29	build_resources()	The routine starts a build for a set of production resources.	Each time a Company builds production resources.
30	rev_build_resources()	The routine reverses a build for a set of production resources (only possible in same period).	Each time a Company did not require the build after further check (only possible in same period).

31	collab_item()	Hub issues invitation for Collaborations.	Each time a Hub needs Collaborators to qualify for a bid.
32	rev_collab_item()	Hub reverses invitation for Collaborations (only possible in same period).	Each time a Hub did not need Collaborators after further check (only possible in same period).
33	remove_resource()	The routine removes a set of resources.	Each time a Company removes unneeded coordination or production resources.
34	partial_two()	The routine evaluates all possible sets of one Hub and two Partners from all potential Partners.	Each time two or more potential Partners are available for Collaboration.
35	partial_three()	The routine evaluates all possible sets of one Hub and three Partners from all potential Partners.	Each time three or more potential Partners are available for Collaboration.
36	Other routines	Keeps track of number of periods and unique numbers for Demands, Companies, Internal contracts, Partnerships and Contracts. Calculates measures for each iteration and compile into run.	Activated at appropriate times by other routines.

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C2. 2011, March 29. Interview with a Technical Manager, engaged in research and development at NASA, the US aerospace agency.

C3. 2011, April 18. Interview with a Manager, engaged in business development at RIM, a major North American telecommunications company.

C4. 2011, April 20. Interview with a Manager, engaged in software development at US Airways, a major North American airline.

C5. 2011, May 27. Interview with a Manager of Berkeley Garage Doors & Repairs, a contractor company in North America.

C6. 2011, June 22. Interview with a Project Manager, engaged in project management at Atos, a major European company. Interview was at Asian subsidiary.

C7. 2011, June 22. Interview with a Manager, engaged in services support at Fujitsu Technology, a major Japanese company. Interview was at Asian subsidiary.

C8. 2011, July 4. Interview with a Technical Manager, engaged in internal software development at Atos, a major European company. Interview was at Asian subsidiary.

C9. 2011, July 23. Interview with a Technical Manager, engaged in business development at ASM Technology, an European manufacturer. Interview was at Asian subsidiary.

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