Strategic Coopetition - A Conceptual Modeling Framework for Analysis and Design

by

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Abstract

In complex socio-technical multi-agent systems, agents cooperate and compete simultaneously to increase combined welfare through cooperation while maximizing individual gains through competition. Coopetition requires agents to adopt strategies that maximize benefits and minimize costs from concomitant cooperation and competition. Analyzing coopetition can be challenging since cooperation and competition are paradoxical social behaviours that are undergirded by contradictory logics, hypotheses, and assumptions. Therefore, the ability of systems designers to represent and reason about coopetition in a structured and systematic manner can benefit their efforts to design win-win strategies.

This thesis proposes an approach for modeling and analyzing strategic coopetition. This approach was developed by following three main steps: (i) first, we identified primary characteristics for modeling and analyzing strategic coopetition (*complementarity*, *trustworthiness*, *interdependence*, and *reciprocity*) by surveying scholarly literature; (ii) second, we developed requirements for articulating and assessing these characteristics; and (iii) third, we constructed a framework comprised of artefacts for expressing and evaluating these characteristics. This framework consists of a modeling language, analysis techniques, knowledge catalogues, and a method. It is used to discriminate among alternative coopetitive strategies, and to generate strategies in search of positive sum outcomes.

We combine and extend extant modeling approaches including *strategic actor modeling*, *value modeling*, and *game-theoretic* modeling to represent and reason about strategic coopetition. Strategic actor modeling, based on *i** (iStar), is used to articulate and assess *interdependence* among actors as well as *trustworthiness* of actors. Value modeling, based on *e3value*, is used to express and evaluate the *complementarity* between actors as well as synergy among activities. Game-theoretic modeling, specifically *Game Trees*, is used to articulate and analyze *reciprocity* of actions by actors.

This modeling framework is supported by catalogs of design knowledge that include: (i) generic strategies for competing and cooperating; as well as (ii) targeted approaches for information-sharing and assessing trustworthiness.

We evaluated the usability and usefulness of this modeling framework by applying it to: (i) a published case study of coopeting mega-vendors in the global software industry; and (ii) an empirical study of startups under coopetition in the market of data science professional development.

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- Pant, V., Yu E. (2019). A Modeling Approach for Getting to Win-Win in Industrial Collaboration under Strategic Coopetition. *Complex Systems Informatics and Modeling Quarterly (CSIMQ) Journal*, 19: 19-41.
- Pant, V., Yu, E. (2018). "Modeling simultaneous cooperation and competition among enterprises". Invited Paper to: *Journal Business & Information Systems Engineering (BISE)*, Special Issue "Enterprise Modeling for Business Agility". Springer.

Conference Papers (6)

- Pant, V., Yu, E. (2018). Getting to Win-Win in Industrial Collaboration under Coopetition: A Strategic Modeling Approach. In: *17th International Conference on Perspectives in Business Informatics Research (BIR 2018)* (pp. 47-66).
- Pant, V., Yu, E. (2018). Generating Win-Win Strategies for Software Businesses under Coopetition: A Strategic Modeling Approach. In: *9th International Conference on Software Business (ICSOB) 2018* (pp. 90-107).
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- Pant, V., Yu E. (2019). Towards a Catalog of Goals for Strategic Coopetition, In: *The 6th International Workshop on Conceptual Modeling in Requirements Engineering and Business Analysis (MREBA 2019)*.
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- Pant, V., Yu, E. (2017). "Towards Reasoning About Strategic Moves and Reciprocity With *i** and Game Trees". In: *10th International i* Workshop 2017*.
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1. Introduction

1.1 Background

Coopetition describes a relationship in which two or more actors cooperate and compete with each other simultaneously (Brandenburger & Nalebuff, 1996). It is a counter-intuitive social phenomenon that is comprised of seemingly antithetical behaviours which are undergirded by contradictory logics, hypotheses, and assumptions (Bengtsson & Kock, 2000; Raza-Ullah, Bengtsson, & Kock, 2014). However, coopetition is frequently observed within strategic relationships (Baglieri, Carfi, & Dagnino, 2012) such as partnerships, joint ventures, alliances, and networks. Many organizations leverage advances in technology, such as social media (Fan & Gordon, 2014; Kane, 2015), to cooperate and compete with each other simultaneously.

Information Systems (IS) have become critical tools in many organizations because software, such as applications and databases, support the operationalization and realization of enterprise strategies (ES). This has necessitated many organizational decision-makers to co-design their IS and ES. A modeling framework for coopetition can be used to support the synchronization and harmonization of IS and ES by relating IS decisions about data, processes, and interfaces with strategic considerations about actors, goals, and value. This is likely to impact IS decisions about transaction processing, data sharing, compliance monitoring, and process integration.

This imperative has risen in significance because coopetition is expected to grow as an industrial practice as: (1) more organizations pivot from pipeline-based business models to platform-oriented business models; and (2) as many organizations join up with each other on ecosystems. Examples of platforms or ecosystems include many open source communities, standards bodies, and trade associations. Platforms and ecosystems, such as online marketplaces, bring together participants/members that cooperate to achieve shared goals and compete to satisfy individual objectives.

Organizations may cooperate with each other because they share certain goals that cannot be attained alone. However, they may also compete with each other because they have certain objectives that each must fulfil alone. This requires decision-makers, at coopeting organizations, to balance collaborative and conflictual activities delicately as an imbalance can expose their organization to the threat of exploitation by its rivals or the risk of expulsion by its partners. The former can occur if the focal organization is perceived to be too collaborative while the latter can occur if the focal organization is regarded as being too conflictual.

Only that strategy which equilibrates the oppositional forces of cooperation and competition can allow an organization to sustain its coopetitive relationships over the longer term. However, designing and implementing such a strategy is problematic due to the paradoxical nature of cooperation and competition.

Specifically, the types of IS that are used in an organization as well as the data that goes into them can be impacted by cooperation, competition, and coopetition with other organizations. Therefore, a modeling framework that allows the structured and systematic expression and evaluation of strategic coopetition can serve as a bedrock capability for IS decision-makers.

1.2 Motivating Examples

Researchers have noted rapid proliferation of coopetition in two parts of the economy: entrepreneurial segment comprised of startups (Ejsmont, 2017), and software industry consisting of technology providers as well as platform operators (Yoo et al, 2020). The near ubiquity of strategic coopetition in these domains makes them suitable candidates for analysis with a conceptual modeling framework.

1.2.1 Startup Segment

Startups cooperate with each other to collectively compete with common rivals such as mature incumbent firms. For example, startups in the higher education industry team up to compete with established organizations such as private colleges. A mature incumbent firm may possess more resources than each of the startups separately, but the startups can pool their resources to outmatch a mature incumbent firm. Startups may combine their resources to jointly position value propositions in the market that are superior in comparison to value propositions from traditional organizations. None of the startups can offer such value propositions alone, but they can offer them by collectivizing their resources. However, while cooperating, these startups also compete with each other over: profitable customers in same markets; critical supplies from shared vendors; financing from mutual investors; and promising recruits from overlapping talent pools. This requires decision-makers in coopeting startups to balance cooperation and competition at the same time. Specifically, decision-makers must answers questions such as[1]: which organizations are involved in coopetitive relationships with them; does complementarity exist between them and other coopeting organizations; are they and other organizations capable of reciprocating; what kind of trust exists between them and other organizations that coopete with them; is interdependence mutually beneficial for them and other organizations under coopetition?

1.2.2 Software Industry

The software industry is characterized by multi-faceted organizational relationships involving alliances between rivals such as Amazon and Microsoft. This industry entails long R&D cycles that require large cost outlays and are susceptible to high failure rates. These factors motivate competing software vendors to cooperate with each other in order to spread costs, share resources, pool technologies, and diffuse risks.

[1] Additional details may be found in: Roig-Tierno, Kraus, & Cruz (2017); Lechner, Soppe, & Dowling (2016); Soppe, Lechner, & Dowling, (2014); Bengtsson, & Johansson (2014); and Mione (2009)

However, software organizations under coopetition also attempt to expropriate knowledge from partners for gaining knowledge asymmetries by learning faster (i.e., a learning race) to strengthen their overall competitive positions. This requires decision-makers in coopeting software firms to simultaneously consider both competitive and cooperative facets of their relationships. In particular, they need to answer questions including[2]: what are the goals of each coopeting organization; how can an organization increase its share of the co-created value surplus; is reciprocality mutually beneficial for each organization in a coopetitive relationship; are perceptions of trust assessments symmetrical among coopeting actors; and how can an actor increase or decrease its dependence on another actor?

1.3 Problem Statement

Interorganizational coopetition is a multifaceted, complex, strategic, dynamic, and seemingly contradictory phenomenon. It is multifaceted because it can occur at multiple levels – i.e., between organizations and between networks of organizations (Lin & Kulatilaka, 2006). It is complex because it can take place between organizations/networks directly as well as indirectly (Rusko, 2014). It is also strategic because it can have long-term ramifications across organizations/networks based on the moves and countermoves of other organizations/networks (Brandenburger & Nalebuff, 1996). Moreover, it is dynamic because the roles and positions of the coopetitors can change throughout their relationships (Bengtsson, Eriksson, & Wincent, 2010). Additionally, it seems to be contradictory because it requires the combination of two behaviours that are undergirded by contrary logics, hypotheses, and assumptions (Bengtsson & Kock, 2000; Raza-Ullah, Bengtsson, & Kock, 2014). However, despite apparent difficulties in cooperating and competing simultaneously, coopetition is nearly ubiquitous in the economy (Baglieri, Carfì, & Dagnino, 2012).

A range of socio-technical factors can impact a strategy for interorganizational coopetition. This is because such a strategy impacts and is impacted by the people, processes, technology, and structure within relevant organizations. In terms of people, organizational stakeholders, such as managers, need to be capable of cooperating and competing simultaneously (Bengtsson, Raza-Ullah, & Vanyushyn, 2016) with peers from rival organizations. Moreover, even if one stakeholder group, such as employees, accept the decision to cooperate with peers from their rivals it does not mean that another stakeholder group, such as suppliers, will follow suit. From a structural perspective, coopetition may alter power relationships (Bengtsson, Eriksson, & Wincent, 2010) and introduce new control hierarchies within focal organizations. Structures of the focal organizations will also change depending on whether competitors decide to cooperate directly or indirectly (i.e., through a separate organization such as a joint venture).

[2] Additional details are provided in: Nguyen-Duc et al. (2019); Pellegrin‐Boucher, Le Roy, & Gurău' (2018); Nguyen-Duc et al., (2017); Zhang, & Wang (2017); and Kewen, & Changyuan (2016)

Coopetition also requires changes to processes within organizations (Kotzab, & Teller, 2003) which can require new activities, rules, measures, and tasking. Changes to processes may also call for asset reallocations as well as resource investments that can upset long range plans and forecasts. Such change can create turmoil and upheaval in organizations whose performance is attributable to stability and constancy of workflows. From a technological perspective, adopting a coopetition strategy requires organizations to consider the interoperability, integration, overlaps, and differences of their IS. They also need to assess the information privacy and data security aspects of sharing knowledge with their rivals. This is because it is possible for an organization to expropriate its partner's information while hoarding, and not disclosing, its own information (Heiman & Nickerson, 2004; Ritala, Olander, Michailova, & Husted, 2015; Trkman & Desouza, 2012).

The choice of modeling and analysis of strategic coopetition between organizations as the focus of this research recognizes the complexity of interorganizational coopetition as well as the criticality of organizational information systems in the digital economy. Contemplating simultaneous competition and cooperation between organizations requires the ability to analyze many interrelated factors. However, the means for representing coopetition strategy in a systematic and structured manner do not exist. This absence, of means for modeling and analyzing coopetition strategy in a meticulous and methodical way, can expose organizational decision-makers to omissions and confusions that can lead to errors and mistakes. By contrast, a systematic and structured framework for modeling and analyzing strategic coopetition can be used to design superior enterprise strategies and update them sustainably over time.

1.4 Research Objectives

The goal of this research was to develop a framework for modeling and analyzing strategic coopetition. This goal can be refined and elaborated into the following research objectives,

RO 1. Understand the main characteristics that are relevant for modeling strategic coopetition. Ascertain key factors that are necessary for analyzing abstract patterns and decontextualized representations of strategic coopetition.

RO 2. Identify key requirements of each characteristic that are necessary for modeling strategic coopetition. Determine the relationships between the requirements of each characteristic. Understand the implications of each requirement on the analysis of strategic coopetition.

RO 3. Develop constructs, metamodels, and methods to enable analysis of strategic coopetition. Develop a conceptual modeling framework by using, extending, and combining existing modeling languages.

RO 4. Develop instantiations to test and illustrate application of conceptual modeling framework on coopetitive relationships.

RO 5. Propose design catalogs of knowledge to support the generation of win-win strategies and positive-sum outcomes. Compile content in design catalogs from academic, scholarly, and research publications.

1.5 Research Approach

1.5.1 Design Science Research

Design Science Research (DSR) offers an appropriate paradigm for studying socio-technical phenomena (Hevner, March, Park, & Ram, 2008; Peffers, Tuunanen, Rothenberger, & Chatterjee, 2007). It affords a researcher the ability to analyze people, organizations, and technologies under study individually as well as collectively. This enables a researcher to identify the components of a phenomenon/system, recognize the impact of each component on that phenomenon/system, and understand the relationships between each of those components. DSR focuses on constructs, models, methods, and instantiations to portray and ponder IS in their environments. This allows a researcher to understand what IS do (functionality) as well as why (intentionality) and how (application) they are used. As such DSR offers a fuller explanation of IS by depicting them in their respective contexts rather than in isolation.

The concept of design in DSR refers to an activity (verb) as well as an artefact (noun) (Hevner, March, Park, & Ram, 2008). This allows a researcher to improve the products that are created by critically examining the processes through which they are created. It also allows that researcher to enhance the processes that are used to create the products by critically examining those products. This virtuous cycle of continual improvement is described as the "build and evaluate loop" by March and Smith (1995). It yields high quality design activities and artefacts for researching changing socio-technical phenomena. This feature of DSR also enables the development of innovations whereby existing as well as new problems are solved via novel approaches. This characteristic of DSR also differentiates it from routine design in which existing approaches are applied to solve existing problems. The outline of this research, based on March and Smith's (1995) framework, is presented in Table 1-1. This presentation style is inspired by Osterwalder's (2004) doctoral thesis about business model ontology.

This research applied each of the seven guidelines, by Hevner et al. (2008), for conducting DSR. These guidelines encompass the full lifecycle of research by covering the following areas: (1) Design as an Artifact, (2) Problem Relevance, (3) Design Evaluation, (4) Research Contributions, (5) Research Rigor, (6) Design as a Search Process, and (7) Communication of Research (Hevner et al., 2008). The key artefacts of this research are constructs, models, methods, and instantiations for understanding strategic coopetition (1 and 2). These were developed using generally accepted research best practices and widely used methodologies

(5). The usability and usefulness of these artefacts were tested by applying them to study phenomena and systems of interest to industrial partners (3, 4, and 6). Findings from this research were shared with researchers and practitioners via workshops, juried conferences, and peer-reviewed journal publications (7). Evaluation was performed by testing the resulting framework on a published case and an empirical study.

<table>
<tr><th></th><th></th><th colspan="5">Research Activities</th></tr>
<tr><th rowspan="10">Research Output</th><th colspan="2"></th><th>Build</th><th>Evaluate</th><th>Theorize</th><th>Justify</th></tr>
<tr><td>Constructs</td><td></td><td>Explore key characteristics for modeling coopetition from literature</td><td>Discern relevance, necessity, and sufficiency of key characteristics with reference to case studies</td><td></td><td></td></tr>
<tr><td rowspan="2">Model</td><td>Ontology</td><td>Develop an ontology for representing coopetition</td><td rowspan="2">Use case studies to verify conformance and compliance of ontology and language with reality</td><td></td><td></td></tr>
<tr><td>Language</td><td>Develop a modeling language for expressing coopetition</td><td></td><td></td></tr>
<tr><td rowspan="2">Method</td><td>Analysis Techniques</td><td>Develop techniques for analyzing interorganizational coopetition</td><td rowspan="2">Test adequacy and compatibility of techniques and methods using case studies</td><td></td><td></td></tr>
<tr><td>Model construction method</td><td>Develop method for building models of interorganizational coopetition</td><td></td><td></td></tr>
<tr><td rowspan="2">Instantiation</td><td>Sample models to demonstrate expressiveness and analysis</td><td>Build models that express interorganizational coopetition</td><td rowspan="2">Validate models and design knowledge via case studies relating to interorganizational coopetition from the real world</td><td></td><td></td></tr>
<tr><td>Sample design knowledge to achieve coopetition objectives</td><td>Codify design knowledge to document goals of coopetition</td><td></td><td></td></tr>
</table>

Table 1-1 Research outline, inspired by Osterwalder (2004) and, based on March and Smith's (1995) framework

1.5.2 Action Research

Action Research (AR) refers to a paradigm in which a researcher deliberately and actively attempts to bring about a change in their domain of study (McKay & Marshall, 2000). The domain under study can be an organization and the change can affect the strategy of that organization. The goal of an AR study "is to focus on the promotion and management of change within a particular organizational setting" (Leitch, 2007). An intervention can be recommended or suggested by the researcher (i.e., promoted) and it can be implemented and effectuated (i.e., managed) by the practitioner. AR is a goal-directed paradigm in which the motivation for the change is the pursuit of achievement of some objective. Therefore, the "AR process begins with a notion in the practitioner's mind that a change in work practice is desirable" (French, 2009). The researcher purposefully intervenes in a focal domain while generating knowledge about that domain (Midgley, 2000). AR is useful in management research because its "research output results from an involvement with members of an organization over a matter which is of genuine concern to them" (Eden & Huxham, 1996). It is also relevant in IS research because it can be used to comprehend processes of change in social systems (Baskerville, 1999).

1.5.3 Case Studies

DSR and AR were complemented, in this research, by a case studies from the literature as well as an empirical study from the industry. Case studies accommodate the consideration of human interpretations (Walsham, 1995) and hence they are appropriate for conducting research, such as model-based analysis, into socio-technical phenomena, such as strategic coopetition.

In this research, an empirical study was conducted and a case study from literature was performed to evaluate models of strategic coopetition in the industry. In table 1, the second column (Evaluate) lists the relevance of case studies for evaluating artefacts (i.e., constructs, models, methods, and instantiations). These industrial cases were utilized to refine and elaborate these artefacts by testing them with reference to real-world organizations. These industrial cases on coopeting organizations yielded a thorough evaluation of the usability and usefulness of this framework.

Each of these studies, focused on the coopetitive relationships among organizations. In the empirical study, site selection was based on the scope and intensity of the interorganizational coopetitive activities undertaken by participating organizations. This case study concentrated on the utility of the modeling framework for analysing coopetition at focal organizations in contrast to ad-hoc or unsystematic/unstructured analysis.

As recommended by Yin (2013), data were gathered from a variety of sources including documentation, interviews, and direct observation. Analysis and exposition of data was performed in conformance with a research protocol that was approved by the Research Ethics Board in the University of Toronto.

Evaluation of the constructs, models, methods, and instantiations pertaining to these studies ensured that the resulting artefacts reflected real-world phenomena.

1.6 Research Contribution

This research advances the state of the art and state of the practice in the field of IS. It proposes a conceptual modeling framework that has been purposefully built for modeling and analyzing strategic coopetition. It encompasses abstract patterns and decontextualized representations of the main characteristics of strategic coopetition. The implications of each of these components, for the analysis of strategic coopetition, are explained to facilitate reasoning.

The constructs, models, methods, and instantiations within this framework are useful for analyzing strategic coopetition in a variety of contexts and domain settings. This framework has been designed and developed by using, extending, and combining extant techniques and tools that are widely used by IS researchers and industrial practitioners. Moreover, new or extended artefacts have been proposed when existing artefacts were found to be insufficient for modeling and analyzing strategic coopetition.

Currently, no conceptual modeling-based approaches exist for representing and reasoning about strategic coopetition in a structured and systematic manner. Game theorists have proposed the Value Net approach (Brandenburger & Nalebuff, 1995, 1996; Nalebuff, & Brandenburger, 1997) for analyzing coopetitive relationships. However, this approach is suitable for descriptive, but not explanatory, application because it lacks an ontology as well as semantic support which makes it vulnerable to arbitrary usage.

Similarly, game theorists have proposed quantitative tools such as Game Tree and Payoff table (Dixit & Nalebuff, 2008) that can be used to assess coopetitive strategies. However, these techniques are suitable for evaluating pre-set solutions to predefined problems. They are not conducive to generative and exploratory analysis in which the design space is refined and elaborated progressively over successive iterations with new problems and solutions introduced in each round.

IS researchers have also proposed frameworks for modeling and analyzing IS designs with reference to strategic management concepts. For example, many peer-reviewed papers[3] in the research literature on conceptual modeling incorporate ideas from strategic management. These papers are discussed in Section 3.3.2 which presents an overview of literature on conceptual modeling. However, none of these frameworks focus specifically on modeling and analysis of coopetition.

This research advances the stream of scholarship pertaining to conceptual modeling by proposing a framework for modeling and analyzing simultaneous cooperation and competition. In doing so, this research completed novel and original work that proposed new artefacts for expressing and analyzing strategic coopetition.

Constructs, models, methods, and instantiations that emerged from this endeavor illuminate abstract patterns and decontextualized representations related to strategic coopetition that are pertinent for researchers and practitioners.

[3] Select conceptual models of strategic management ideas that appear in peer-reviewed publications include: Carvallo & Franch, 2012; Giannoulis, Petit, & Zdravkovic, 2011a; Giannoulis, Petit, & Zdravkovic, 2011b; Giannoulis & Zdravkovic, J., 2012; Pijpers, Gordijn, & Akkermans, 2008; Samavi, Yu, & Topaloglou, 2008.

1.7 Thesis Organization

This dissertation is comprised of eleven chapters. The next chapter (Chapter Two) presents a review of scholarly literature about strategic coopetition. Chapter Three defines requirements for modeling and analyzing simultaneous cooperation and competition. Chapter Four describes the design of a framework that satisfies the requirements for modeling and analyzing strategic coopetition.

Chapters Five through Eight explain each of the five facets of our framework in detail and illustrate the application of each facet. Chapter Five elucidates the two foundational facets of our framework that encompasses goal- and basic actor-modeling.

We differentiate between foundational and advanced facets to simplify the application of our framework. By using the term foundational we mean that advanced facets build upon certain fundamental functionality in our framework. This fundamental functionality is relevant for each analysis while advanced facets may not be needed in particular analyses.

Chapter Six expounds the first advanced facet of our framework that covers differentiated actor modeling. Chapter Seven explains the second advanced facet of our framework that entails value modelling. Chapter Eight elucidates the third advanced facet of our framework that comprises modelling of sequential moves.

Chapter Nine assesses our framework by applying it to a published case study involving global software mega-vendors under coopetition. Chapter Ten evaluates our framework by applying it to an empirical case of coopeting startups within the data science professional development market in Toronto.

Lastly, Chapter Eleven summarizes the results from our research and describes the contributions, limitations, significance, as well as future directions of our research.

2. Review of Literature on Strategic Coopetition

2.1 Strategic competition and cooperation

The methodical study of interorganizational relationships emerged within the field of Strategic Management (SM) in the mid-1900s (Ghemawat, 2002). SM is concerned with the "creation, success, and survival" of organizations as well as "understanding their failure, its costs, and its lessons" (Rumelt, Schendel, & Teece, 1991). It is a domain of practice that became a field of scholarly inquiry after World War II (Ghemawat, 2002). Several economists were central to its inception and influenced its development as a field of study that was related to but separate from economics (Rumelt, Schendel, & Teece, 1991).

Early research in SM was shaped by the work of economists who applied theories of industrial organization to understand the relationships between "rivals" (Porter, 1981). Such economic explanations of inter-firm relationships privileged a competitive view because neoclassical economics idealized competition as the means for achieving market-clearing efficiency through the optimal allocation of resources.

Bain's (1956) Structure Conduct Performance paradigm (SCP) posited that industry structure governed the conduct of firms in that industry which in turn determined their respective performance. Porter (1979, 1991) popularized this view through his research about the impact of industry forces on the competitive advantage of firms. Henderson (1981, 1983), adopting a Darwinian view, ascribed long-term survival of firms to their ability to outcompete rivals in their conflictual quests for resources. This perspective complemented theories about resource-based view (Barney, 2001), dynamic capabilities (Teece, Pisano, & Shuen, 1997), and core competences (Prahalad & Hamel, 1990) that ascribed enduring differential benefits of firms to their idiosyncratic resource/capability/competence portfolios. This competitive perspective, which was inspired by theories from economics, served as the dominant explanation of inter-firm relationships from the inception of SM research.

This "militaristic" perspective was challenged by SM researchers who argued in favour of collaborative and cooperative relationships between organizations (Ketelhöhn, 1993; Lado, Boyd, & Hanlon, 1997; Zaheer, Gulati, & Nohria, 2000). This view asserted that organizations did not exhibit purely competitive behaviors towards each other. Moreover, competition was rife in many partnerships and many joint ventures were set up by rivals (Harbison & Pekar, 1998). Researchers started to apply alternate theoretical lenses to interpret interorganizational interactions to bridge this gap in the SM literature. Sociology, with its rich pool of literature on topics such as networks and alliances, offered a prolific source of relevant insights for SM theory building (Frank & Baum, 2000).

As SM matured over time and became established as a prominent field of research it benefited from the insights of sociologists (Pettigrew, Thomas, & Whittington, 2002). Many scholars who were conducting this strain of SM research eschewed the competitive view and instead promoted a view centered on interorganizational collaboration and cooperation. This view maintained that cooperation allowed organizations to achieve strategic objectives (Inkpen & Ross, 2001) through pooling of resources (Koza & Lewin, 2000), sharing of risks (Das & Teng 1996), diffusion of costs (Todeva & Knoke 2005), acquisition of knowledge (Jiang & Li, 2009), and gaining of market access (Gebrekidan & Awuah 2002). Dyer and Singh (1998) posited that "relational rents" were idiosyncratic relationship-specific performance enhancements that accrued to organizations because of their unique partnership portfolios.

While SM assumed its own intellectual identity it was nonetheless shaped by ideas from economics and sociology. One example of the commonality between these three domains can be found in their respective foci wherein each of these disciplines study objects within their contexts – i.e., economists study firms within industries, sociologists study individuals within populations, and SM researchers study organizations within markets (Dobbin & Baum, 2014).

2.2 Theoretical Research on Strategic Coopetition

Throughout the 1980s, the competitive and cooperative schools of thought came to dominate SM thinking on interorganizational relationships. The competitive view argued that firms succeeded by sustaining competitive advantages over their rivals. These enduring differential benefits allowed firms that possessed them to outperform other firms in the markets for factor inputs as well as finished outputs. Per this view cooperation amongst adversaries obviated their motivation for innovating and created the conditions for market failure through reduction of consumer surplus as well as creation of deadweight loss. On the contrary, proponents of the cooperative view claimed that the competitive view encouraged organizations to maintain a perpetual war footing which engendered disequilibrium in the market through the erosion of trust, reduction of goodwill, and triggering of mutually harmful outcomes.

By the mid 1990s these dichotonic explanations of interorganizational relationships had become firmly entrenched within the research literature on SM. However, observations from the industry indicated that firms adopted a "both/and" approach to competition and cooperation rather than an "either/or" approach (Raza-Ullah, Bengtsson, & Kock, 2014). This meant that purely competitive or solely cooperative explanations of interorganizational relationships were incomplete at best and incorrect at worst. It was during this time that two game theorists proposed an esemplastic theory (Brandenburger & Nalebuff, 1996) for harmonizing these antipodal perspectives.

Their syncretistic approach prescribed organizations to "cooperate to grow the pie and compete to split it up" (Brandenburger, & Nalebuff, 1995). It was related to game theory research in the areas of biform games (Brandenburger & Stuart, 2007) and value-based business strategies (Brandenburger & Stuart, 1996).

Coopetition encouraged organizations to cooperate for achieving joint objectives while competing to maximize their individual gains (Nalebuff & Brandenburger, 1997). Coopetition research has experienced a surge in prominence in the two decades since its introduction. A number of literature reviews[4] as well as special editions of reputable scholarly journals[5] have noted the proliferation of academic papers on this subject in peer reviewed publications. Moreover, coopetition research has moved beyond the realm of SM and has been applied by researchers to discourses in diplomacy (Alber, de Boisgrollier, Kourkoumelis, & Micallef, 2006), civics (Racine, 2003), and political science (Fleisher, 2001).

2.3 Theoretical Research on Dyadic/Network and Intra-/Interorganizational Coopetition

Coopetition research has focused on three main topics which are simultaneous cooperation and competition between individuals, groups, and organizations. Furthermore, this research has concentrated on coopetition within dyads and networks. Dyadic coopetition refers to concomitant cooperation and competition between two actors, which can be individuals, groups, or organizations, while network coopetition refers to concurrent cooperation and competition between three or more actors (Chiambaretto & Dumez, 2016). Padula and Dagnino (2007) posit that understanding dyadic coopetition is a prerequisite for comprehending network coopetition because "the dyad is nothing but the simplest level of analysis, where each of the relevant issues that may enable a thorough investigation of coopetition are actually present".

Direct coopetition describes a configuration in which the two actors cooperate and compete simultaneously with each other (Dowling, Roering, Carlin, & Wisnieski, 1996). However, indirect coopetition refers to an arrangement where two firms cooperate and compete with each other by competing and cooperating with one or more common firms (Dowling, Roering, Carlin, & Wisnieski, 1996). Thus, while two firms may only compete/cooperate with each other directly – they may cooperate/compete with one another indirectly by cooperating/competing with common firms. Thus, dyadic coopetition necessitates direct coopetition while network coopetition creates opportunities for direct and indirect coopetition.

Brandenburger and Nalebuff (1995, 1996) introduced the concept of Value Net in their formative work on coopetition. They take a broad view of coopetition which encompasses network and indirect arrangements. However, Bengtsson et al. (2010) disagree with such an approach by arguing that network coopetition is not simultaneous cooperation and competition because the cooperation and competition may take place

[4] Select literature reviews that appeared in peer-reviewed publications include: Devece, Ribeiro-Soriano, & Palacios-Marqués, 2019; Köseoğlu, Yildiz, Okumus, & Barca, 2019; Niesten & Stefan, 2019; Zacharia, Plasch, Mohan, & Gerschberger, 2019; Bengtsson & Raza-Ullah, 2016; Dorn, Schweiger, & Albers, 2016; Bouncken, Gast, Kraus, & Bogers, 2015; Czakon, Mucha-Kus, & Rogalski, 2014; Gast, Filser, Gundolf, & Kraus, 2015; Walley, 2007.
[5] Select special editions of scholarly journals include: Czakon, Dagnino, & Roy (Eds.), 2016; Roy & Czakon (Eds.), 2016; Roy, Dagnino, & Czakon (Eds.), 2016; Roy & Yami (Eds.), 2009; Baglieri, Dagnino, Giarratana, & Gutiérrez (Eds.), 2008; Dagnino (Ed.), 2007.

between different actors in the network. They describe network coopetition as the structural precondition for dyadic coopetition whereby two of the actors in a network can coopete with each other (Bengtsson et al., 2010).

Researchers have also explored coopetition within organizations (i.e., between different groups, teams, divisions, etc.). Sroka, Cygler, & Gajdzik (2014) note "intra-organizational coopetition relations include both branch level, and corporate level. Those units cooperate with each other, while at the same time facing internal competition". Tsai (2002) studied the presence of coopetition between teams within the same organization. He investigated "how knowledge sharing is coordinated among competing units" in the same multiunit organization where "many units are forced to both compete and cooperate with each other" (Tsai, 2002). Luo, Slotegraaf, & Pan (2006) analyzed the "underlying nature of cooperation and competition in cross-functional relationships" within the same organization. They found that domain knowledge and interorganizational learning were important for "exploiting cooperative ability and intensity among competing departments for better firm performance" (Luo, Slotegraaf, & Pan, 2006). Ritala, Välimäki, Blomqvist, & Henttonen (2009) studied the impact of intrafirm coopetition on innovation processes within an organization. They posited that, within an innovation process in an organization, cooperation should be used for knowledge creation while competition should be used for knowledge utilization (Ritala, Välimäki, Blomqvist, & Henttonen, 2009). Rossi & Warglien (2000) investigated the role of fairness and reciprocity on intra-organizational coopetitive relationships. They found that the level of fairness in a coopetitive relationship within an organization was motivated by a sense of reciprocity (Rossi & Warglien, 2000).

Luo (2005) researched the tensional duality of "cooperation and competition that simultaneously occur between two or more geographically dispersed subunits" of a multinational enterprise. He concluded that "in order to maximize system gains from inter-unit coopetition….it is important to build the intranet system, incentive system, encapsulation system, and coordination system" (Luo, 2005). Song, Lee, & Khanna, (2016) studied "internal co-opetition among affiliate companies within a diversified business group or business divisions within a (multi-business) affiliate company." They noted that "it is difficult to attain a good balance between cooperation and competition at any company, and even more so at a large and diversified business group" (Song, Lee, & Khanna, 2016).

2.4 Empirical Research on Strategic Coopetition

Researchers have analyzed the phenomenon of "coopetition along the antecedents-process-outcomes trail" (Czakon, Mucha-Kus, & Rogalski, 2014; Lado, Boyd, & Hanlon, 1997) through a number of empirical studies. A summary of key assertions and findings from notable empirical studies on industrial coopetition is presented in Table 2-1. Keywords are underlined in Table 2-1 to emphasize concerns (e.g., qualities and quantities) that are relevant for modeling. Bengtsson & Kock (1999) conducted a case study spanning four Swedish companies in the rack and pinion industry. This empirical exploration allowed them to “achieve a multi-faceted description of relationships between competitors” and they posited four types of inter-firm behaviours (Bengtsson & Kock, 1999). They classified these inter-firm behaviours as competition, cooperation, coexistence, and coopetition (Bengtsson & Kock, 1999).

Their research indicated that the firms in their case study conflicted, collaborated, avoided, or simultaneously competed and cooperated with each other based on their perceptions of each other’s power, dependence, and trust (Bengtsson & Kock, 1999). Powerful rivals that were not mutually dependent on their competitors tended to be more competitive with their partners while weaker rivals that depended on their competitors (e.g., for access to resources) tended to be more cooperative with their rivals. A similar observation, which is discussed below, was made by Jankowska (2011) with respect to the correlation between firm size (i.e., SME or large) and perceptions of employees about coopetition. In a subsequent study, Bengtsson & Kock (2000) analyzed coopetition between firms in Lining, Brewery, and Dairy industries. This study found that firms typically competed “in activities closer to buyers” (i.e., in downstream activities or output markets) and cooperated “in activities carried out at a greater distance from buyers” (i.e., in upstream activities or in input markets) (Bengtsson & Kock, 2000)[6]. Wang & Krakover (2008) analyzed this “distance to the customer” proposition quite literally through an empirical study of destination marketing. They investigated “the business relationships among tourism industry stakeholders”, many of whom were competitors, in a town in the USA (Wang & Krakover, 2008). They found that rival businesses in that town cooperated to run marketing campaigns, in distant locations, to attract tourists to their region but once the visitors arrived then those businesses advertised their own services individually in local media (Wang & Krakover, 2008).

Gnyawali & Park (2011) also observed similar behaviour through an in-depth case study of Sony and Samsung in the flat panel television market. They noted that Sony and Samsung competed with each other over the lucrative market for flat panel televisions (Gnyawali & Park, 2011). However, at the same time each of these firms also cooperated to establish Liquid Crystal Display (LCD) as the standard for flat panel televisions over the rival Plasma technology (Gnyawali & Park, 2011)[7]. This case study showed that “the potential to own and establish a standard tends to outweigh the concerns of competition in the product market” (Lin & Kulatilaka, 2006). Such behaviour is an operationalizing of Brandenburger & Nalebuff’s (1995) recommendation to “cooperate to grow the pie and compete to split it up”.

[6] This idea draws from Porter’s (1985) conception of a Value Chain in which a firm buys raw materials from suppliers that are “upstream” from it and sells finished products to customers that are “downstream” from it.
[7] Shapiro, Varian, & Becker (1999) have referred to such interactions as “standards war”.

Researchers	Industry	Region	Main Assertions/Findings
Bengtsson & Kock (1999)	Rack and Pinion	Sweden	Employee perceptions of each organization's power, dependence, and trust influence coopetition among them.
Bengtsson & Kock (2000)	Lining, Brewery, and Dairy	Sweden and Finland	Organizations compete "closer to the customer" and cooperate "farther from the customer".
Wang & Krakover (2008)	Tourism	USA	Organizations cooperated to generate consumer demand for a destination but competed for procuring customer business at that location.
Gnyawali & He (2006)	Steel	Global	Organizations that operated coopetitive hubs competed relatively more than organizations that acted as spokes.
Gnyawali & Park (2011)	Consumer Electronics	Global	Organizations competed in markets but cooperated in laboratories.
Jankowska (2011)	Multiple	Poland	Employees in small and midsize enterprises viewed coopetition favorably while employees of large organizations viewed it skeptically.
Yami & Nemeh (2014)	Telecommunication	Europe	Dyadic coopetition was suitable for incremental innovation while network coopetition was suitable for radical innovation.
Ritala, Hurmelinna-Laukkanen, & Blomqvist (2009)	Media	Finland	Organizations cooperated relatively more during the early stages of coopetition and competed relatively more during the later stages of coopetition.
Okura (2009)	Insurance	Japan	Organizations in coopetitive relationships protected their data but demanded data from other organizations.
Bonel & Rocco (2007)	Beverage	Italy	Coopetition can imbalance existing systems of complementarities by introducing risks and uncertainties into working business systems.
Meade II, Hyman, & Blank (2009)	Beverage	Global	Relationships that are overtly and explicitly competitive can serve purposes that are covertly and implicitly cooperative.

Table 2-1 Summary of main assertions and findings from empirical research on industrial coopetition

Gnyawali & He's (2006) empirical research attempted to understand the strategic dynamics within coopetition networks. Their research focused on the global steel industry and examined data about strategic alliances in that industry (Gnyawali & He, 2006). They found that firms that were at the hubs of coopetition networks tended to exhibit more competitive behaviour than those that were not (Gnyawali & He, 2006). This means that a firm with many partners was more likely to exhibit competitive behaviour towards its partners than a firm that had relatively few partners. This can be explained by the fact that a firm with many partners could afford to lose a few partners, or miss out on some new relationships, and still benefit from its remaining partnerships. However, a firm with a few partners could not afford to lose them, or forego opportunities to create new partnerships, because that would impair its ability to perform.

Jankowska (2011) studied coopetition with respect to different firm sizes in order to understand the perceptions of employees, in SMEs and large firms, about coopetition. She interviewed employees in 57 companies in Poland to analyze their preconceptions and expectations about coopetition (Jankowska, 2011).

Her research found that employees in SMEs viewed coopetition more favorably than their counterparts in large firms and were more willing to practice it in their business dealings (Jankowska, 2011). This was because SMEs "face a shortage of resources, and cooperation among others with rivals is a way to cope with this" (Jankowska, 2011). Larger firms are typically more self-sufficient in terms of meeting their own requirements and thus they are willing to compete with their rivals. However, SMEs don't enjoy similar resource abundance and thus they are more dependent on other firms even if some of those are their rivals.

Yami & Nemeh (2014) conduced empirical research to analyze the differences between dyadic and network coopetition with respect to innovation[8]. They used the case study method to examine five collaborative R&D projects involving competing telecommunications firms in Europe (Yami & Nemeh, 2014). Their goal was to discover the appropriateness of different forms of coopetition (i.e., dyadic or network) for different types of innovation (radical or incremental) (Yami & Nemeh, 2014). They found that "competitors choose between two different forms of coopetition for different motives" because, "multiple coopetition is successfully pursued for radical innovation, dyadic coopetition is more suitable for incremental innovation" (Yami & Nemeh, 2014). Ritala, Hurmelinna-Laukkanen, & Blomqvist (2009) conducted a case study to analyze the viability of coopetition as a strategy for innovating new services. Their case focused "on the development of mobile TV services in Finland" wherein the operators "could be described as highly collaborative" with respect to joint R&D while, at the same time, they were also "highly competitive in the end-product markets" (Ritala, Hurmelinna-Laukkanen, & Blomqvist, 2009). They studied the strategic interactions between mobile TV operators over a period of time to understand the sequence of cooperative and competitive activities between them (Ritala, Hurmelinna-Laukkanen, & Blomqvist, 2009). They found that early in the collaboration process (e.g., R&D) the interests of various firms aligned and this led to more cooperation than competition (Ritala, Hurmelinna-Laukkanen, & Blomqvist, 2009). However, the interests of the mobile TV operators became "more individual the closer commercialisation gets" (e.g., marketing) and this resulted in more competition than cooperation (Ritala, Hurmelinna-Laukkanen, & Blomqvist, 2009). Okura (2009) studied coopetitive strategies within the insurance industry in Japan as a means to reduce insurance fraud. He noted that while insurance companies competed to sell policies to clients they also shared information with each other to compile risk profiles of common clients as well as to block suspicious claims (Okura, 2009). Insurers that obtained this kind of information from other insurers reduced their losses from fraudulent claims (Okura, 2009). However, while insurers were interested in using data from other insurers they were reluctant to share their data in return (Okura, 2009). This was because each insurer wanted access to a larger dataset than its competitors [83]. Okura (2009) noted "that voluntary information exchange is difficult to achieve" because insurers were "not prepared to disclose their own

[8] Yami & Nemeh (2014) refer to network coopetition as multiple coopetition.

information voluntarily" even though they were prepared to access information from their rivals. This reflects an important aspect of coopetition wherein cooperative and competitive intentions affect each other.

Bonel & Rocco (2007) conducted "inductive research aiming to draw a theoretical distinction of several classes of risks deriving from coopetition." They studied an Italian soft drinks company, San Benedetto SpA, as it simultaneously competed and cooperated with other companies such as Ferrero, Schweppes, Coca-Cola, and PepsiCo (Bonel & Rocco, 2007). Their research found that while co-opetition offered certain benefits to San Benedetto SpA it also came at a cost since "coopetition involves changes that might have an impact on the original system of complementarities on which a firm's business model rests" (Bonel & Rocco, 2007). They identified different classes of risks that can occur in coopetition as a result of saturation (i.e., overloading capacity) and incompatibility (i.e., force-fitting) of activities across partners (Bonel & Rocco, 2007). Therefore, they advised managers to plan and manage coopetition in a systematic manner because otherwise "interferences" and "unintended consequences" can undermine its potential benefits (Bonel & Rocco, 2007). Meade II et al. (2009) also studied the soft drink industry in order to examine the role of marketing promotion in implementing a coopetition strategy. They analyzed the marketing promotions offered by leading soft drink vendors, such as Coke and Pepsi, to unpack their competitive and cooperative aspects (Meade II et al., 2009). Their research uncovered the dual-role of marketing promotions wherein "strong brands compete for switchers at the same time they cooperate to preserve margins on loyal customers" (Meade II et al., 2009). They found that while rivals poached bargain shoppers from each other via promotional offers (e.g., coupons) they did not adopt across the board price cuts (Meade II et al., 2009). In this manner, even though some customers defected to a rival (as a result of a promotion) loyal customers did not switch and continued to pay full price for their soft drink of choice (Meade II et al., 2009). By doing this, not only did each firm create the appearance of competition (i.e., by offering promotions) but it did so in a way that avoided mutually destructive price wars (Meade II et al., 2009). This type of behaviour can be regarded as covert or tacit coopetition because while the overt or explicit behaviour appears to be purely competitive it results in partially cooperative results. Such behaviour is described further by Chen, Narasimhan, & Zhang (2001).

2.5 Summary

In this chapter, we presented a review of the literature pertaining to strategic coopetition. The next chapter explains the requirements of a conceptual modeling framework for analysis and design of strategic coopetition. It describes the characteristics of such a framework and situates them in the context of insights about coopetition strategy that are presented in this chapter. It also evaluates extant modeling languages with respect to these requirements.

3. Requirements for a Coopetition Modeling and Analysis Framework

In this chapter, we explain the requirements for a conceptual modeling framework for analyzing strategic coopetition. The existence and presence of factors that vivify and sustain strategic coopetition were generalized within a collection of enterprise requirements. These requirements were expressed in a systematic and structured manner to explore choices and generate options for strategic coopetition. The enterprise level objectives and configurations that pertain to these requirements were incorporated in the design and development of the modeling and analysis framework (i.e., the "framework").

3.1 Primary characteristics[9]

SM researchers have identified various characteristics of coopetition that are essential for analyzing coopetitive relationships[10]. These include complementarity (Tee & Gawer, 2009), reciprocity (Rossi & Warglien, 2000), interdependence (Luo, 2005), and trustworthiness (Bouncken & Fredrich, 2012). Additionally, coopetition is a social phenomenon that involves a minimum of two actors and the ability to represent and reason about actors is a requirement for representing coopetition. In this context, an actor can be any entity that can carry out cooperative and competitive actions. Individuals, groups, teams, divisions, departments, organizations, ecosystems, networks, and nations are examples of actors that can coopete.

3.2 Requirements for expressing and evaluating strategic coopetition

We performed an exploratory literature review to discern the building blocks of strategic coopetition as they appear in the scholarly literature. An exploratory literature review offers "illumination on a process or a problem" leading to a "better understanding" of a focal phenomenon (Hart, 1998). An exploratory literature review is helpful for understanding the key issues and debates; main theories, notions, and approaches; as well as primary questions and problems related to a focal phenomenon as they are presented in scholarly literature (Hart, 1998).

This kind of a literature review (i.e., 'exploratory') is suitable for our purpose because our research undertaking is the first attempt at developing a conceptual modeling framework for analyzing coopetition. As such, our aim is not to be comprehensive and to claim completeness (thereby requiring a 'systematic' literature review), but rather to include those concepts, features, and characteristics that are more frequently, regularly, and customarily invoked in the literature for analyzing coopetition.

[9] Acknowledgement: This section is partially based on: Pant, V., Yu, E. (2018). "Modeling simultaneous cooperation and competition among enterprises". Journal Business & Information Systems Engineering (BISE), Special Issue "Enterprise Modeling for Business Agility". Springer.

[10] Peer-reviewed publications that list primary characteristics of coopetition include: Bengtsson, Eriksson, & Wincent, 2010; Bonel, Pellizzari, & Rocco, 2008; Chin, Chan, & Lam, 2008; Gnyawali & Park, 2009; Zineldin, 2004.

We used Google Scholar to perform an exploratory review of the research literature about coopetition. We selected Google Scholar because it "identifies a collection of articles for a particular research topic" and "provides historical trends in research" (Zientek et al., 2018). A recent assessment of Google Scholar has noted that "the results of the analysis of the size, coverage, growth rate, and speed of indexing of GS fully justify considering this platform as a big data bibliographic tool" (López-Cózar et al., 2019).

Similarly, earlier studies have also validated Google Scholar's scope of coverage of scholarly literature. For example, Chen (2010) asserted that, when contrasted with eight prominent academic databases, Google Scholar resulted in "100 percent retrieval for six databases and 98 percent for the other two databases." Walters (2007) noted that, in comparison to seven leading academic databases, "Google Scholar indexes the greatest number of core articles (93%) and provides the most uniform publisher and date coverage."

During June 2016, we used Harzing's Publish or Perish software to search Google Scholar because this software is useful for analyzing search results from Google Scholar. We performed a search with the keyword "coopetition" and added the terms "feature", "characteristic", "aspect", and "component" to that search. We used the 'OR' operator between "feature", "characteristic", "aspect", and "component" terms and used the 'AND' operator to connect these terms with the main search term (i.e., "coopetition").

This search resulted in approximately[11] 6,660 records with the first publication from 1995 and the last publication from 2016 (i.e., spanning a period of 21 years). We sorted the results by citation to identify research papers with relatively high impact. We filtered search results to include only those research papers with 100 or more citations. This isolated 53 research papers from the overall search results and we read those research papers between June 2016 and September 2016.

We repeated this search in January 2020 to obtain an updated result set and this search resulted in approximately 11,900 records. We filtered search results to include only those research papers published between 2017 and 2020 (i.e., spanning period of 3 years) with 25 or more citations. We reduced the minimum number of citations in our filter from 100 to 25 to account for the relatively shorter duration since the publication of those research papers. This resulted in 13 research papers from the focused search results and we read those research papers between January 2020 and March 2020.

Our reading of these research papers allowed us to identify recurring characteristics that are useful for analyzing coopetition. We compiled a list of characteristics by focusing on aspects of coopetition analysis

[11] Google Scholar does not provide an exact number of results corresponding with a search and offers an estimate of the number of records in a result set.

that appeared frequently in those research papers. Primary characteristics for modeling coopetition as well as the requirements for expressing each characteristic are listed in Table 3-1.

Characteristics	Requirements	Description for Modeling Support
Actor	[A1] Many Actors	Multiple actors.
	[A2] Actor Abstraction	Specialization and composition of actors.
	[A3] Actor Intention	Internal intentional structure of actors.
Complementarity	[C1] Resource / Asset / Object	Entity associated with some value, benefit, or utility.
	[C2] Value Added	Value Added of an activity in a value chain.
	[C3] Added Value	Added Value of an actor to a multi-party economic relationship.
Interdependence	[I1] Dependency	Dependency wherein something must be achieved, performed, or furnished by an actor.
	[I2] Importance of Dependency	Perceived importance of a dependency for an actor from its own perspective.
	[I3] Relative Dependence	Balance or imbalance in perceived importance of dependencies between actors.
Trustworthiness	[T1] Types of trust assessment	Different categories of trust assessments in terms of nature and composition.
	[T2] Determinants of trust assessment	Factors that contribute to trust assessment.
	[T3] Importance of Determinants	Perceived importance of a determinant of trust assessment for an actor from its own perspective.
Reciprocity	[R1] Task	Individual (step) or collection (process) of actions.
	[R2] Sequence	Transitions among states.
	[R3] Outcome	Impact of a decision (in terms of gain, loss, or nothing) for an actor from its own perspective.

Table 3-1 Requirements for modeling strategic coopetition (Source: Adapted from Pant & Yu (2018a))

Research papers in our exploratory literature review framed these characteristics as primary because of their irreducibility for the purpose of analyzing coopetition. These characteristics could not be decomposed into "lower-level" concepts for coopetition analysis. While research papers referred to additional characteristics (e.g., power, control, and influence) they do not appear in Table 3-1. This is because these characteristics could themselves be constructed from the primary characteristics that are listed in Table 3-1 and thus were not regarded as primary. Characteristics such as power, control, and influence were not irreducible, with respect to coopetition analysis, as they could be explained with reference to the primary characteristics in Table 3-1.

The requirements for each characteristic were synthesized based on their descriptions and explanations in research papers in our exploratory literature review. We inferred the requirements for modeling and analyzing each characteristic by carefully reviewing their meaning and nature as discussed in those research papers. By performing the exploratory literature review in 2016 and repeating it in 2020, we were able to confirm that this list of characteristics as well as our understanding of these characteristics remained accurate and grounded in the research literature.

We acknowledge that other researchers may select other sources or otherwise determine that different requirements are necessary for modeling and analyzing coopetition. This list of requirements may also change if the conceptions of these characteristics are updated in the research literature about coopetition.

Reasoning about coopetition in a structured and systematic manner necessitates the orderly contemplation and methodical consideration of each characteristic. This entails expressing and evaluating the requirements of each characteristic thoroughly and prudently because the requirements of a characteristic portray its parts. The requirements of a characteristic collectively offer a holistic depiction of it. Inability to express a requirement of a characteristic may impair full representation of that characteristic. This can lead to incomplete models that are susceptible to errors and omissions during the analysis phase.

3.2.1 Actors

The framework should support the expression and evaluation of actors. An actor can be any entity that has the capability to engage in coopetition such as a person, a team, an organization, or an ecosystem. Requirement A1 in Table 3-1 is "many actors" which refers to the modeling of "multiple actors" because coopetition occurs between two or more actors (Brandenburger & Nalebuff, 1995). Requirement A2 is "actor abstraction" which refers to modeling of "specialization and composition of actors" because coopetition is a multi-level phenomenon in which different kinds and groups of actors can have simultaneously cooperative and competitive relationships with each other (Brandenburger & Nalebuff, 1996). Requirement A3 is "actor intention" which refers to modeling of "internal intentional structure of actors" because coopetition can be willful and voluntary or it can be coincidental and accidental (Nalebuff & Brandenburger, 1997). Some of the questions about actors that should be answerable by applying the modeling framework to a particular case are listed in Table 3-2. These questions can help to support an integrative assessment of coopetition by representing each actor and its relationships.

Sample Question	Significance
Which actors are involved in a coopetitive relationship?	If pure competition/cooperation is better in comparison to coopetition then an actor might not coopete.
What are the goals of each coopeting actor?	If goals can be achieved without simultaneous cooperation and competition then coopetition will be unnecessary.
Why do actors depend on each other in a coopetitive relationship?	External factors beyond the control of actors may impel or impede coopetition among those actors.
Are actors coopeting directly or indirectly (i.e., via intermediary actors)?	Structural configuration of coopetition will impact nature and scope of cooperation and competition.
How do actors judge and compare options for achieving their goals?	Trade-offs among available choices to fulfil objectives may need to be analyzed.

Table 3-2 Questions about actors that should be answerable by applying the modeling framework to a particular case (Source: Derived from Brandenburger & Nalebuff (1995, 1996))

3.2.2 Complementarity[12]

The framework should support the articulation and assessment of complementarity because complementarity is a key motivator of coopetitive relationships. Brandenburger & Nalebuff (1996) note that coopetition occurs when organizations cooperate to grow the pie and compete to split the pie. Synergy, which is colloquially referred to as the 'whole being greater than the sum of its parts', can be used to grow the pie in a coopetitive relationship. Milgrom & Roberts (1995) credit Edgeworth for introducing this concept into economics, where it has been studied extensively. They note that the notion of complementarity can be applied to inputs, such as goods and services, as well as activities (Milgrom & Roberts, 1994).

Complementarity exists when certain entities are perceived as being more valuable when they are together than when they are separate. Requirement C1 in Table 3-1 is "Resource/Asset/Object" which refers to the modeling of "entity associated with some value, benefit, or utility" because "complementarity refers to the degree to which the value of an asset or activity is dependent on the level of other assets or activities" (Kyriakopoulos & Moorman, 2004).

Brandenburger & Nalebuff (1995, 1996) assert that coopetition is predicated on the logic of cooperating to "grow the pie" and competing to "split the pie". In order to coopete, organizations collaborate to create higher collective value while rivaling to appropriate maximum individual value. This requires this framework to accommodate the representation of value.

Two aspects of value that must be supported by a framework for modeling coopetition include *value-added* of an activity in a value chain and *added-value* by an actor in a strategic relationship. *Value-added* of an activity refers to incremental value that is added by the performance of an activity in a value chain. In contrast, *added-value* refers to the increase in the overall worth of a strategic relationship that is attributable to the participation in that relationship by a specific actor.

Each of these concepts are relevant for understanding the extent to which cooperation among actors can help to create value surplus and the degree to which each actor can obtain a share of that surplus value through competition. The absence of this capability to encompass these two kinds of value can inhibit a full understanding of simultaneous cooperation and competition among organizations.

Brandenburger & Nalebuff (1996) explain that a "complementor" is an actor that makes a focal actor more valuable/attractive to a buyer/seller when that buyer/seller can buy/sell from/to both actors rather than when it can only do so with one of them alone. Requirement C2 is "Value Added" which refers to the modeling

[12] Acknowledgement: This section is partially based on: Pant, V., & Yu, E. (2017). Modeling Strategic Complementarity and Synergistic Value Creation in Coopetitive Relationships. In: Proceedings of 8th International Conference of Software Business, ICSOB 2017, Essen, Germany. Berlin: Springer.

of "value-added of an activity in a value chain" because "complementarity refers to the combined returns from the combination of two or more assets, with some combinations resulting in higher value creation than other combinations" (Tee & Gawer, 2009).

The effects of complementarity can be observed in a variety of enterprise functions ranging from marketing and sales to production and distribution. Examples of the former include goods/services that are regarded by consumers as being more valuable together than separately. For instance, Barquera et al. (2008) and Ng et al. (2012) claim that coffee and milk are complements. Examples of the latter include economies of scope wherein it is cheaper for a firm to manufacture/deliver goods/services jointly in comparison to manufacturing/delivering each good/service individually. For instance, Tsuji (1999) asserts that economies of scope can be found in "department stores which offer consumer loans" and "electric appliances makers which produce PCs". Complementarity is a key motivation for rival vendors to join software ecosystems.

An important challenge in managing complementarity between organizations pertains to the division of surplus value that is co-created by those organizations (Brandenburger & Nalebuff, 1996). Each complementor has a claim on the value surplus because gains from synergy are jointly created by all complementors (Brandenburger & Stuart, 1996).

Requirement C3 is "Added Value" which refers to the modeling of "added-value of an actor to a multi-party economic relationship" because each complementor leverages its bargaining power and negotiating leverage over other complementors to maximize its individual share of the surplus value that is jointly created by those complementors (Brandenburger & Nalebuff, 1995). Some of the questions about complementarity that should be answerable by applying the modeling framework to a particular case are listed in Table 3-3.

Sample Question	Significance
Does complementarity exist between focal actors in a coopetitive relationship?	If the potential for collectively creating value surplus is not available then actors might not choose to coopete.
Can focal actors co-create value surplus?	Inability to collectively realize potential value surplus will undermine coopetitive intent.
Can each actor appropriate a portion of surplus value?	Inability to individually appropriate surplus value may void motivation for coopetition among incapable actors.
Are gains from synergy equally available to each actor?	Major imbalance in appropriability of surplus value may discourage weaker actors from engaging in coopetition.
How can an actor increase its share of the co-created value surplus?	Ability for an actor to increase its share of co-created value surplus may incentivize that actor to coopete.

Table 3-3 Questions about complementarity that should be answerable by applying the modeling framework to a particular case (Source: Derived from Brandenburger & Nalebuff, 1995, 1996; Nalebuff, & Brandenburger, 1997)

3.2.3 Reciprocity[13]

The framework should support the modeling and analysis of reciprocity because reciprocity is a vital component of coopetitive relationships. Reciprocity is colloquially referred to as "tit-for-tat" which signifies the instinctive impulse in humans for rewarding a benefactor for favorable behaviour and retaliating against an adversary for injurious conduct. Sobel (2005) asserts that strategic actors should "expect this behavior from others" because, as Fehr & Gächter (2000) note, this reflects "a rather stable behavioral response by a nonnegligible fraction of the people".

Requirement R1 in Table 3-1 is "task" which refers to the modeling of "individual (step) or collection (process) of actions" because a reciprocal event is triggered by some other event (Fehr & Gächter, 2000). Requirement R2 is "sequence" which refers to the modeling of "transitions among states" because reciprocality entails a series of events that are linked in a causal chain (Wilhelm & Sydow, 2018). Requirement R3 is "outcome" which refers to the modeling of "impact of a decision (in terms of gain, loss, or nothing) for an actor from its own perspective" because reciprocity entails "rewarding kindness with kindness and punishing unkindness with unkindness" (Ashraf et al 2006).

The near ubiquity of reciprocity serves as a signal that the actions of an actor will very likely be met by similar actions by impacted actors. In this way, reciprocity serves as a reliable predictor of actions. For example, if an organizational partner cheats its ally then the aggrieved actor will likely retaliate by engaging in opportunistic conduct. Conversely, if an organizational partner noticeably foregoes opportunism then its ally will likely also refrain from cheating. Therefore, an actor can safely assume that its organizational partners are likely to respond to its actions symmetrically. Some of the questions about reciprocity that should be answerable by applying the modeling framework to a particular case are listed in Table 3-4.

Sample Question	Significance
Is each actor capable of reciprocating?	Some actors may be capable of reciprocating directly while others may only be able to do so indirectly (i.e., via intermediaries).
Is reciprocality mutually beneficial for each actor in a coopetitive relationship?	Reciprocation may discourage other actors from behaving opportunistically and may encourage them to behave benevolently.
How can reciprocation be disadvantageous for any actor?	Spontaneous retaliation may damage reputation and deplete goodwill.
Is symmetrical/asymmetrical reciprocation advantageous/disadvantageous?	Disparity between move and countermove may alter degree of benefit/harm from reciprocation.
Which types of barriers can impede an actor's ability to reciprocate vis-à-vis another actor?	External factors such as laws and customs may impede reciprocation.

Table 3-4 Questions about reciprocity that should be answerable by applying the modeling framework to a particular case (Source: Derived from Rossi & Warglien, 2000)

[13] Acknowledgement: This section is partially based on: Pant, V., Yu E. (2019). A Modeling Approach for Getting to Win-Win in Industrial Collaboration under Strategic Coopetition. Complex Systems Informatics and Modeling Quarterly (CSIMQ) Journal.

3.2.4 Trustworthiness[14]

The framework should support the expression and evaluation of trustworthiness because trust is an essential component of coopetitive relationships. Hutchinson et al. (2012) define trust as "the expectation that another business can be relied on to fulfill its obligations". Judge & Dooley (2006) note that it helps to "reduce the level of potential and actual opportunism". Fernandez, Roy, & Gnyawali (2014) assert that trust is a "key factor for success of co-opetitive strategies". Trust plays a role in every relationship where any party is vulnerable to exploitation by another party due to a fundamental drawback in all contracts that govern strategic relationships[15].

Requirement T1 in Table 3-1 is "types of trust assessment" which refers to the modeling of "different categories of trust assessments in terms of nature and composition" because trust can be: calculative, understanding, and bonding (Child, Faulkner, & Tallman, 2006). In the first type, organizations codify the terms and conditions of their relationship so that the benefits from cooperation and costs of reneging are explicitly documented (Child, Faulkner, & Tallman, 2006). Each organization, in this type of trust, monitors its dealings with other organizations closely to learn about their intentions and motivations (Child, Faulkner, & Tallman, 2006). In the second type, organizations begin to rely less on formal agreements or binding covenants as they begin to understand each other through recurring interactions and continued engagements (Child, Faulkner, & Tallman, 2006). Over time, through repeated fair dealings and mutually advantageous collaborations, the employees of cooperating organizations form emotional bonds with each other (Child, Faulkner, & Tallman, 2006). In the third type, employees from different organizations establish social relationships which obviates the need for detailed contracts (Child, Faulkner, & Tallman, 2006). In this type, punitive remedies are supplanted by positive inter-personal relationships as guarantors of favorable treatment and beneficial conduct (Child, Faulkner, & Tallman, 2006).

Requirement T2 is "determinants of trust assessment" which refers to the modeling of "factors that contribute to trust assessment" because trust operates through, "(a) impartiality in negotiations, (b) trustworthiness, and (c) keeping of promises" (Bouncken & Fredrich, 2012). Requirement T3 is "importance of determinants" which refers to the modeling of "perceived importance of a determinant of trust assessment for an actor from its own perspective" because "trustworthiness is an attribute of individual

[14] Acknowledgement: This section is partially based on: Pant, V., Yu, E. (2018). Using *i** to Analyze Trust-Building Strategies for Organizations under Coopetition. In: 11th International *i** Workshop 2017.

[15] In his seminal work on Transaction Cost Economics, Williamson (1979) notes that contracts governing strategic relationships are "necessarily incomplete (by reason of bounded rationality)". This is because the state space of choices and decisions in real-world strategic relationships is incomprehensibly large and it is impossible to predict all possible options and potential decisions by every party in advance (i.e., when a contract is being negotiated).

exchange partners” (Barney & Hansen, 1994). Some of the questions about trustworthiness that should be answerable by applying the modeling framework to a particular case are listed in Table 3-5.

Sample Question	Significance
What kind of trust exists between actors in a coopetitive relationship?	Kind of trust may impel or impede cooperation among coopeting actors.
Which factors contribute to a coopeting actor's perception of the trust assessment of another actor?	Degree of trust among coopeting actors may be predicated upon several factors.
Are perceptions of trust assessments among actors symmetrical in a coopetitive relationship?	Variances in trust perceptions among coopeting actors may encourage/discourage different behaviours.
Do all cooperative actions by an actor increase trust?	Intention to improve perception of trust assessment by an actor may encourage specific conduct.
Do all competitive actions by an actor decrease trust?	Intention to avoid damaging perception of trust assessment by an actor may discourage specific conduct.

Table 3-5 Questions about trustworthiness that should be answerable by applying the modeling framework to a particular case (Source: Derived from Bouncken & Fredrich, 2012)

3.2.5 Interdependence[16]

The framework should support the expression and evaluation of interdependence because interdependence is a key facet of coopetitive relationships. Requirement I1 in Table 3-1 is “dependency” which refers to the modeling of a “dependency wherein something must be achieved, performed, or furnished by an actor” because it depicts “the extent to which work processes that have strategic implications are interrelated” (Luo, 2005). Organizations in a coopetitive relationship can be mutually dependent on each other for resources, activities, or both. Typically dependence arises when an organization is not able to achieve its goals by itself and thus relies on another organization for the completion of a task or procurement of an asset.

Interdependence is necessary in coopetitive relationships to increase gains from cooperation while minimizing risks from competition. Requirement I2 is “importance of dependency” which refers to the modeling of “perceived importance of a dependency for an actor from its own perspective” because “each competitor will have a specific individual interest in carrying out an agreement” of a cooperative nature (Garraffo & Rocco, 2009). Requirement I3 is “relative dependence” which refers to the modeling of “balance or imbalance in perceived importance of dependencies between actors” because participants in coopetitive relationships typically share “partially congruent interest structures” since coopetition requires competitors to cooperate (Castaldo & Dagnino, 2009).

[16] Acknowledgement: This section is partially based on: Pant, V., Yu, E. (2018). “Modeling simultaneous cooperation and competition among enterprises”. Journal Business & Information Systems Engineering (BISE), Special Issue “Enterprise Modeling for Business Agility”. Springer.

Perceived aggregate interdependence among coopeting actors moderates the relative intensities of cooperation and competition within a coopetitive relationship. Greater perceived aggregate interdependence fosters relatively more cooperation than competition while lesser perceived aggregate interdependence results in relatively more competition than cooperation. Therefore, symmetrical and proportionate perceived aggregate interdependence can equilibrate and stabilize a coopetitive relationship. Some of the questions about interdependence that should be answerable by applying the modeling framework to a particular case are listed in Table 3-6.

Sample Question	Significance
Is perceived relative dependence between coopeting actors symmetrical?	Uneven dependencies may lead to imbalances in relative importance of actors and thereby destabilize coopetition.
Is interdependence mutually beneficial for actors in a coopetitive relationship?	Mutual dependencies between actors might indicate value creation opportunities for each actor.
Can independence reduce any of the risks or uncertainties stemming from interdependence?	Vulnerabilities from depending on another actor may outweigh opportunities from that dependency.
How can an actor increase or decrease its dependence on another actor?	Ability to increase/decrease dependence on another actor may alter importance of an actor in a relationship.
Which types of barriers can impede an actor's ability to increase or decrease its dependence on another actor?	Inability to increase/decrease dependence on another actor may alter importance of an actor in a relationship.

Table 3-6 Questions about interdependence that should be answerable by applying the modeling framework to a particular case (Source: Derived from Chai, et al., 2019)

3.3 Related Work

3.3.1 Background

Our research focuses on strategic relationships between coopeting actors and our conceptual modeling framework supports the discrimination as well as generation of win-win strategies. No other conceptual modeling framework focuses specifically on this phenomenon. Therefore, none of the existing conceptual modeling frameworks are directly comparable in totality to our framework in terms of scope and objective. Our work represents the first systematic and structured exploration of strategic coopetition using conceptual modeling. However, subsets of requirements for modeling and analyzing strategic coopetition (described in Table 3-1) can be met to different extents by various conceptual modeling frameworks. This subsection provides an overview of related work.

Conceptual modeling entails "representation of selected phenomena of a specific real-world domain to better analyze and design that domain" (Strohmeier & Röhrs, 2017). It "can be seen as a process whereby individuals reason and communicate about a domain in order to improve their common understanding of it" (Gemino & Wand, 2004). It "involves the development of an expressive presentation notation" (Xu, Wang, & Wang, 2005) for information visualization. It is relevant for analyzing strategy as it can be used for "articulating knowledge about relevant business domain features" (Recker & Rosemann, 2010). Jurisica et al. (2004) propose a taxonomy of conceptual modeling ontologies that is comprised of four cateogies: static, dynamic, intentional, and social.

Various conceptual modeling techniques have been proposed to articulate and represent real world entities and their relationships in graphical and diagrammatic formats. For example, *i** (Yu, 2011) is a socio-technical modeling language that focuses on *actors* that are related to each other through *dependencies*.

The Non Functional Requirements (NFR) framework (Chung et al., 2000) is a *goal*-oriented modeling language that focuses on *goals* and their operationalizations that are related through various types of *contribution links*. e3value (Gordijn, Akkermans, & Van Vliet, 2001) is a *value* modeling language that focuses on economic *exchanges* between *actors* that occur via *transactions*.

KAOS (Dardenne, Van Lamsweerde, & Fickas, 1993), which stands for 'Knowledge Acquisition in Automated Specification' also known as 'Keep All Objectives Satisfied', is a *goal*-oriented modeling in which *goals* are assigned to *human* and *software* agents. *Goal*-oriented Requirements Language (GRL) is a modeling language that is useful for analyzing socio-technical systems in terms of *goals* and *agents* (Liu & Yu, 2001).

Conceptual modeling is supported by visual modeling that is used to represent information from conceptual models within artefacts such as diagrams and figures. Such artefacts serve as graphical interfaces of conceptual models (Chi & Lee, 2008).

Alabastro, Beckmann, Gifford, Massey, & Wallace (1995) define visual modeling as “a knowledge acquisition approach that capitalizes on the capability to use pictures to facilitate the communications process.” Modelers typically represent entities and links using notations that conform to one or more standards to depict objects and relationships of interest.

Quatrani (1998) notes “visual modeling is a way of thinking about problems using models organized around real-world ideas.” Koo, Son, & Seong (2003) similarly describe “visual modeling as a way of thinking about problems using models that depict real-world ideas in a visual manner.”

Visual models are helpful for showing objects of interest as well as their relationships with each other and with their respective environments.

Chung and Lee (2003) assert that visual models are used “to visualize, specify, construct, and document work products in standardized diagrams” while Strobl and Minas (2010) point out that “visual modeling is already one of the most useful techniques for describing complex systems”.

3.3.2 Conceptual Modeling

Mylopoulos (1998) describes an approach for evaluating conceptual modeling techniques with respect to requirements for modeling and analyzing any phenomenon or domain. That approach assesses the degree of support offered by each technique (i.e., great, good, OK, so-so, none) vis-à-vis every requirement for modeling and analyzing that focal phenomenon or domain (Mylopoulos, 1998).

We adopt this approach but adapt the set of evaluation scores (i.e., full, partial, none). These evaluation scores are: full (shown as a filled circle) indicating that the standard semantics and syntax of a technique satisfy a requirement and no extensions or modifications are needed; partial (shown as a half-filled circle) indicating that the standard semantics and syntax of a technique do not satisfy a requirement and minor extensions or modifications are needed; and none (shown as an empty circle) indicating that the standard semantics and syntax of a technique do not satisfy a requirement and major extensions or modifications are needed.

An assessment of various techniques in terms of requirements for representing and reasoning about strategic coopetition is presented in Table 3-7. Each requirement is described in Table 3-8.

The selection of these techniques as well as their evaluation in Table 3-7 resulted from a subjective and qualitative assessment of the scholarly literature about conceptual modeling. The techniques in Table 3-7 were selected because they were applied frequently, in the scholarly literature, to express and evaluate strategies.

We acknowledge that these are not the only techniques that can be used to model strategy and other researchers may select other techniques for this purpose. During evaluation, the ontology underlying each technique was reviewed to assess semantic similarity between the concepts in that ontology and the requirements for coopetition modeling.

We also acknowledge that other researchers might interpret the semantics of these techniques differently thereby obtaining different evaluation results with respect to the ability of a technique to meet these requirements. These evaluations are not based upon an overarching consensus among all researchers and should not be regarded as being universally true.

Technique	A1	A2	A3	C1	C2	C3	I1	I2	I3	T1	T2	T3	R1	R2	R3
NFR Framework (Chung et al., 2000)	○	○	○	○	○	○	○	○	○	●	●	●	○	○	○
KAOS (Dardenne et al, 1993)	●	○	○	●	○	○	○	○	○	◓	●	○	●	◓	◓
*i** (Yu, 2011)	●	●	●	●	◓	◓	●	◓	◓	◓	●	○	◓	○	◓
GRL (ITU-T, 2008, 2018)	●	○	●	●	◓	○	●	○	◓	◓	●	○	◓	○	◓
e3value (Gordijn et al, 2006)	●	◓	○	●	●	◓	◓	○	◓	○	○	○	●	◓	◓
Business Model Canvas (Osterwalder et al, 2005)	◓	○	○	●	◓	○	◓	○	○	○	○	○	◓	○	○
Value Network Analysis (Allee, 2008)	●	○	○	●	◓	○	◓	○	◓	○	○	○	●	●	○
Payoff Table (Dixit & Nalebuff, 2008)	●	○	◓	●	○	○	○	○	○	○	○	○	●	○	●
Game Tree (Dixit & Nalebuff, 2008)	●	○	◓	●	◓	◓	○	○	○	○	○	○	●	●	●
Change Matrix (Brynjolfsson et al., 1997)	○	○	○	○	◓	○	○	○	○	◓	●	◓	◓	○	◓

Table 3-7 Assessment of modeling support for requirements from Table 3-1.

Requirement	Type	Description
A1	Many Actors	Multiple actors.
A2	Actor Abstraction	Specialization and composition of actors.
A3	Actor Intention	Internal intentional structure of actors.
C1	Resource / Asset / Object	Entity associated with some value, benefit, or utility.
C2	Value Added	Value Added of an activity in a value chain.
C3	Added Value	Added Value of an actor to a multi-party economic relationship.
I1	Dependency	Dependency wherein something must be achieved, performed, or furnished by an actor.
I2	Importance of Dependency	Perceived importance of a dependency for an actor from its own perspective.
I3	Relative Dependence	Balance or imbalance in perceived importance of dependencies between actors.
T1	Types of trust assessment	Different categories of trust assessments in terms of nature and composition.
T2	Determinants of trust assessment	Factors that contribute to trust assessment.
T3	Importance of Determinants	Perceived importance of a determinant of trust assessment for an actor from its own perspective.
R1	Task	Individual (step) or collection (process) of actions.
R2	Sequence	Transitions among states.
R3	Outcome	Impact of a decision (in terms of gain, loss, or nothing) for an actor from its own perspective.

Table 3-8 Requirements for modeling interorganizational coopetition reproduced from Table 3-2.

The rationale for these evaluations is presented next.

NFR Framework: NFR Framework (Chung et al., 2000) does not include any notion of intentional agents and therefore 'Actor' (A1, A2, A3) and 'Interdependence' (I1, I2, I3) requirements are depicted as empty circles. The concept of value is also absent in NFR Framework and hence requirements pertaining to 'Complementarity' (C1, C2, C3) are also shown as empty circles. NFR Framework does not provide any means for satisfying 'Reciprocity' (R1, R2, R3) requirements and thus these are depicted as empty circles. Trustworthiness (T1, T2, T3) requirements need support for modeling *goal* hierarchies (T2) with *prioritization* (T3) as well as *type* and *topic* refinement (T1). Each of these requirements can be met by the NFR Framework so these requirements are depicted as full circles.

KAOS: KAOS (Dardenne, Van Lamsweerde, & Fickas, 1993) includes the notion of *agent* such that any number of *agents* can be depicted in a KAOS model. This aspect of KAOS can be used to fully satisfy 'Actor' requirements related to multiple actors (A1). However, KAOS does not support specialization or composition of actors and therefore requirement A2 cannot be satisfied. In KAOS, *requirements* can be assigned to *agents* as *responsibilities* but KAOS does not support the depiction of the *goals* of those *agents* (A3). Moreover, KAOS does not include any concept of dependence that can be used to reason about reliance among *agents*. Therefore, KAOS is unable to satisfy 'Interdependence' criteria (I1, I2, I3). KAOS includes the notion of *object* and this can be used to satisfy the 'Complementarity' requirement pertaining to an *object* that yields some benefit (C1). Since KAOS lacks the notion of value, it cannot be used to meet the requirements associated with value-added (C2) and added-value (C3) respectively. KAOS supports connections between *requirements* and *operations* through *operationalization* links and thus 'Trustworthiness' requirement T2 can be fully satisfied. While KAOS supports *goal* hierarchies, those *goal* hierarchies do not support type and topic refinement and hence requirement T1 is only partially satisfied. KAOS does not include the concept of prioritization or importance and thus T3 cannot be satisfied. KAOS includes the notion of *operation* and this can be used to fully satisfy 'Reciprocity' requirement R1. *Goals* in KAOS can have temporal attributes (i.e., achieve, maintain, cease, avoid) to support event-oriented reasoning related to state-transitions. However, this temporal attribute is coarse-grained and its value is constrained to a pre-set list therefore requirement R2 cannot be fully satisfied. The notion of *operationalization* in KAOS can be used to reason about impact of an *operation* on a *requirement*. However, since actor intentionality is omitted in KAOS models, this impact cannot be assessed in terms of the subjective perceptions of various *agents*. Therefore, R3 is only partially satisfied in KAOS.

i*: *i** (Yu, 2011) supports the notion of generic as well as specialized (*agents*, *positions*, and *roles*) *actors*. This can be used to fulfill 'Actor' requirements A1 and A2. Additionally, *actors* in *i** are intentional entities and their internal intentional structures can be depicted in *i** models. This can be used to satisfy requirement A3. The *resource* object in *i** represents physical or information entities and this can be used to satisfy

‘Complementarity’ requirement C1. The contribution of a *resource* to the achievement of a *goal* can be ascertained by tracing the relationship of that *resource* to one or more *tasks* that satisfy that *goal*. However, this can be used to only partially satisfy requirement C2 because *i** does not support the analysis of the degree of contribution that is made by a *resource* to the fulfilment of a *task*. *i** supports the depiction of the *priority* (open/uncommitted, committed, critical) of a *dependency* among *actors.* While this is relevant for understanding the relative worth of an actor in a multi-party economic relationship, it can be used to only partially achieve requirement C3 because this attribute is coarse-grained and it can only be assigned a value from a pre-defined list. The notion of *dependency* in *i** can be used to satisfy ‘Interdependence’ requirement I1. As indicated above, *i** supports the depiction of *priority* of a dependency but that this attribute is coarse-grained and can only assume a value from a pre-specified list. Therefore, requirement I2 can be only partially fulfilled with *i*.* It is possible to compare dependencies between each pair of actors in an *i** model, in an ad hoc manner, to assess their relative dependence on each other. However, *i** does not provide any means for performing this analysis in a systematic manner and thus I3 can only be partially satisfied. *i** supports depiction of *goal* hierarchies but does not support type and topic refinement. Therefore, this can be used to only partially satisfy ‘Trustworthiness’ requirement T1. *i** supports the depiction of *task decomposition* (to show relevant *resources*) as well as *contribution links* between *tasks* and *goals* as well as *softgoals*. This can be used to satisfy requirement T2. However, T3 cannot be satisfied because *goals* cannot be *prioritized* in *i*. i** includes the notion of *task* and this can be used to satisfy ‘Reciprocity’ requirement R1. *i** does not support temporal reasoning or reasoning with sequence therefore ‘Reciprocity’ requirement R2 cannot be fulfilled with *i*. i** includes the concept of *goals* and *softgoals* (quality criteria) and these can be used to understand *tasks* in terms of their impact. However, these *tasks* cannot be arranged in a sequential manner and thus R3 can be only partially fulfilled.

GRL: Goal-oriented Requirement Language (GRL) includes the notion of *actors* (ITU-T, 2008, 2018) and this can be used to achieve the ‘Actor’ requirement A1. GRL supports the representation of the international intentional structure of *actors* and this can be used to fulfill requirement A3. However, GRL does not support the specialization or composition of *actors* and hence A2 cannot be satisfied. The *resource* object in GRL can be a physical or informational entity that is necessary for performing a *task* that is needed to achieve some *goal*. This can be used to achieve ‘Complementarity’ requirement C1. The contribution of a *resource* to the fulfilment of a *goal* can be analyzed by mapping the relationship of that *resource* to one or more *tasks* that satisfy that *goal*. However, this can be used to only partially satisfy requirement C2 because *GRL* does not support the assessment of the magnitude of contribution that is made by a *resource* to the completion of a *task*. GRL does not support the prioritization of *dependencies* among *actors* and therefore it cannot be used to assess the economic worth of an actor in a multi-party economic relationship. Therefore, C3 cannot be achieved with GRL. The concept of *dependency* in GRL can be used to fulfill

‘Interdependence’ requirement I1. As indicated above, GRL does not support the depiction of *priority* of a *dependency* and hence, requirement I2 cannot be fulfilled with GRL. It is possible to compare dependencies between each pair of actors in an GRL model, albeit without an understanding of their respective priorities, to analyze their relative reliance on each other. However, GRL does not provide any means for conducting this assessment in a systematic manner and thus I3 can only be partially satisfied. GRL supports depiction of *goal* hierarchies, but without type and topic refinement, so this can be used to only partially satisfy ‘Trustworthiness’ requirement T1. GRL supports the depiction of *task decomposition* (to show pertinent *resources*) as well as *contribution links* between *tasks* and *goals* as well as *softgoals*. This can be used to satisfy requirement T2. However, T3 cannot be satisfied because *goals* cannot be *prioritized* in GRL. The concept of *task* is included in GRL and this can be used to achieve ‘Reciprocity’ requirement R1. GRL does not support temporal analysis or reasoning with sequence therefore ‘Reciprocity’ requirement R2 cannot be fulfilled with GRL. The notions of *goals* and *softgoals* (quality criteria) are included in GRL and these can be used to comprehend *tasks* in terms of their impact. However, these *tasks* cannot be sequenced in a sequential manner and hence R3 can be only partially fulfilled.

e3value: e3value (Gordijn et al, 2006) includes the concept of *actor* and this can be used to satisfy the ‘Actor’ requirement A1. *Actors* in e3value can be composed of other *actors* but they cannot be specialized. Therefore, requirement A2 can be met only partially with e3value. Actor intentionality cannot be depicted with e3value and thus A3 cannot be fulfilled using e3value. The notion of *value objects* in e3value can be used to satisfy ‘Complementarity’ requirement C1. e3value supports the representation of *value exchanges* between *actors* and this can be used to meet requirement C2. In e3value, *value objects* in *value exchanges* between *actors* can be compared to understand the value created by each *actor*. However, e3value does not provide any means for directly assessing the worth of an actor in a multi-party economic relationship independent of *value transactions* and hence C3 can be only partially satisfied. *Value objects* within *value exchanges* in e3value can be used to show dependence between different *actors* for various things. However, this can be used to only partially fulfill ‘Interdependence’ requirement I1 because its scope is solely limited to those dependencies that involve *value objects*. e3value does not support the concept of importance with respect to *value exchanges*, or the *value objects* within them, and hence e3value cannot be used to satisfy requirement I2. *Value objects* in *value exchanges* between different pairs of *actors* can be analyzed to comprehend the degree of inter-dependence among those *actors*. However, this can be used to only partially satisfy I3 because this is not a part of standard analysis that is performed with e3value. e3value does not include any concepts that are pertinent for depicting the notion of trust and thus ‘Trustworthiness’ requirements T1, T2, and T3 cannot be satisfied with e3value. *Activity* in e3value can represent one or more actions and this can be used to satisfy ‘Reciprocity’ requirement R1. Sequence cannot be expressed directly in e3value but the notion of *value transfer* implies a temporal separation between *value transactions*.

Therefore, requirement R2 can be met only partially with e3value. In e3value, the impact of a *value transfer* cannot be contextualized in terms of the goals of an *actor*. However, the outcome from a *value transfer* can be analyzed for an *actor* in terms of *value objects* and thus R3 can be only partially achieved with e3value.

Business Model Canvas: Business Model Canvas (BMC) includes the notions of *partners, channels,* and *customer segments* (Osterwalder et al, 2005). This can be used to only partially satisfy 'Actor' requirement A1 because these are specific types of actors and other types of actors cannot be depicted in a BMC. It is not possible to specialize or compose actors in BMC and therefore requirement A2 is not satisfied. Moreover, BMC does not support the depiction of actor intentionality and thus requirement A3 cannot be fulfilled. BMC includes the concept of *value propositions* and these can be used to satisfy the 'Complementarity' requirement C1. BMC supports the depiction of *key activities* and these can be used to infer the value associated with an activity. However, this can be used to only partially satisfy requirement C2 because activities are unconnected and the contribution of an activity is not contextualized within a value chain. BMC does not provide any means for reasoning about the worth of an actor in a multi-party economic relationship and therefore C3 is not fulfilled. BMC does not support the notion of reliance among various types of actors (e.g., *partners, channels, customer segments*) and any relationships can solely be deduced indirectly based on domain knowledge or contextual understanding. Therefore, 'Interdependence' requirement I1 can be only partially satisfied with BMC. BMC does not offer any means for representing importance of relationships among actors and therefore requirements I2 and I3 cannot be satisfied. BMC supports the depiction of *key activities* and this can be used to only partially satisfy 'Reciprocity' requirement R1 because *activities* are not connected to any kind of objectives. Requirement R2 cannot be satisfied with BMC because support for linking *activities* is not provided. R3 cannot be fulfilled with BMC since objectives cannot be modeled and thus it is not possible to assess the impact of any activity. BMC does not include any concept that is suitable for depicting the notion of trust and therefore 'Trustworthiness' requirements (T1, T2, T3) cannot be satisfied.

Value Network Analysis: Value Network Analysis (VNA) supports the notion of *actors* (Allee, 2008) and this can be used to satisfy 'Actor' requirement A1. However, VNA does not support specialization or composition of *actors* and thus it cannot be used to fulfill requirement A2. Moreover, actor intentionality cannot be expressed in VNA therefore A3 cannot be achieved. VNA includes the concept of *value* and this can be used to satisfy 'Complementarity' requirement C1. VNA can be used to reason about *tangible* and *intangible* exchanges of *value*. This can be used to only partially achieve requirement C2 because incremental value added by a specific exchange cannot be isolated. It is not possible to satisfy C3 with VNA because there are no means to depict the relative worth of an *actor* within a multi-party economic relationship. *Deliverables* within *value exchanges* in VNA can be used to show reliance for various objects among different actors. However, this can be used to only partially fulfill 'Interdependence' requirement I1 because it only covers those dependencies that involve objects. VNA does not support the notion of importance with respect to *value exchanges*, or the *deliverables* within them, and thus VNA cannot be used to satisfy requirement I2. *Deliverables* in *value exchanges* between different pairs of *actors* can be assessed to understand the degree of inter-dependence in those dyads. However, this can be used to only partially satisfy I3 because this can be performed solely in an ad hoc manner with VNA. 'Trustworthiness' requirements T1, T2, and T3 cannot be fulfilled with VNA as it does not provide any means to represent the notion of trust within relationships. The concept of *value exchange* in VNA can be used to satisfy the 'Reciprocity' requirement R1. The order of value exchanges can be depicted in VNA and this can be used to fulfill requirement R2. VNA does not support the depiction of goals of *actors* and thus the impact of a *value exchange* cannot be assessed. Therefore, R3 cannot be achieved with VNA.

Payoff Table: Payoff Table (Dixit & Nalebuff, 2008) includes the concept of *players* and this can be used to satisfy 'Actor' requirement A1. However, actor specialization or composition is not supported with Payoff Tables hence they cannot be used to achieve requirement A2. Actor intentionality is encoded within *payoffs* in a Payoff Table but the causes of those *payoffs* are not expressed directly. Therefore, A3 can be only partially fulfilled with Payoff Tables. Payoff Tables model simultaneous *move games* and the notion of *move* in Payoff Tables can be used to achieve 'Complementarity' requirement C1 because a *player* earns a *payoff* based on its *move*. However, Payoff Tables do not support the depiction of multiple *moves*/*countermoves* in a *decision path* and therefore they cannot be used to satisfy requirements C2 and C3. Payoff Tables do not support an explicit notion of dependency among *players*. Interdependence among *players* is deduced from their presence in the same *game* but it is not expressed directly in Payoff Tables. Therefore, 'Interdependence' (I1, I2, I3) requirements cannot be satisfied with Payoff Tables. Similarly, Payoff Tables do not support the portrayal of trust among *players*. It may be feasible to infer trust between *players* based on *payoffs* associated with the *move* of each *player* in the same *game*. However, this is not a part of standard analysis that is supported by Payoff Tables and hence 'Trustworthiness' (T1, T2, T3) requirements cannot be fulfilled with Payoff Tables. The *move* of each *player* can be expressed in Payoff Tables and this can be used to satisfy 'Reciprocity' requirement R1. In a Payoff Table, each *player* only makes a single *move* in a *game* therefore the requirement R2 cannot be satisfied with a Payoff Table. The *move* by a *player* results in the *payoff* that is received by that *player* and this can be used to fulfill R3.

Game Tree: Game Tree (Dixit & Nalebuff, 2008) includes the notion of *players* and this can be used to satisfy 'Actor' requirement A1. However, Game Trees do not support actor specialization or composition thus they cannot be used to achieve requirement A2. Game Trees encode actor intentionality within *payoffs* however they do not explicate the causes of those *payoffs*. Therefore, A3 can be only partially fulfilled using Game Trees. Game Trees model sequential *move games* and the concept of *moves*/*countermoves* in Game Trees can be used to satisfy 'Complementarity' requirement C1 because they are associated with *payoffs* for *players*. *Payoffs* can also be examined to understand the utility of complete *decision paths* for each *player*. However, Game Trees do not support the decomposition of a *payoff* into parts associated with individual *moves*/*countermoves* in a *decision path*. Therefore, it can be used to only partially achieve requirement C2. *Payoffs* along different *decision paths* can be compared to understand the worth of a *player* in a multi-party economic relationship. However, the underlying factors that determine the worth of any *player* cannot be understood from Game Trees and hence, it can be used to only partially fulfill C3. Game Trees do not include an explicit notion of dependency among *players*. Inter-reliance among *players* is inferred from their presence in common *decision paths* but it is not indicated directly in Game Trees. Therefore, 'Interdependence' (I1, I2, I3) requirements cannot be satisfied with Game Trees. Similarly. Game Trees do not support the representation of trust among *players* in an explicit manner. It may be possible to extrapolate trust among *players* based on *payoffs* associated with different *decision paths*. However, this is not a part of standard reasoning that is supported by Game Trees and hence 'Trustworthiness' (T1, T2, T3) requirements cannot be achieved with Game Trees. Game Trees support the expression of *move*/*countermove* among *players* and this can be used to satisfy 'Reciprocity' requirement R1. A *decision path* depicts a particular sequence of steps in which each step corresponds to a *move*/*countermove* by a *player*. This notion of *decision path* can be used to fulfill requirement R2. Each *decision path* yields the *payoff* that is received by each *player* and this can be used to achieve R3.

Change Matrix: Change Matrix (Brynjolfsson et al., 1997) does not include the notion of intentional entities such as actors or agents and therefore it can not be used to satisfy 'Actor' (A1, A2, A3) and 'Interdependence' (I1, I2, I3) requirements. Goals are represented in a Change Matrix in terms of multi-level *practices* that that lead to the attainment of desired outcomes. This can be used to only partially satisfy 'Trustworthiness' requirement T1 because *practices* cannot be refined in terms of type and topic. Complementary and competing *interactions* among *practices* can be depicted in a Change Matrix and this can be used to fully satisfy requirement T2. *Practices* can be prioritized to show the relative importance of one *practice* vis-à-vis another. This can be used to only partially satisfy T3 because the notion of priority is not explicitly attached to a *practice* but rather it is implicitly encoded in that *practice* (i.e., expressed in wording of its label). Change Matrix does not support the notion of objects explicitly and assumes that relevant objects are included in the scope of a *practice*. This inhibits the ability of distinguishing between objects and actions in Change Matrix and thus 'Complementarity' requirement C1 cannot be satisfied. Change Matrix includes the notions of *complementary* and *competing practices* to assess the significance of one practice on another and the *value* of a *practice* is judged in the context of other *practices* that are impelled or impeded by it. This can be used to only partially satisfy requirement C2 because utility or benefit of a *practice* can only be assessed in term of other *practices* but not other criteria that are independent of *practices*. The worth of an actor in a multi-party economic relationship (C3) cannot be analyzed in a Change Matrix but there is no support for modeling of *actors*. The transition from *existing* to *target practices* in Change Matrix represents a shift among states that can be used to only partially achieve 'Reciprocity' requirement R1. This is because this state transition is not portrayed directly but rather inferred from the difference between *existing* and *target practices*. Moreover, one Change Matrix can only show one state transition for each pair of *existing* and *target practices*. Therefore, it cannot be used to satisfy requirement R2. The notion of *existing practice* in Change Matrix can be used to model outcomes and this can be used to only partially satisfy R3 because some outcomes may indicate goals explicitly while others may not.

Next, we present a summary of these evaluations.

Actor: Among the ten languages that are listed in Table 3-7, eight support the depiction of multiple actors (A1). Languages such as KAOS, *i**, GRL, e3value, VNA, Payoff Table, and Game Tree do not restrict the types of actors that can be modeled. However, BMC only supports the depiction of specific kinds of actors (partners, channels, and customer segments). NFR Framework and Change Matrix do not include the notion of actor of any kind. *i** is the only language in in Table 3-7 that supports specialization and composition of actors (A2) while e3value supports composition but not specialization. The remaining eight languages do not support specialization or composition. Actor intentionality (A3) can be depicted with only four languages in Table 3-7. *i** and GRL support the representation of internal intentional structure of *actors* while Payoff Table and Game Tree implicitly encode the intentionality of a *player* into its *payoff*. The other six languages in Table 3-7 do not support the depiction of actor intentionality.

Complementarity: Eight languages in Table 3-7 include concepts that are relevant for modeling entities that are associated with value, benefit, or utility (C1). *i** and GRL include *resources*, e3value and KAOS include *objects*, VNA includes *deliverables*, BMC includes *value propositions*, and Payoff Table as well as Game Tree include *moves*. These can be used to depict entities that are related to value, benefit, or utility. The remaining two languages do not support the depiction of such entities. Among the ten languages that are included in Table 3-7 seven support the representation of value added by an activity in a value chain (C2). *Value exchanges* in e3value can be analyzed to understand the contribution of *value activities* for each *actor* in terms of *value objects*. Goal satisfaction analysis can be performed in *i** and GRL but value for each *actor* can only be inferred indirectly based on the achievement of objectives. BMC supports the representation of *key activities* and these can be used to deduce the value associated with an activity. VNA can be used to analyze *tangible* and *intangible* exchanges to extrapolate *value*. In Game Tree, *payoff* associated with a *decision path* can be assessed to deduce value gained or lost by each *player*. *Interactions* among *complementary*/*competing practices* in Change Matrix can be used to extrapolate the impact of introducing *target practices*. The other three languages in Table 3-7 do not support the direct or indirect depiction of value. The worth of an actor in a multi-party economic relationship can be analyzed with three of the ten languages in Table 3-7. *i** supports the depiction of the *priority* (open/uncommitted, committed, critical) of a *dependency* among *actors*. However, this attribute is coarse-grained and its value can only be assigned from a pre-set list. In e3value, *value exchanges* and *value transactions* between *actors* can be compared to extrapolate differences between *value objects*. However, this cannot be done outside the context of *value transactions* and thus other factors that contribute to the worth of an *actor* may be omitted. In Game Tree, *payoffs* along different *decision paths* can be compared but the determinants of a player's worth cannot be discerned from Game Trees. The remaining seven languages are not suitable for assessing the worth of an actor in a multi-party economic relationship.

Interdependence: Five languages in Table 3-7 support the depiction of dependencies among actors (I1). *i** and GRL contain the notion of *dependency* between a *depender* and a *dependee* over a *dependum*. e3value, and VNA do not support the explicit representation of dependencies but contain the notion of *value exchanges* through *value objects* that can be used to indirectly infer reliance. Similarly, BMC does not include any means for directly reasoning about dependencies but its concepts of *value proposition* and actors (*customer segment*, *partner*, and *channel*) can be helpful for deducing the reliance among various actors. The remaining five languages do not support the representation of dependencies among actors. Among the ten languages that are included in Table 3-7, only one supports the depiction of the importance of dependencies (I2). *i** includes a *priority* attribute within the notion of *dependency* and, while this is limited to three pre-specified values (open/uncommitted, committed, critical), this can be used to compare dependencies in terms of their significance. The remaining nine languages cannot be used to depict the importance of dependencies. Four languages in Table 3-7 provide means for assessing the relative dependence among actors (I3). The degree of dependence between actors can be indirectly estimated in *i**, GRL, e3value, and VNA by comparing the *dependencies* among *actors* in *i** and GRL as well as *value exchanges* between *actors* in e3value and VNA respectively. However, such analysis is performed in an ad hoc manner and none of these languages prescribe a systematic means for analyzing inter-reliance among actors. The remaining six languages do not support the evaluation of degrees of dependence among actors.

Trustworthiness: Five languages that are listed in Table 3-7 include concepts that are pertinent for modeling various types of trust assessments (T1). KAOS, *i**, and GRL support *goal* hierarchies while Change Matrix support multi-level *practices*. However, refinement along type and topic is not supported in these languages. Only NFR framework supports goal hierarchy with prioritization as well as type and topic refinement. The remaining four languages cannot be used to model different types of trust assessments.

Five languages in Table 3-7 support the depiction of factors that contribute to trust assessments (T2). Modeling of *contribution links* is supported in NFR Framework, *i** as well as GRL. Modeling of *resources* is supported in *i** as well as GRL while depiction of *objects* as well as *interactions* is supported in KAOS and Change Matrix respectively. The remaining four languages do not support the depiction of determinants of trust assessments. Only two languages support the representation of the perceived importance of a determinant of trust assessment (T3). NFR framework supports the explicit depiction of *priority* of a *goal* while Change Matrix supports the implicit portrayal of *priority* of a *practice*. The remaining eight languages do not support the modeling of the importance of a determinant of trust assessment.

Reciprocity: Nine languages in Table 3-7 include concepts that are relevant for modeling actions (R1). KAOS includes *operation*, *i** and GRL include *task*, e3value includes *activity*, BMC includes *key activities*, VNA includes *exchange*, Change Matrix includes transition from *existing* to *target practices*, and Payoff Table as well as Game Tree includes *move*. NFR Framework cannot be used to model the notion of actions. Four of the languages that are listed in Table 3-7 can be used to depict actions that result in state transitions (R2). the notion of *value transfer* implies a temporal separation between value transactions even though sequence cannot be expressed directly in e3value. VNA supports modeling of the sequence of *value exchanges*. A *decision path* in a Game Tree can be used to depict the sequence of *moves*/*countermoves* by *players*. The remaining six languages do not support the modeling of actions that result in state transitions. Seven languages in Table 3-7 include concepts that are relevant for modeling impact of actions as perceived by actors (R3). *Goal* satisfaction in *i** and GRL models can be analyzed to understand the impact of an action. In e3value, *value exchanges* can be assessed in terms of the net gain or loss of *value objects* by *actors* to understand the impact of an *activity*. *Payoffs* in Payoff table and Game Tree can be evaluated to understand the impact of a *move* for a *player*. Difference between *existing* and *target practices* in Change Matrix can be assessed to understand the impact of transitions between those practices. The other three languages in Table 3-7 do not support the depiction of actor intentionality.

An assessment of Table 3-7 reveals that none of these modeling languages meet all the requirements identified in Table 3-1 for modeling and analysis of strategic coopetition. However, it can be noted that combinations of modeling languages can meet more requirements collectively than any language can individually. It could be argued that a modeling framework that integrates all of these languages can be used to meet every requirement since each requirement is met by at least one modeling language. However, such a modeling framework is unlikely to be practical for two primary reasons: (i) during design, combining the ontologies, notations, and methodologies of each language into a framework will be a complicated undertaking, and (ii) during use, the application of semantics and syntax of all languages in this framework will be a complex endeavor. Therefore, a framework with a subset of these languages is preferable to a framework with their superset.

Researchers have also proposed conceptual modeling techniques, with visual support, that are purpose-built for representing enterprise strategies. Carvallo and Franch (2012) apply key concepts from Porter's (1979) Five Forces Model to offer a modeling technique for depicting interorganizational competition. Giannoulis, Petit, & Zdravkovic (2011) incorporate main ideas from Porter's (1985) conception of Value Chain into models of organizational relationships. Pijpers, Gordijn, & Akkermans (2008) present a modeling technique for expressing the interconnected business strategies of various actors.

Giannoulis, Petit, & Zdravkovic (2011) proffer a modeling technique for articulating balanced scorecard and strategy maps. Samavi, Yu, & Topaloglou (2008) tender a modeling technique for portraying Christensen's (2006) Disruptive Innovation approach. Giannoulis & Zdravkovic (2012) introduce a modeling technique for describing Kim and Mauborgne's (2005) Blue Ocean Strategy. Sales et al. (2018a, 2018b) offer an ontology for modeling competition. This ontology introduces elements related to various facets of competition (Sales et al. 2018a, 2018b). Sousa and do Prado Leite (2014) offer GPI (goals, processes, and indicators) technique, which combines *i** goal models, BPMN process models, and KPI (key performance indicators), to show positive and negative correlations between strategies. Sales et al. (2019) offer an ontology for clarifying the concept of value in enterprise architectures. Poels et al. (2020) explore opportunities to integrate ArchiMate for enterprise architecture engineering and Value Management Platform (VMP) for value stream mapping.

Many of these techniques extend extant modeling languages, such as *i** and e3value, by adding entities and relationships pertaining to strategic management constructs. While relevant for modeling certain aspects of simultaneous cooperation and competition (depicted in Table 3-1), none of the extant techniques have been purpose-built with an explicit focus on modeling and analysis of strategic coopetition. The framework to be proposed in this research is the first conceptual modeling technique that has been designed and developed specifically for expressing and evaluating strategic coopetition.

3.4 Summary

In this chapter, we compiled a set of requirements for a conceptual modeling framework for analysis and design of strategic coopetition. The next chapter explains the architecture and components of a proposed framework that satisfies these requirements. It describes each facet of this framework and contextualizes every facet with respect to requirements described in this chapter. It identifies constituent modeling languages in each facet, proposes relevant extensions to those languages, and explains the rationale for the selection and combination of those languages.

4. A Framework for Modeling and Analyzing Strategic Coopetition

In this chapter we present the overall structure of the framework and provide an overview of its main components— the conceptual modeling approach taken to address the coopetition characteristics listed in Table 3-1. We describe which of the existing modeling language(s) were adopted, with or without extension, and explain why in comparison to alternate approaches. Subsequent chapters will present the modeling ontology, visual notation, methodology, and analysis techniques for the modeling languages in this framework.

Recall that none of the techniques in Table 3-7 were purpose-built specifically for modeling strategic coopetition. Therefore, none of them meet every requirement in Table 3-7 individually. Consequently, in this research, we designed and developed a dedicated framework for modeling and analyzing strategic coopetition. This framework combines and extends these techniques to meet the requirements for modeling strategic coopetition. It distills the essence of simultaneous cooperation and competition among organizations into abstract patterns and decontextualized representations. It comprises of a set of artefacts such as ontological constructs, models, and methods that are useful for expressing and evaluating coopetitive strategies. This framework is not limited in terms of its applicability to any specific industry, functional area, or geographic region due to its qualities of abstraction and generalization. Therefore, users can apply this framework to analyze a broad range of coopetitive strategies.

This framework includes a set of prescriptive guidelines and methods that are useful for building models and sample illustrations of relevant problem and solution domains. Ontological constructs allow meanings of ideas to be encoded within models and this helps ideas to be incorporated within models in a consistent manner. A visual modeling interface allows concepts such as entities and relationships to be depicted graphically. This diagrammatic support is useful for making models that are intuitive, comparable, and can be comprehended by humans. Knowledge catalogs offer generative support to modelers by providing them with readymade content that they can incorporate into models.

In adopting *i**, this framework supports, what Horkoff & Yu (2009) term, "a qualitative, interactive evaluation procedure". Analysts can iterate over successive versions of a model to refine and elaborate the design space. They can assess goals that motivate a focal strategy and they can also examine the achievement of certain goals through various alternatives. Thus, a problem can be understood by elaborating the goal structure while solutions can be identified by elaborating the alternatives for satisfying goals. This approach of continuous refinement and elaboration is helpful for uncovering new goals and novel solutions in the design space. This feature distinguishes this framework from other frameworks previously proposed for analyzing coopetition from game theory such as Payoff Table and Game Tree

(Dixit & Nalebuff, 2008). In those frameworks, the problems and their solutions are known a priori so those frameworks are useful for comparing known solutions to existing problems. However, they do not support exploration of new problems or generation of novel solutions.

4.1 Analysis of Strategic Results and Outcomes

This framework is oriented towards the discrimination and generation of win-win strategies leading to positive-sum outcomes. Analyzing the strategic results and outcomes for parties in a relationship is important for evaluating the success or failure of coopetition. Coopetition is predicated on the rationale of positive-sum outcomes through which all actors are better off by coopeting rather than by purely competing or solely cooperating. This aspect of coopetition requires decision-makers in coopeting organizations to develop and analyze win-win strategies.

As noted in Section 2.2, coopetition research originated in the field of game theory where researchers applied game-theoretic concepts to explain the motivations of coopeting actors. According to game theory, three types of results are possible in strategic relationships between players: positive-sum, zero-sum, and negative-sum (Dixit & Nalebuff, 2008). In positive-sum outcomes all players are better off and in negative-sum outcomes all players are worse off (Dixit & Nalebuff, 2008). In zero-sum outcomes the amount of gain by some players equals the amount of loss by other players (Dixit & Nalebuff, 2008).

These outcomes map to distinct types of strategies that are adopted by players in coopetitive relationships: win-win, win-lose, and lose-lose (Brandenburger & Nalebuff, 1996). Win-win strategies are the only durable options for sustaining coopetitive relationships because only these strategies are advantageous for all actors (Brandenburger & Nalebuff, 1995). Win-lose/lose-lose strategies are unsustainable in coopetitive relationships because some/all actors (i.e., those that are disadvantaged) are worse off as a result and these actors are likely to withdraw from or abandon such relationships (Nalebuff & Brandenburger, 1997). This framework supports the identification/creation of existing/new win-win strategies.

4.2 Multi-faceted Framework

The framework is structured as consisting of two foundational facets and three advanced facets. It is comprised of distinct facets to support multi-faceted analysis wherein each facet yields specific insights about an aspect of coopetition. The foundational facets provide adequate support for minimal viable analysis of coopetition while advanced facets are for performing deeper analysis. Each advanced facet is useful for analyzing some aspect of coopetition that cannot be analyzed by the foundational facets (e.g., complementarity, reciprocity). Advanced facets can be independently selected and used together with other ones too. Sections 4.4 to 4.8 discuss the facets of this framework in a logical order.

This framework comprises of these modeling facets: goal and basic actor, differentiated actor, value, and sequential moves. We differentiate between foundational and advanced facets to streamline the application of our framework. By using the term foundational we indicate that each advanced facet builds upon certain baseline functionality in our framework. This baseline functionality is implicated in each analysis while advanced facets offer additional capabilities which may not be needed in certain analyses.

The foundation of the framework comprises of two facets, which are goal modeling and basic actor modeling. These facets help to explain the objectives that actors wish to achieve/avoid by coopeting as well as constraints/enablers on their actions through their interrelationships. These facets are further explained in Sections 4.4 and 4.5. The full details of these 2 facets are presented in Chapter 5 including modeling ontology, visual notation, methodology, and analysis technique.

The three advanced facets are: differentiated actor, value, and sequential moves. The differentiated actor facet is comprised of differentiated actor modeling through which various actor abstractions within a coopetitive relationship can be examined. This helps to explain differences between differentiated and undifferentiated actors in a coopetitive relationship. The value facet is comprised of value modeling to express the collective and individual gains of the coopeting actors. This helps to explain the benefits and costs for each actor in a coopetitive relationship. The sequential moves facet offers reasoning support for analysis of sequence-dependent strategic moves. This helps to explain the dynamics of coopetition and the sustainability/survivability of a coopetitive relationship.

4.3 Knowledge catalogs

The framework includes four knowledge catalogs to assist with the identification and generation of win-win strategies. These catalogs present codified knowledge from published literature. Domain specialists and subject matter experts can use these catalogs to supplement and augment their own knowledge during modeling and analysis phases. These catalogs are beneficial for two main reasons which are: (i) increasing the variety of relational configurations considered during modeling and analysis, as well as, (ii) reducing the time and effort needed to develop new relational configurations.

We performed an exploratory literature review[17] on Google Scholar (GS) to compile each catalog. These catalogs are not meant to be exhaustive and other researchers may determine that additional or different content needs to be included these catalogs. The content in these catalogs may also change if relevant ideas

[17] An exploratory literature review was adequate for our purposes since we do not claim that our catalogs are complete or universal. Rather, these catalogs were compiled to demonstrate the infusion of knowledge from peer-reviewed literature within our methodology. Therefore, we compiled these catalogs with content that was sufficient for illustrative purposes. Moreover, Badger et al. (2000) note that it is possible to conduct a comprehensive literature review even though it may not be systematic in a technical sense.

are updated in the scholarly literature. This involved searching GS using keywords representing the topics that were relevant for assembling each catalog. In each search we added the terms “business”, “management”, and “strategy” using AND operators to target only results pertaining to business, management, and strategy contexts. Our decision to use GS was justified by Martín-Martín et al.'s (2018) findings that “GS finds significantly more citations than the WoS Core Collection and Scopus across all subject areas” and that “Spearman correlations between GS and WoS, and GS and Scopus citation counts are very strong across all subject categories”. To populate each catalog, we searched GS (between February 2019 and May 2019) for the phrases:

- Competition catalog: “goals of competition”, “aims of competition”, “objectives of competition”, and “purpose of competition”.
- Cooperation catalog: “goals of cooperation”, “aims of cooperation”, “objectives of cooperation”, and “purpose of cooperation”.
- Knowledge sharing catalog: “knowledge sharing”, “information sharing”, “knowledge transfer”, “knowledge exchange”, and “organizational learning”.
- Trust assessment catalog: “trust”, “trust building”, “trust creation”, “trustworthy”, and “trustworthiness”.

We sorted the result sets for each search on GS by relevance and read the most highly cited research papers and book chapters from each result set. We constructed content hierarchies of pertinent ideas in these sources by progressively refining relatively higher-level elements into their lower-level elements based on the content of these research papers and book chapters. When sources disagreed about the relationships among any ideas then we based our conclusions on textual majority.

Catalogs of competition, cooperation, and knowledge sharing, presented in Chapter 5, are *softgoal* catalogs. Catalog of trustworthiness, presented in Chapter 6, is a *belief* catalog. These catalogs focus on interdependencies among *softgoal*/*belief* and *tasks*/*resources* that operationalize/confirm those *softgoals*/*beliefs* while deferring consideration of relationships among *actors*. Cooperation, knowledge sharing, and trustworthiness catalog utilizes type and topic refinement from the NFR framework. The label of an entity in a catalog can be expressed as “Type [Topic]”. Text enclosed within square-brackets in the label of an entity depicts the topic of that entity while text outside those square-brackets denotes the type of that entity. In each catalog, *softgoals*/*beliefs* are connected via three main types of *contribution links* which are: intentional Help, incidental Help, and incidental Hurt. An intentional Help link indicates *softgoal*/*belief* refinement wherein a lower-level *softgoal*/*belief* intentionally impacts the higher-level *softgoal*/*belief* with which it is associated positively. An incidental Help/Hurt link shows an unintentional positive/negative side-effect of a *softgoal*/*belief* on any other *softgoal*/*belief* in a specific catalog. Incidental

Help/Hurt links are referred to as correlation links in the NFR framework (Chung et al., 2000). The presence of positive and negative links in these *softgoal*/*belief* catalogs necessitates decision-makers to analyze trade-off among various configuration of *softgoal*/*belief*. To utilize these catalogs for informing their strategies, decision-makers need to compare and contrast *softgoals*/*beliefs* of interest by taking into account their intended effects and incidental side-effects.

In the real world, the selection of one configuration over another is likely to result from deliberation by subject matter experts and domain specialists. These knowledge catalogs complement and supplement their reasoning and analysis rather than substitute or obviate it. Online and interactive versions of these knowledge catalogs can be accessed at http://research.vikpant.com. Each *softgoal*/*belief* in these catalogs is hyperlinked to its source in an online bibliography. The full bibliographies from which each knowledge catalog is compiled can also be accessed on that webpage.

A modeler can benefit from these knowledge catalogs in two main ways which are *softgoal*/*belief* search and impact evaluation. In the first case, a modeler can start with a higher-level *softgoal*/*belief* and explore relatively lower-level *softgoals*/*beliefs* or *tasks*/*resources* that can be used to achieve/confirm that higher-level *softgoal*/*belief*. This top-down approach can assist a modeler in identifying potential lower-level options for satisfying/checking their higher-level aspirations/understanding. In the second case, a modeler can start with a focal *softgoal*/*belief* or *task*/*resource* and trace its intentional and incidental contributions to other *softgoals*/*beliefs*. This is useful for understanding the holistic impact of one element on another element and is useful for scenario planning in which "what-if" type of questions are answered.

4.4 Foundational Facet #1: Goals

Based on an analysis of Table 3-7, we have chosen *i** as the base of our conceptual modeling framework because, in comparison to other techniques in Table 3-7, *i** satisfies the most requirements for coopetition modeling. *i** supports the modeling and analysis of *goals* and this is relevant because cooperation is motivated by convergence in the goal structures of actors while competition emerges from the divergence in those goal structures. *i** supports the depiction of internal intentional structures of *actors* including their *goals* and this is useful for understanding the rationales for relationships among those actors based on their *goals*. *i** supports the modeling of intentionality of each *actor* at multiple levels though decomposition and means-ends reasoning (Yu, 2011).

Game theoretic modeling techniques, such as Game Tree, Payoff Tables (Dixit & Nalebuff, 2008), and Value Net (Brandenburger & Nalebuff, 1995, 1996; Nalebuff & Brandenburger, 1997), are typically used to support the analysis of interorganizational coopetition. However, these modeling techniques do not offer the means for representing the internal intentional structure of an actor. They can be used to express the outcomes (i.e., what) and alternatives (i.e., how) that are available to an actor. However, they do not readily support the depiction of the objectives of any actor and cannot be used to justifiably reason about the decisions (i.e., why) of an actor. Moreover, they do not support the expression of the preference structure of an actor. This means that they are not reliable for understanding the causes of the trade offs between alternatives. Such modeling techniques rely on an modeler's implicit assumptions about the goals of an actor for inferring the possible reasons for their decisions. Hence, these techniques may result in faulty analyses because such assumptions may not be valid from the perspective of a focal actor.

These shortcomings can be addressed through the use of *i**. This is because *i** can be used to express the internal intentional structure of an *actor* via *goals*, *tasks*, and *softgoals*. These entities can also be used to reason about the preference structure of an *actor*. A *goal* refers to a state of affairs in the world that an *actor* wishes to achieve, a *task* refers to a means for achieving an end, and a *softgoal* refers to a quality objective or non-functional requirement without clear cut definition of achievement and whose satisfaction can be assessed subjectively from the perspective of an *actor*. A *resource* is a physical or informational entity that is necessary for performing a *task*. These concepts are illustrated in Chapter 5. Modeler assumptions pertaining to *actor* intentions and preferences are incorporated within *i** models. Codification of intentional and preference structures helps to minimize possibility of erroneous analyses stemming from inaccurate assumptions by a modeler. However, as detailed in Section 3.3.2, *i** models are by themselves insufficient in certain respects for reasoning about strategic coopetition.

4.5 Foundational Facet #2: Basic Actors

This framework adopts and extends *i** for basic actor modeling because *i** provides support for modeling and analysis of *actors*. This is relevant because coopetition occurs when two or more actors cooperate and compete concomitantly. The focus of *i** is on modeling and analysis of strategic *dependencies* among *actors*. It supports the modeling of *dependencies* among *actors* that are motivated by the intentionality of those *actors*. This enables the analysis of the causes of *dependencies* between *actors* as well as the effects of the satisfaction and denial of those *dependencies* on those *actors*.

Game theoretic modeling techniques are commonly utilized to support reasoning about strategic coopetition. However, these modeling techniques, that include Game Tree and Payoff Table (Dixit & Nalebuff, 2008), do not support the explicit depiction of social relationships between *players*. They can be used to represent the results (what) and the choices (how) that are available to each *player* but they cannot be used to plainly express the reasons (why) behind the decisions of a player. In many cases, the choices of a *player* are constrained and dictated by their social relationships. Legal requirements (e.g., contracts, laws) as well as relational considerations (e.g., reputation, goodwill) serve as rules that permit and prohibit the choices that are available to *players* and the *payoffs* (results) that are available to them. These factors cannot be clearly portrayed using such techniques and, at best, can be implicitly approximated through the configuration of choices and associated results. This can lead to incomplete models that are vulnerable to inchoate analysis.

In this framework, these requirements have been addressed through the use of *i** because *i** models support the depiction of social relationships between *actors* through the portrayal of *dependers*, *dependees*, and *dependums*. A *depender* is an *actor* that depends, a *dependee* is an *actor* that is depended upon, and a *dependum* is the subject of a *dependency*. An *actor* can depend on another *actor* for a *goal* to be satisfied, a *task* to be completed, a *resource* to be provided, or a *softgoal* (i.e., quality objective or non-functional requirement) to be achieved. Yu (1999) extends *i** to include support for representation of strength of dependencies as open (uncommitted), committed, and critical. *Dependencies* can be regarded as the essence of social relationships because they can impel or inhibit specific courses of action by *actors*. Therefore, they can provide opportunities to *actors* if they collaborate but can also expose those actors to vulnerabilities if they conflict. These concepts are illustrated in Chapter 5.

4.6 Advanced Facet #1: Differentiated Actors - Addressing Trustworthiness and Interdependence Requirements

This framework adopts and extends *i** for addressing trustworthiness and interdependence requirements in Table 3-1. *Actor* abstraction is useful for representing and reasoning about coopetition strategies therefore this framework utilizes *i** to support modeling and analysis of differentiated actor abstractions. *i** also supports the modeling of *actor* abstraction by allowing composition and specialization of *actors* (Yu, 2011). We also address Interdependence and Trustworthiness requirements from Table 3-1 using differentiated actor modeling. It is possible to model Interdependence and Trustworthiness using basic actor modeling. However, as described below, actor abstraction has implications for evaluations of perceived relative dependence among actors as well as assessments of trustworthiness between actors. Therefore, addressing Interdependence and Trustworthiness requirements with basic actor modeling can lead to incomplete models and analyses.

Competition and cooperation may unfold differently with respect to *actors* at different levels of abstraction therefore *actor* abstractions are relevant for analyzing coopetitive relationships. At one level of abstraction, *actors* may perceive each other as competitors; at another level of abstraction they may think of each other as cooperators; and at yet another level of abstraction may consider each other as coopetitors. Therefore, it is important to be able to separate and separately analyze roles from entities that play those roles. This requires the intentionality of each actors as well as their dependencies on each other to be analyzed systematically. For example, diversified software businesses such as Microsoft and Amazon cooperate and compete at various levels of abstraction. At the corporate parent level, Microsoft and Amazon operate as partners because Amazon uses Microsoft software in its ecommerce technology stack and Microsoft uses Amazon as a strategic supplier of consumer data. However, at the direct sales unit level, Microsoft and Amazon behave as competitors because they compete to sell substitute cloud computing services to the same enterprise customers. Additionally, at the marketing unit level, Microsoft and Amazon behave as coopetitors because they run joint advertising campaigns that showcase their collective offerings while highlighting their software components in those offerings.

Relative dependence is important for understanding the degree of overall interdependence among actors in a coopetitive relationship. We present a technique for calculating the relative dependence among actors in a coopetitive relationship in Section 6.5.2. Our technique uses a slightly extended version of *i** to calculate the perceived dependence of each *actor* on every other *actor*. Overall degree of interdependence among a pair of *actors* is calculated by combining the perceived dependence of individual *actors* into a composite metric such as a ratio. We propose a formula that takes into account the degree of importance of a *dependum* for a *depender*, the intentional element within that *depender* to which that *dependum* is connected (i.e., the direct cause of the dependency), as well the relative importance of that intentional element vis-à-vis its substitutes. Relationships with disproportionate degrees of dependence among *actors* can lead to power imbalances and control asymmetries therefore understanding relative dependence among *actors* in a coopetitive relationship is important. These imbalances and asymmetries can undermine the cooperative aspect of a coopetitive relationship and result in a purely competitive relationship.

Actor abstraction impacts perceptions of interdependence among actors at various levels of abstraction. In a strategic relationship, some actors may not have any dependencies on each other at one level of abstraction. However, at another level of abstraction, these actors may have many dependencies on each other. The level of abstraction at which actors are analyzed in a coopetitive relationship will determine their balance of dependencies on each other. This is important because actors that regard each other as highly interdependent, at one level of abstraction, may be more likely to act collaboratively. Conversely, actors that regard each other as totally independent of each other, at another level of abstraction, may be more likely to act competitively. If these different levels of actor abstraction are not adequately considered, then the results of analysis may be misleading and confuse decision-makers leading to conflicts.

Similarly, actor abstraction has implications for assessments of trustworthiness because degrees of trust assessment between actors may differ at different levels of abstraction. For example, at the regional unit level, Microsoft and Amazon may have low trust assessments of each other because their track record does not involve camaraderie or benevolence. At this level, their salespersons endeavor to sell substitute software to the same customers and their consulting professionals also offer advisory services to the same clients.

However, at the corporate parent level, Microsoft and Amazon may have high trust assessments of each other due to many strategic collaborations between their executives in positioning against common rivals such as Oracle. These trust assessments are likely to be further bolstered by strong social ties between those executives at the interpersonal level since both Microsoft and Amazon are headquartered in Seattle (US).

Trust is an important consideration in many strategic relationships therefore researchers have proposed techniques for trust modeling. Gans, et al. (2001) extend the *i** modeling language to analyze trust at multiple levels. They note the importance of treating distrust as a conceptual entity by itself rather than regarding it merely as the absence of trust (Gans et al., 2003). Yu & Liu (2001) proposed an *i**-based approach for evaluating contributions to trustworthiness using a qualitative reasoning approach. They note the importance of expressing different kinds of trust within conceptual models (Yu & Liu, 2001). Horkoff, Yu, and Liu (2006) analyze trust between actors by applying a qualitative evaluation procedure for assessment of *i** goal satisfaction. Researchers of multi-agent systems have also proposed computational techniques for trust modeling (Lu & Lu, 2020). However, none of these approaches focus on modeling of trust within coopetitive relationships.

Our approach overcomes this limitation by offering a catalog of design knowledge that is populated with content that is specifically focused on trust within coopetitive relationships. Our approach for assessing trustworthiness draws upon earlier work on frameworks for design rationale and argumentation. Lee & Lai (1991) propose a technique for the explicit codification of design rationales. Chung et al. (2000) apply this approach to capture design rationales by linking operationalizing *softgoals* to a hierarchy of NFR *softgoals* using claim *softgoals*. Their approach applies type and topic refinement to model a particular NFR at multiple levels (i.e., type) as well as in relation to pertinent subject matters (i.e., topic). We present a catalog of *beliefs* about trust that is underpinned by information *resources*. This catalog can be applied in a coopetitive relationship to measure the degree of trust among actors in that relationship. It can also be used to create pathways for increasing the degree of trust in that relationship while safeguarding against the erosion of trust.

4.7 Advanced Facet #2: Value Modeling - Addressing Complementarity Requirements

This framework adopts and extends e3value for addressing complementarity requirements in Table 3-1. In comparison to other techniques in Table 3-7, e3value fully satisfies the most requirements for modeling and analysis of complementarity. Based on an analysis of Table 3-7, we combine e3value with *i** to meet complementarity requirements because neither e3value nor *i** fully meet any of these requirements alone.

e3value is a value modeling language that shows the exchange of economic value, benefit, or utility among actors (Gordijn, Akkermans, & Van Vliet, 2001). It is useful for modeling networks that are setup to facilitate economic exchanges between organizations (Gordijn, Yu, & van der Raadt, 2006). Its main semantics and syntax support quantitative and semi-automated analysis of *value exchanges* between *actors* (Lucena et al., 2008; Souza et al., 2016).

Despite its suitability for depicting various aspects of value, e3value lacks certain explanatory power. It does not support the representation of actor intentions and thus it is not possible to fully understand the causes of transactions among actors from e3value models. e3value models do not explain actor motivations in long-term strategic relationship where reasons other than benefit/utility and reciprocity, such as long-term goodwill and altruism, motivate recurring exchanges.

Gordijn, Yu, & van der Raadt (2006) overcome this limitation of e3value by using *i** models in conjunction with e3value wherein e3value models are used to show value transactions while *i** models are used to explain the reasons for those transactions. Our approach draws upon this earlier work and addresses complementarity modeling requirements through the combined use of *i** and e3value modeling. As described in Section 3.2.2, modeling of complementarity requires the ability to express and evaluate *value-added* and *added-value* as two related but distinct concepts.

Value-added pertains to the difference between the value of inputs and value of outputs of an activity (Brandenburger & Stuart, 1996). This can be represented in e3value using inbound and outbound *value exchanges* of an activity. However, *added-value* pertains to the worth of an actor in a strategic relationship (Brandenburger & Stuart, 2007). This cannot be directly represented in e3value as it is a relational rather than a transactional construct. In *i**, the support for representation of dependencies among actors is useful for understanding the *added-value* of an actor. The ability for an actor to appropriate surplus value in synergistic relationship depends upon its bargaining power and negotiating leverage. These are contingent upon its balance of dependencies which can be modeled in *i**. These concepts are illustrated in Chapter 7.

Economic value is a key motivator of interorganizational coopetition and the achievement of numerical objectives is a measure of performance. A relevant limitation of *i** models is their inability to support quantitative reasoning. While quantities can be represented within *i** models as goals their achievement can only be measured in absolute terms. It is not possible to practically reason about the partial achievement of quantitative objectives. While suitable for evaluating quantitative goals where satisfaction can be assessed in binary terms it is not feasible to reason about goals where achievement must be analyzed in relative terms.

Goal-oriented Requirements Language and User Requirements Notation (ITU-T, 2008, 2018) support numerical reasoning support. However, GRL supports only two bounded numerical scales whose specific values (-100 to +100 and 0 to +100) are mapped to degrees of goal satisfaction or denial (Akhigbe et al., 2014). This finite bound and rigid mapping imposes constraints on a modeler's ability to compose and construct quantities in a creative and free manner.

4.8 Advanced Facet #3: Sequential Moves - Addressing Reciprocity Requirements

This framework adopts and extends Game Tree modeling for addressing reciprocity requirements in Table 3-1. In comparison to other techniques in Table 3-7, Game Tree fully satisfies the most requirements for modeling and analysis of reciprocity. Based on an analysis of Table 3-7, we combine Game Tree with *i** to meet reciprocity requirements because neither Game Tree nor *i** fully meet any of these requirements alone.

A Game Tree is a directed acyclic graph that support representation of decisions and *payoffs* associated with *players* in a *game*. In Game Theory, a *game* refers to any social situation in which two or more *players* are involved. A *player* is an active participant in a strategic relationship with one or more *players*. A *payoff* is the reward or penalty associated with a specific course of action for each *player*. A *decision* path (i.e., course of action) is a sequence of decisions and actions undertaken by the players in a *game*. Solving a game refers to selecting a *reward* maximizing or *penalty* minimizing strategy for one or more *players*.

Game Tree modeling is a decision modeling language that shows the *moves* and *countermoves* of *players* resulting in *payoffs* (Dixit & Nalebuff, 2008). It is useful for analyzing *payoffs* yielded by *decision* paths comprising of many sequences of multi-step *moves* and *countermoves* by *players*. Its main semantics and syntax support quantitative and semi-automated analysis of gains and pains associated with various courses of action. It is relevant for analyzing reciprocity because it can be used to compare *payoffs* for each *player* in the context of different *decision* paths. These concepts are illustrated in Chapter 8.

We combine Game Tree with *i** because, “while Game Trees support the depiction of payoffs they do not explicitly codify the reasons for those payoffs” (Pant & Yu, 2017c). However, “even though the internal intentional structure of an actor cannot be expressed directly in Game Trees it can be represented via *i** Strategic Rationale (SR) diagrams” (Pant & Yu, 2017c). We proposed the use of *i** models to represent and reason about internal intentional structures of *actors* jointly with Game Trees to express and evaluate decisions and *payoffs* of those *players* (Pant & Yu, 2017c, 2018a). This is useful because, “Game Trees and actor modeling with *i** can be used together to achieve a deeper understanding of the decision space as well as to secure a stronger decision rationale” (Pant & Yu, 2017c).

Reciprocity refers to tit-for-tat (TFT) behavior in which an actor responds symmetrical to a move by another actor—that it perceives to be cooperative or competitive. Sundali and Seale (2002) note that reciprocity is a useful predictor of countermoves within coopetitive relationships. Cygler and Sroka (2016) assert that reciprocity increases the welfare in a relationship because cooperative actions by an actor are rewarded by cooperative actions of other actors in return. However, Ma (1998) notes TFT is not an ideal strategy in all situations because under certain circumstances forbearance yields more favorable outcomes than retaliation. Therefore, in coopetitive relationships, it is important for decision-makers to understand when and why restraint is preferable to revenge. Strategic coopetition is a relational construct whose understanding can benefit from static (i.e., point in time) and sequence (i.e., sequential moves) analysis. Static analysis can help to explain the costs and benefits associated with coopetition due to the structural aspects of a strategic relationship. However, static analysis cannot be used to comprehend those aspects of a relationship where sequence of moves matters. Analysis of sequential moves can help to explain the costs and benefits associated with coopetition due to the processual aspects of a strategic relationship. While *i** and e3value, two modeling languages in this research, readily support sequence-independent static reasoning – they are not suited for analysis of sequential moves where sequence is relevant. Tropos, which extends *i**, offers real-time linear sequence reasoning support (Castro, Kolp, & Mylopoulos, 2002). However, Tropos does not support the representation of sequential moves or the reasons for sequencing of moves. Certain actions may only be possible in a certain order because an action may be a prerequisite of another action or the performance of an action may mandate the completion of another action. KAOS supports event-oriented sequence reasoning. However, KAOS only supports passive linking between goals and actors without ascribing intentionality to those actors (i.e., actors do not have a choice about the goals that are assigned to them). Koliadis, et al. (2006) propose a technique for interconnecting *i** goal models with BPMN process models which may be helpful for depicting sequence among goals. A fundamental limitation of this approach is that it too does not offer a means for sequencing goals or the reasons for sequences of goals.

4.9 Summary

In this chapter, we presented an overview of our conceptual modeling framework for analysis and design of strategic coopetition. We described the components of the foundational as well as advanced facets. We explained the rationale for selecting and combining conceptual modeling languages to meet the requirements for coopetition modeling. The next four chapters present the five facets in detail. The next chapter explains the foundational facets in this framework by focusing on *goal* and *actor* modeling. We also present three knowledge catalogs that can be used to discriminate and generate coopetitive strategies. An illustration of the foundational facets is provided to demonstrate practical application. An understanding of these foundational facets is also a requirement for applying the advanced facets that are explained in subsequent chapters.

5. Modeling and Analyzing Coopetition – Foundation

This chapter presents the two foundational facets for modeling and analyzing strategic coopetition. It focuses on the expression and evaluation of *actors* and *goals*. In this chapter, we develop and apply approaches for modeling and analyzing these entities using an extended version of original *i** (Yu, 2011). These foundational facets are used to satisfy two requirements from Section 3.2: A1 (Many Actors), and I1 (Dependency).

In this chapter, we explain each component of these foundational facets of our conceptual modeling framework for analyzing and designing strategic coopetition: (5.1) a metamodel that extends *i** to cover relevant concepts and semantics, (5.2) visual notation for utilizing this extended metamodel of *i**, (0) process description detailing construction steps and guidelines for developing and evaluating models based on this extended *i** metamodel, (5.5) analysis techniques including approaches for evaluating models based on this extended *i** metamodel, (5.6) illustrative representation of a real-world scenario to demonstrate expressiveness and analytical power of models based on this extended *i** metamodel.

Additionally, in this chapter, we present three knowledge catalogs (5.3) that encompass knowledge from peer-reviewed scholarly literature about: (5.3.1) competition, (5.3.2) cooperation, and (5.3.3) knowledge sharing. These knowledge catalogs can be used to supplement a modeler's knowledge base. Chapters 6, 7, and 8 depict advanced facets of our conceptual modeling framework that build upon the foundational facets that are presented in this chapter. For consistency of presentation, these chapters are also structured in the same manner as this chapter (although only chapter 6 includes a knowledge catalog).

Throughout the chapters 5-8, we will start with a simple example widely used in Game Theory for illustrating the creation of positive-sum outcomes. We use this example to demonstrate the application of original *i** from Yu (2011) to generate a win-win strategy between two *actors*. This is a simplified illustration because it does not contain all the features in this facet. This example is elaborated and refined in subsequent chapters to explain important concepts of those advanced facets as well.

Let us assume that two siblings, namely CC (Cake Cutter) and SS (Slice Selector), wish to divide a cake among themselves. The only rule that governs their sharing of a cake is that one sibling cuts the cake (CC) into two slices and the other sibling distributes each of those slices (SS). Suppose that both CC and SS wish to obtain the large slice of that cake for themselves and that CC has only one alternative available to it which is of cutting the cake into two unequal slices. Consequently, SS has two alternatives available to it which are that it can either take the large slice or the small slice for themself and give the remaining slice to CC.

If SS takes the large slice then its objective is satisfied but the objective of CC is denied. Alternatively, if SS takes the small slice then its objective is denied but the objective of CC is satisfied. Therefore, cutting the cake into unequal slices by CC does not lead to a positive-sum outcome. Moreover, if a decision by CC to cut the cake into unequal slices can lead to SS winning and CC losing then these alternatives represent a win-lose strategy. Therefore, CC must explore further alternatives for achieving its objective since in the existing alternative CC is likely to lose. CC can seek a strategy in which it is unlikely to lose by analyzing its own alternatives and objectives as well as those of SS. A new alternative that CC can generate is to cut the cake into equal slices. This new alternative for CC necessitates SS to generate a new alternative as well. This is because there is no such thing as a larger or a smaller slice when the cake is cut into equal slices. Therefore, the new alternative for SS is to take either of the equal slices. This allows both CC and SS to obtain equal slices. Considering the rules of their arrangement this allows both to satisfy their objectives.

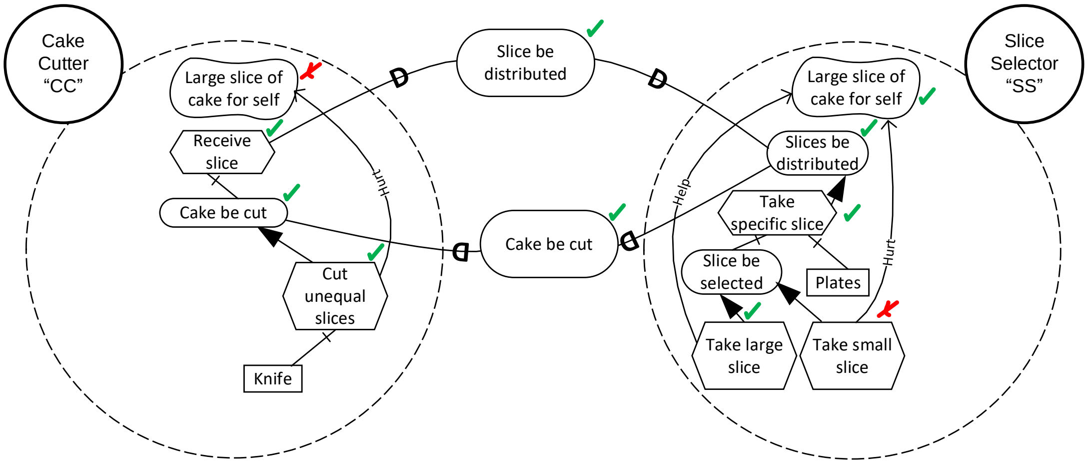


Figure 5-1 *i** model depicting As-Is relationship (Scenario 1: "SS" takes large slice so "CC" loses).

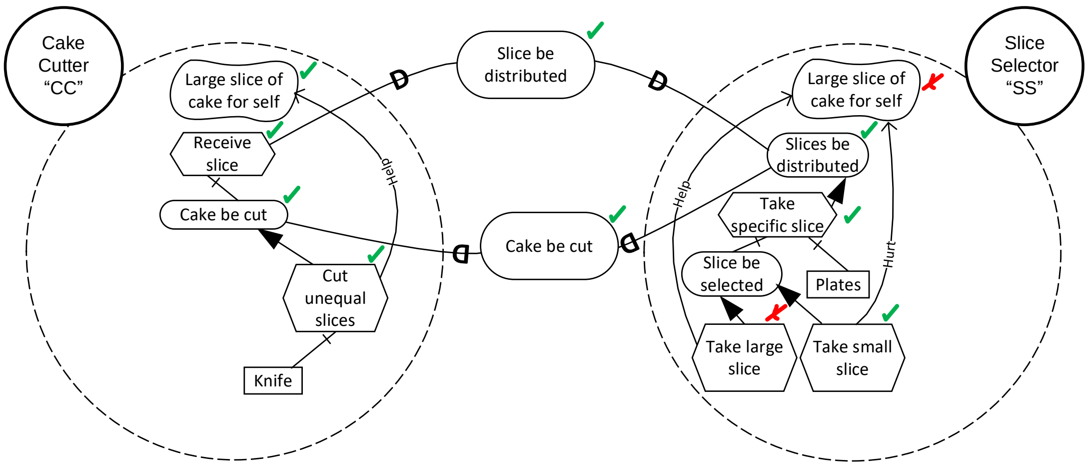


Figure 5-2 *i** model depicting As-Is relationship (Scenario 2: "SS" takes small slice so "SS" loses).

Now we shall depict this illustration with *i**. Readers that are familiar with *i** can skip directly to Section 5.1. In *i**, an *actor* is an intentional entity that applies its know-how to achieve its objectives therefore we can treat each sibling as an *actor*. Figure 5-1 and Figure 5-2 portray the relationship between CC and SS. Both figures show that the primary objective of each *actor* is to get the large share of that cake for itself. Each *actor* uses this as a quality criterion to evaluate and compare alternatives. They assess each option by estimating the impact of an option on their obtaining the large slice of that cake. This quality criterion is depicted as a *softgoal*, which is an objective that lacks clear cut satisfaction criteria and is regarded as achieved or denied from the subjective perspective of an *actor*. A *goal* represents a state of affairs that an *actor* wishes to achieve in the world (e.g., Cake be cut for CC and Slices be distributed for SS). A *belief* (not shown in this example) is a state of affairs in the world that an *actor* holds to be true, but unlike a *goal*, an *actor* does not set about to realize that state of affairs.

A *task* is an activity that can be used to achieve a *goal*. In the As-Is relationship, CC has one way of achieving the *goal* Cake be cut, by performing the *task* Cut unequal slices. *Tasks* can be refined into lower-level *goals*, *tasks*, *softgoals*, and *resources*. These subsidiary *goals*, *tasks*, *softgoals*, and *resources* are related to a higher-level *task* using a *task decomposition link* such that each of the lower level elements must be satisfied in order for their associated higher-level *task* to be fulfilled. A *resource* (e.g., Knife, Plate) is a physical or informational entity required to perform a *task.*

Figure 5-1 and Figure 5-2 show that SS can choose either the large or the small slice for itself and give the other slice to CC. This choice is shown as two alternative *tasks* leading towards the same *goal* via *means-ends* links (with solid arrowhead). A task is related to a goal such that the completion of any *task* leads to the fulfilment of its associated *goal*. Figure 5-1 and Figure 5-2 portray two possible As-Is scenarios – in Scenario 1 (Figure 5-1) SS chooses the large slice for itself and offers the small slice to CC while in Scenario 2 (Figure 5-2) SS chooses the small slice for itself and offers the large slice to CC. SS chooses a slice for itself and decides whether to keep or give the large or small slice to CC. This is shown as a *sub-goal* (Slice be selected). SS compares alternatives by reckoning their ability to help SS obtain the large slice of that cake for itself. This is depicted as a *softgoal* (Large slice of cake for self).

Contribution links (e.g., *help*, *hurt*, *unknown*) (curved arrows with open arrowheads) are used to show the impact of *tasks* and *softgoals* on one or more *softgoals*. *Labels (*e.g., *satisfied, denied)* are propagated along *contribution links* to derive the impact of model elements on other elements. In Scenario 1, cutting the cake into unequal slices will hurt CC's *softgoal* of obtaining the large share of that cake. This is because, per the rules of their arrangement, it is SS that decides the distribution of cake slices. Therefore, when SS keeps the large slice for itself (e.g., exhibiting opportunism) then CC's *softgoal* will not be satisfied.

Conversely, in Scenario 2, cutting the cake into unequal slices will help CC's *softgoal* of obtaining the larger share of the cake. This is because, in this scenario, SS keeps the smaller piece for itself (e.g., demonstrating altruism) thus CC's *softgoal* will be satisfied. However, Scenario 2 is not feasible because SS has a *softgoal* of taking the large slice of that cake for itself and this can only be satisfied if SS selects the large slice for itself and gives the smaller slice to CC. Therefore, CC realizes that it is improbable for SS to act altruistically (i.e., Scenario 2) by selecting the small slice for itself and giving the large slice to CC since SS's *softgoal* does not justify such behavior.

In the As-Is relationship, SS depends on CC for the *goal* Cake be cut to achieve and CC depends on SS for the achievement of *goal* Slice be distributed. This inter-dependency among CC and SS is shown via *dependency links*. A *depender* is an actor that depends on a *dependee* (i.e., another actor) for a *dependum* (i.e., something such as a *task* to be completed, a *goal* to be satisfied, a *resource* to be provided, or a *softgoal* to be fulfilled). The curved side on the D in the *dependency link* faces the *dependee* while the flat side faces the *depender*.

In our example, we suppose that CC changes its relationship with SS to generate a win-win strategy (To-Be). CC does this because the As-Is relationship does not consist of any win-win strategies. Rather, the As-Is relationship comprises of win-lose strategies because in one scenario SS wins and CC loses while in the other scenario CC wins and SS loses. This is understood by comparing the satisfaction labels of *softgoals* of CC and SS in Scenarios 1 and 2 of their As-Is relationship. CC evaluates Figure 5-1 and Figure 5-2 to understand the reasons for the absence of any win-win strategy in the As-Is scenario. CC recognizes that its As-Is strategy of cutting the cake into unequal slices is disadvantageous for itself because SS will always take the large slice of that cake for itself to satisfy its (SS) *softgoal* (Large slice of cake for self).

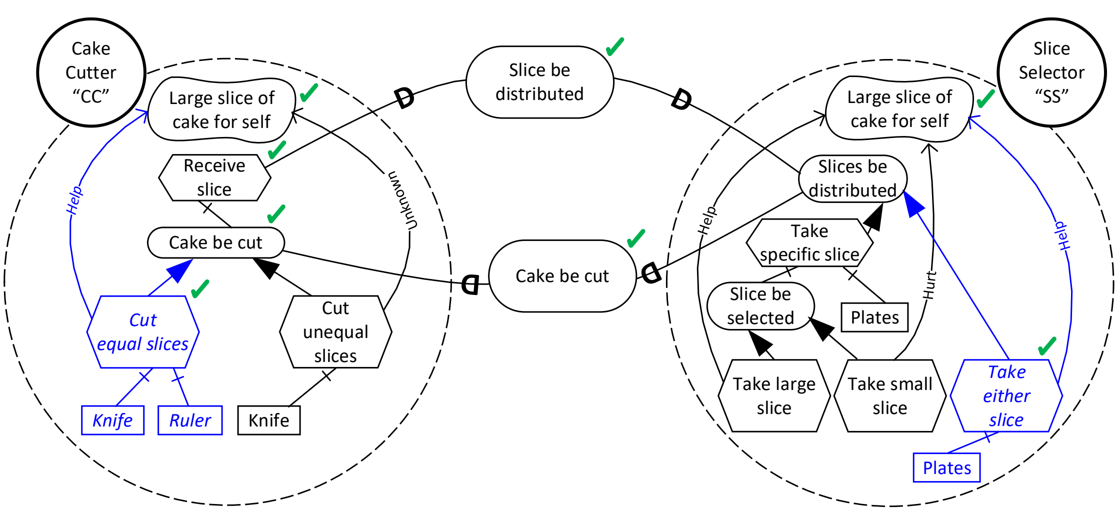


Figure 5-3 *i** model depicting To-Be relationship ("CC" and "SS" win so this is a win-win strategy)

Figure 5-3 depicts To-Be relationship among CC and SS. Model elements with black color represent existing model elements from Figure 5-1 and Figure 5-2 while model elements with blue color represent new model elements in Figure 5-3. To create a win-win strategy CC searches for a new alternative that can help it to achieve its sole *softgoal* (Large slice of cake for self). However, this alternative must also help SS to satisfy its only *softgoal* (Large slice of cake for self).

This new To-Be strategy can only exist if CC cuts the cake into equal slices because with unequal slices only one of the *actors* (CC or SS) will get the large slice of that cake. If CC cuts the cake into equal slices then both slices will be equally large. This new alternative for CC will also change the space of alternatives available to SS. This is because by cutting the cake into equal slices CC will require SS to generate a new alternative so it can Take either slice. This To-Be strategy will allow SS and CC to get the large slice of this cake since both slices are equally large. By generating this new strategy, CC will eliminate the possibility for SS to act either opportunistically or altruistically. This new alternative represents a win-win strategy for both *actors*.

5.1 Modeling Ontology – Foundational Facets

As described in Section 4.1, an extended version of *i** will serve as the base in our conceptual modeling framework. The metamodel of *i** (based on Yu, 2011) is presented in Figure 5-4. Our extensions to original *i** are depicted with red font in Figure 5-4. We extend original *i** by adding the attribute *complete* to the *actor* element. This is the first extension to original *i** in our modeling framework. The value '*true*' for this *complete* attribute indicates that the modeler believes that the model is complete in the sense that there is no unknown information. This belief/assumption is necessary for the modeler to draw conclusions from what is in the model, and only what is in the model. This means that there are no gaps in the knowledge held by the modeler and that what is not in the model does not exist.

Secondly, we extend original *i** by adding the attribute *importance* to *goal*, *softgoal*, and *belief* elements. This is the second extension to original *i** in our modeling framework. This *importance* attribute denotes a qualitative and subjective degree assessment. Degree refers to magnitude that is expressed numerically and is used for comparing elements. This magnitude remains consistent throughout an analysis. It can assume any real number value such as -1, 0, 1, etc. with a higher number indicating greater importance relative to a lower number. It refers to the relative importance of a *goal*/*softgoal*/*belief* for an *actor* that is helpful for performing a finer-grained comparative analysis of *goals*, *softgoals*, and *beliefs*. The scope of *importance* attribute of an intentional element applies across an *actor* in its entirety irrespective of the relative placement of that intentional element in the hierarchy of all intentional elements within that *actor*.

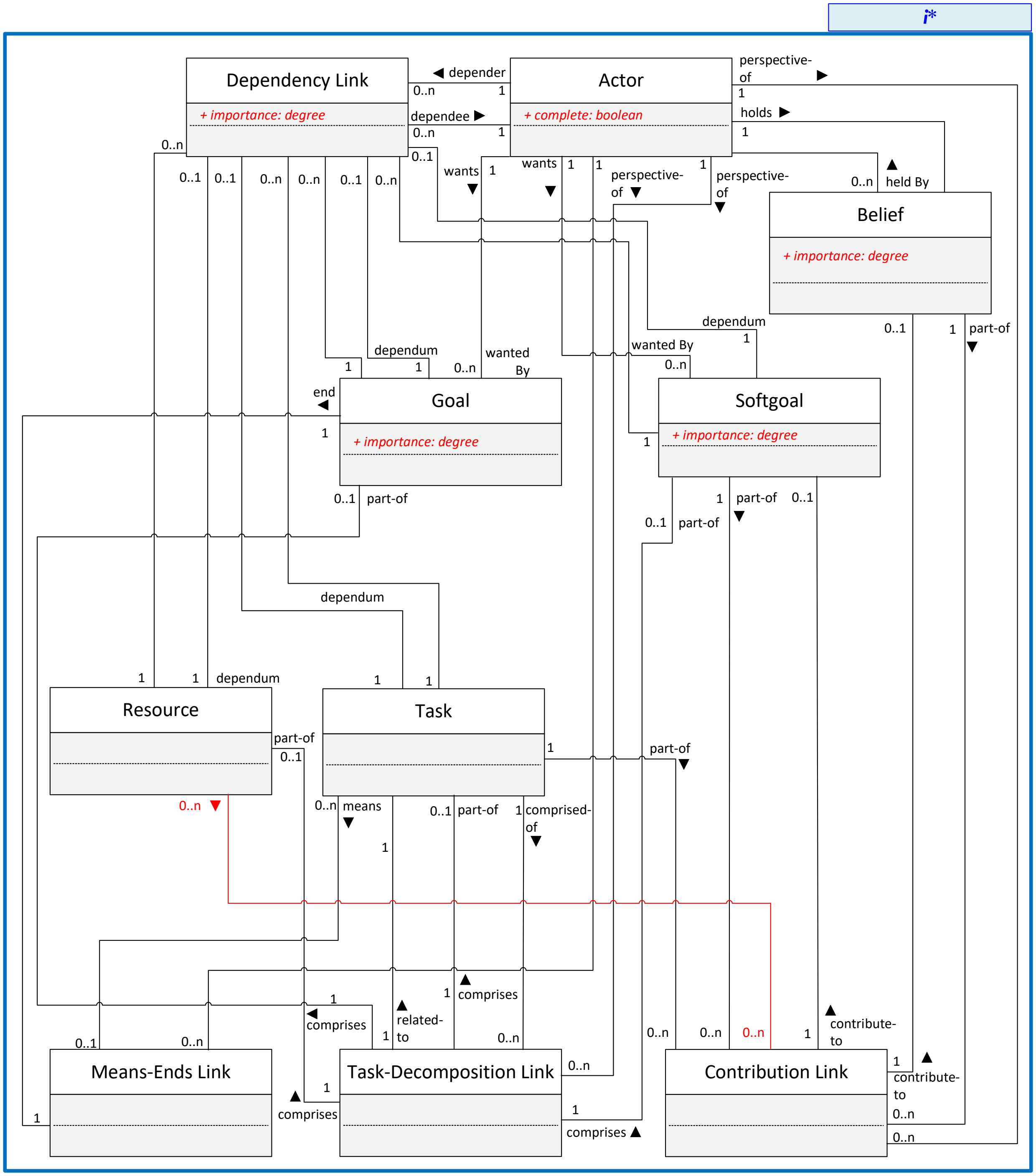


Figure 5-4. Metamodel of *i** (based on Yu (2011)) with extensions in red font

Thirdly, we extend original *i** by adding the attribute *importance* to *dependum* elements. This is the third extension to original *i** in our modeling framework. This *importance* attribute denotes a qualitative and subjective degree assessment and refers to the relative importance of a *dependum* for an *actor* (i.e., *depender*). In the case of *dependencies*, the scope of *importance* attribute of a *dependum* applies across all *dependums* for that *depender* irrespective of the implicated *dependees*. Original *i** allows a dependency to be characterized in terms of its strength, which can be *open*, *committed*, or *critical*. The *importance* attribute in our framework is helpful for performing a finer-grained contrastive analysis of *dependums* in *i** models without limiting the depiction of strength to just three pre-defined degrees.

Goal-oriented Requirements Language (GRL) and User Requirements Notation (ITU-T 2008, 2018) also support numerical reasoning support. However, in GRL, this support is limited to degrees of *goal* satisfaction or denial mapped to only two numerical scales with bounded values (-100 to +100 and 0 to +100) (Akhigbe et al., 2014). This fixed mapping and specific bound restricts a modeler's ability to reason about quantities in a free and creative manner. Therefore, we have introduced extensions for *degree* and *importance* attributes rather than use numerical reasoning support from GRL.

Fourthly, we extend original *i** by adding a relationship between *resource* and *contribution link* entities. This is the fourth extension to original *i** in our modeling framework. This is necessary for showing contributions from *resources* to *beliefs*. A *resource* can make a contribution to none or many *beliefs*. A *resource* can substantiate and confirm a *belief* by making a positive contribution to it or a *resource* can undermine and contradict a *belief* by making a negative contribution to it.

Only those *resources* that endow an *actor* with a strategic advantage are included within *i** models in our framework. These *resources* underpin win-win strategies and motivate competitive as well as cooperative relationships between *actors* (Barney, 1991; Child, Faulkner, & Tallman, 2006). Streamlining and decluttering *i** models by omitting generic or commodity *resources* also improves visual interpretability and explainability of those models. Further justification for this aspect of our framework, as well as model patterns for discriminating among strategic and generic/commodity resources, is detailed in Appendix 1

5.2 Visual Notation

Original *i** includes visual notation for expressing entities and relationships. Symbols and icons corresponding with *i** elements are presented in Figure 5-5. Details about the original notation and syntax rules of *i** can be found in Yu (2011) and details about expression of satisfaction/denial labels can be found in Horkoff & Yu (2009).

Figure 5-6 presents four extensions to original *i** notation.

One extension supports depiction of the relative *importance* of an element in an *i** model. Relative *importance* is depicted by an exclamation mark (!) and multiple exclamation marks can be placed near a model element to depict its *importance* with respect to other model elements. The number of exclamation marks is only a rough indication of relative *importance*. Two elements can be compared on the basis of exclamation marks associated with them and this can be used to understand which of those elements is relatively more important than the other.

Another visual notation extension depicts the *complete* attribute in the *actor* element. The presence/absence of an * (asterisk) is used to depict the '*true*'/'*false*' value of the complete attribute. The presence of an * (asterisk) following the name of an *actor* indicates that the value of the complete attribute for that actor is '*true*'. The absence of an * (asterisk) following the name of an actor indicates that the value of the complete attribute for that actor is '*false*'.

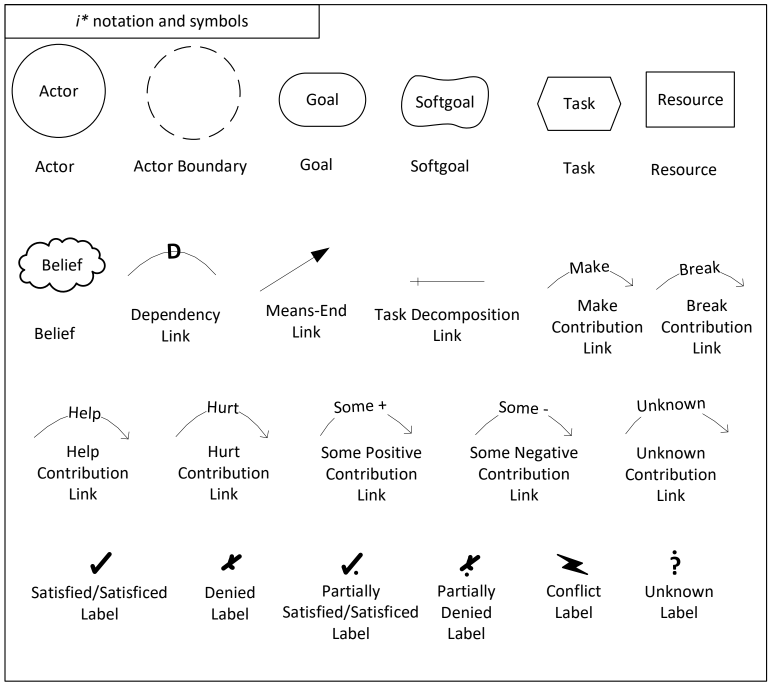


Figure 5-5. Notations and symbols corresponding with *i** (based on Yu (2011) and Horkoff & Yu (2009)).

Another visual notation extension, a circle with a dashed line, depicts the initial labels for model elements. It denotes the values associated with model elements that are necessary for answering the analysis question. It indicates the starting point based on which labels are evaluated and propagated over the model.

The final visual notation extension, within the foundation of our framework, includes two formats for depicting multiple scenarios in the same *i** model. A modeler can select either of these formats based on their preference and convenience.

In our modeling framework, each scenario corresponds to the specific configuration of satisfaction labels in an *i** model. Every scenario is designated a unique identifier (e.g., A, 1, α) and the satisfaction label for each model element that is implicated in a particular scenario is indicated alongside that model element.

In format 1, the satisfaction label corresponding to a specific scenario is presented alongside the identifier. In this format, multiple satisfaction labels, one for each scenario, can be depicted in a side-by-side or top-to-bottom manner.

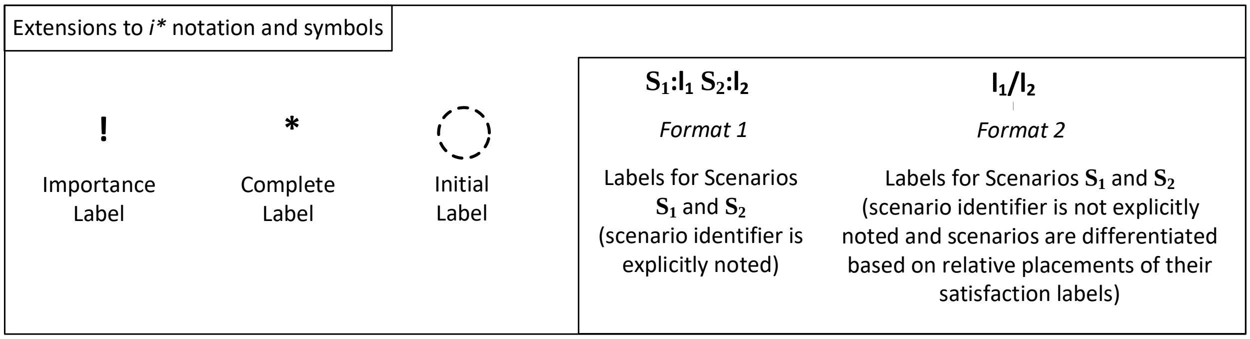


Figure 5-6 Notation extensions and new symbols introduced for *i**.

The scenario identifier is explicitly noted (alongside the corresponding model element) in format 1. In format 2, the satisfaction labels corresponding to multiple scenarios are presented side-by-side and separated by the forward slash (/) character.

The scenario identifier is not explicitly noted (alongside the corresponding model element) in format 2. A particular satisfaction label is mapped/linked to a specific scenario based on its relative position alongside other satisfaction labels.

5.3 Knowledge Catalogs for the Foundational Facets

In this chapter, we present three knowledge catalogs that are relevant for supporting the analysis of competition, cooperation, and knowledge sharing. The content of these catalogs were extracted and compiled from the relevant literature (Section 4.3).

These catalogs of *softgoals* were generated by drilling-down into the source literature until the level of operationalization was reached. We analyzed the source literature to distinguish *softgoals* from their operationalizations as well as to understand the variety of operationalizations for *softgoals* in each catalog.

The catalog of knowledge sharing *softgoals* includes *softgoals* and their operationalizations due to the limited variety of operationalizations for *softgoals* in that catalog. However, the catalogs of competition and cooperation *softgoals* do not include operationalizations due to the vast variety of operationalizations for *softgoals* in those catalogs.

The source literature did not provide a reasonable basis or consistent method for comparing operationalizations (e.g., in terms of importance). This absence of a reasonable basis or consistent method meant that inclusion of some operationalizations, and the exclusion of other operationalizations, would have been based on arbitrary choice. Therefore, a modeler will need to combine the knowledge in the catalogs of competition and cooperation *softgoals* along with their own knowledge of options for operationalizing those *softgoals*.

5.3.1 Competition

In Section 4.3, we explained that our approach for assessment of competition within a strategic relationship relies on a catalog of *softgoals*. A catalog of competition *softgoals* is depicted in Figure 5-7. It presents visual snippets of this catalog when accessed using a web browser. As it stands at the present, this catalog of competition *softgoals* is comprised of one hundred and twenty goals that are distributed over six levels. These *softgoals* were extracted and compiled from fifty-five source documents.

The topmost *softgoal* in this catalog pertains to growth in the worth of the focal organization (Valuation be increased). The worth of an organization is driven by market adoption (Traction be established), profit generation (Profitability be achieved), and risk mitigation (Risks be reduced).

Intentional Help, incidental Help, and incidental Hurt contribution links between *softgoals* at different levels in this conceptual hierarchy support the analysis of trade-offs. Incidental links are referred to as Correlation links in the NFR framework (Chung et al., 2000). For example, Revenue generation is supported by the creation of sales and marketing channels (Channels be established), targeting prospective customers (Customer segments be addressed), positioning products and services to prospective customers (Value propositions be offered), and meeting customer needs (Customer relationships be managed).

These contributions are depicted through intentional Help links to Revenues be increased. However, some of these *softgoals* (e.g., Customer segments be addressed and Channels be established) are not costless since they drive up costs for the focal organization. These negative contributions to costs are depicted through incidental Hurt links to Costs be decreased.

Mutual exclusivity among goals at the same conceptual level can be discerned by analyzing *softgoals* making intentional Help contributions to the same *softgoal* while making incidental Hurt contributions to each other. An example of this is depicted in Figure 5-7e where *softgoals* Differentiation be promoted and Price advantage be promoted make intentional Help contributions Value propositions be offered. However, these *softgoals* make incidental Hurt contributions to each other. This reflects Porter's (1996) guidance for firms to adopt a strategy that is predicated either on differentiation or on cost leadership but not both at the same time. Porter asserts that the simultaneous adoption of both strategies by a firm inevitably leads that firm to get "stuck in the middle" (1985).

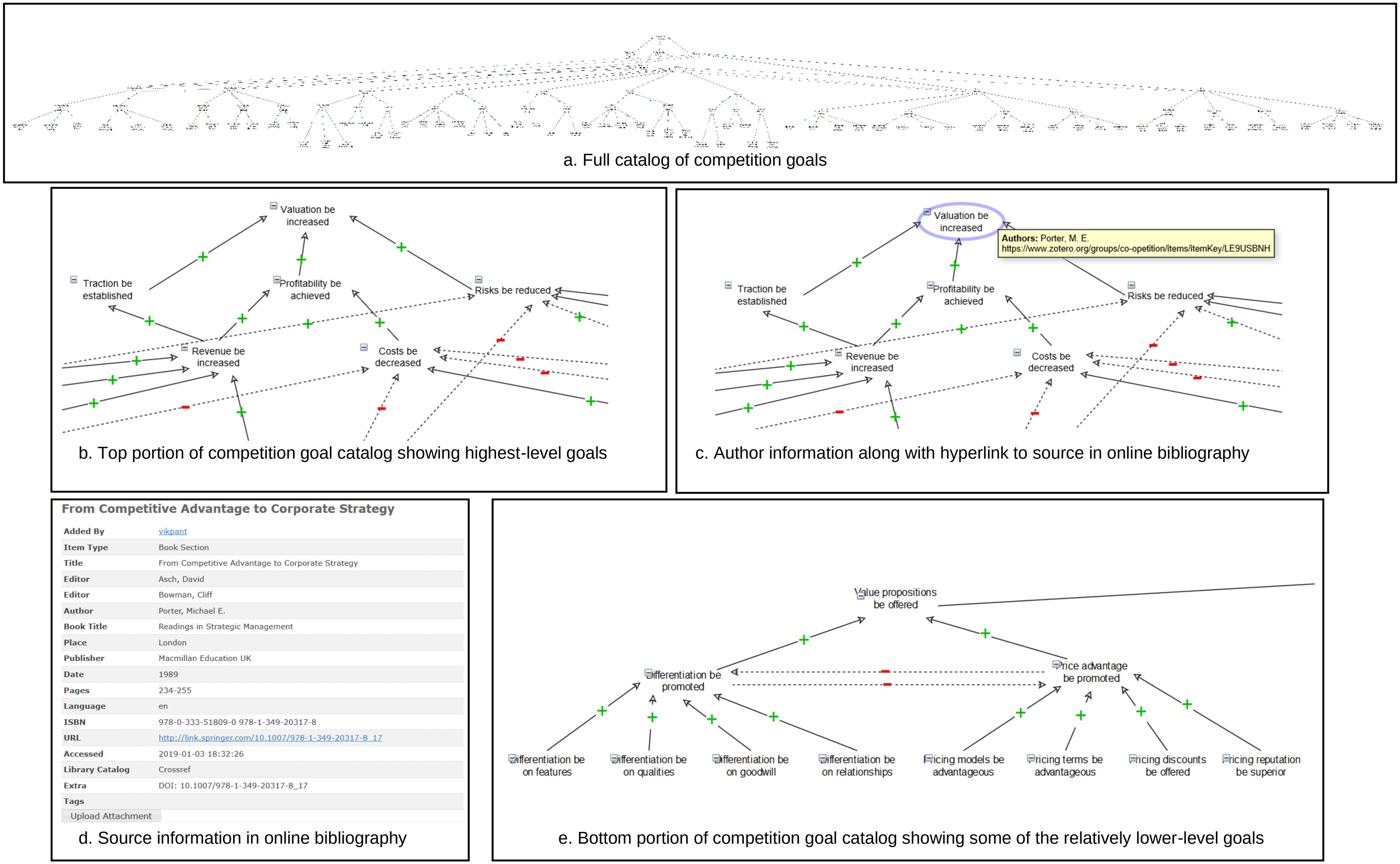


Figure 5-7 A catalog of competition *goals* (Literature source of each *goal* can be identified and accessed via http://research.vikpant.com).

5.3.2 Cooperation

In Section 4.3, we explained that our approach for assessment of cooperation within a strategic relationship relies on a catalog of *softgoals*. A catalog of cooperation *softgoals* is depicted in Figure 5-8. It presents visual snippets of this catalog when accessed using a web browser.

As indicated in Section 4.3, this catalog of cooperation *softgoals* utilizes type and topic refinement from the NFR framework. The label of an entity in a catalog is expressed as "Type [Topic]". Text enclosed within square-brackets in the label of an entity depicts the topic of that entity while text outside those square-brackets denotes the type of that entity. For example, Risks be reduced [Relational] and Risks be reduced [Performance] have the same type (i.e., Risks be reduced) but they relate to different kinds of risks (i.e., relational and performance). This type and topic refinement supports finer-grained analysis of *softgoals*.

The topmost *softgoal* in this catalog Valuation be increased and three *softgoals* make intentional Help contributions to it. These are Traction be established, Profitability be achieved, and Risks be reduced. In this catalog of cooperation *softgoals*, these top-level *softgoals* are identical to the top-level *softgoals* in the catalog of competition *softgoals* (Section 5.3.1).

The reason for this can be understood from Section 2.1 that presents a review of scholarly literature on Strategic competition and cooperation. The roots of competition theory can be traced to perspectives from economics while the roots of cooperation theory can be traced to perspectives from sociology.

Researchers from both schools of thought attempted to explain the same observations about organizations (depicted as top-level *softgoals* in these goal catalogs) albeit with reference to different paradigms. Therefore, while *softgoals* in the top three levels of these competition and cooperation catalogs are the same, the *softgoals* in their bottom three levels are completely different.

The top-level *softgoal* in both catalogs is Valuation be Increased. One level below this *softgoal* are three *softgoals* that make a positive contribution to this top-level *softgoal*. These *softgoals* are Traction be established, Profitability be achieved, and Risks be reduced. One level below these *softgoals* are two *softgoals* that make positive contributions to the *softgoals* Traction be established and Profitability be achieved. These *softgoals* are: Revenue be increased, which makes a positive contribution to the *softgoals* Traction be established as well as Profitability be achieved; and Costs be decreased which makes a positive contribution to the *softgoal* Profitability be achieved.

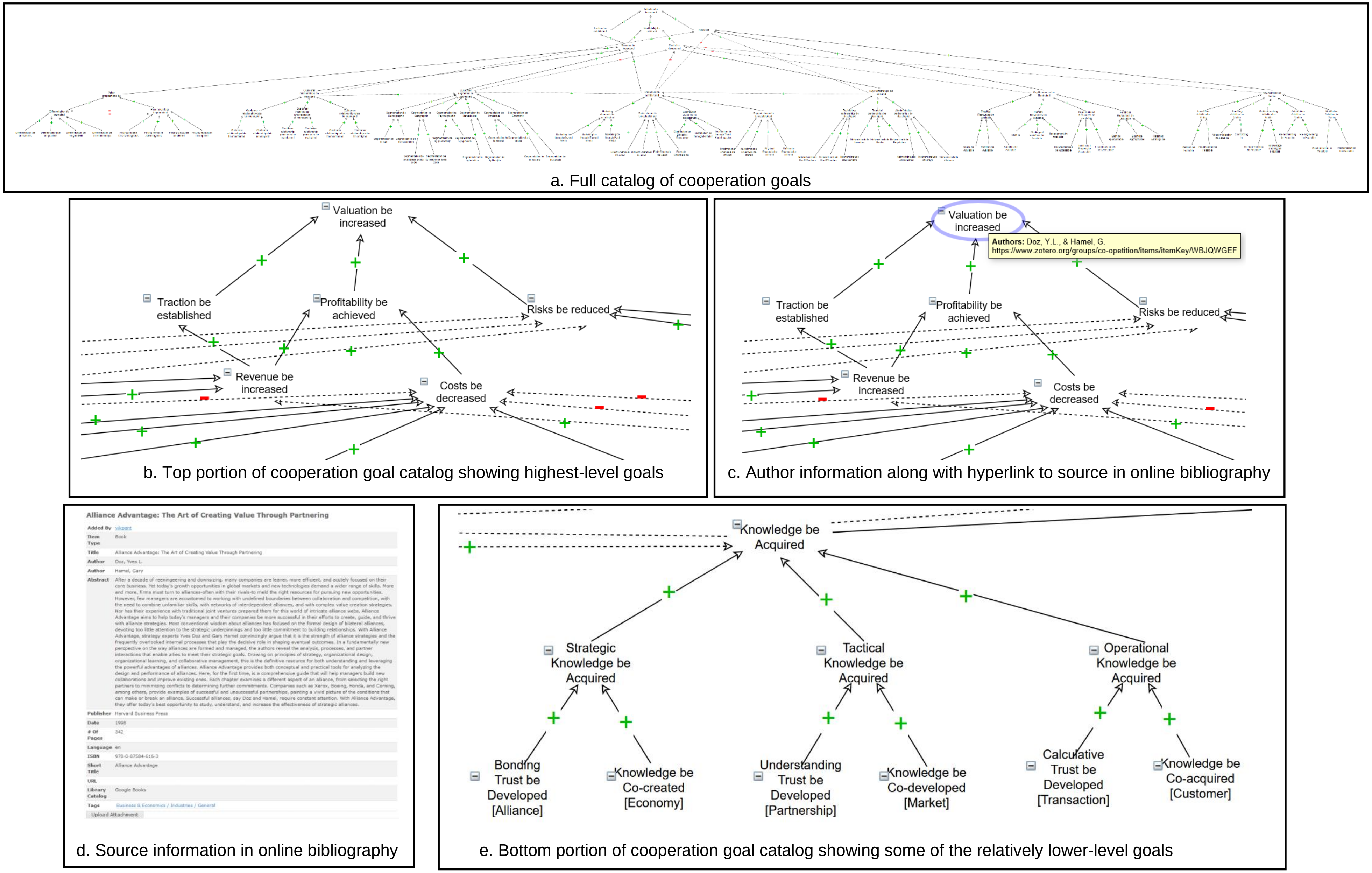
Softgoals in the fourth, fifth, and sixth levels of these catalogs are not the same because the intent of cooperative and competitive strategies are different. For example, in the Cooperation catalog, a fourth-level *softgoal* is Market access be gained and this makes a positive contribution to a third-level *softgoal* Revenue be increased. Inspection of fifth-level softgoals that make positive contributions to this fourth-level *softgoal* shows collaborative-intent among partners. Market access be gained [Domestic] as well as Market access be gained [Foreign] are fifth-level *softgoals* that make positive contributions to Market access be gained at the fourth-level. These fifth-level *softgoals* necessitate cooperation among partners because they refer to market entry through alliances.

In the Competition catalog, a fourth-level *softgoal* is Value propositions be offered and this makes a positive contribution to a third-level *softgoal* Revenue be increased. Inspection of fifth-level softgoals that make positive contributions to this fourth-level *softgoal* shows conflictual-intent among adversaries. Differentiation be promoted as well as Price advantage be promoted are fifth-level *softgoals* that make positive contributions to Value propositions be offered at the fourth-level. These fifth-level *softgoals* require competition because they refer to offering of superior value propositions over those from rivals.

The presence of same *softgoals* in the top three levels of these Cooperation and Competition catalogs shows that these *softgoals* represent fundamental concepts in the Strategic Management literature. These concepts represent foundational intent in competitive as well as cooperative strategies. Therefore, the top three levels of these *softgoal* catalogs can be regarded as complete with respect to concept coverage. However, progressively lower levels in these catalogs show increasing variety in the *softgoals*. This is because many lower level concepts can be associated with the same higher level concepts. Therefore, the lowest three levels of these *softgoal* catalogs can be regarded as partial with respect to concept coverage.

As in the Competition catalog, intentional Help, incidental Help, and incidental Hurt contribution links between *softgoals* at different levels in this conceptual hierarchy support the analysis of trade-offs. As stated earlier, incidental contribution links are referred to as correlation links in the NFR framework.

For example, sharing of resources (Resources be pooled) and distribution of costs (Costs be diffused) among partners can be used to lower costs (Costs be decreased). Risks can be mitigated (Risks be reduced) by managing relational (Risks be reduced [Relational]) as well as performance factors (Risks be reduced [Performance]). New markets can be tapped (Market access be gained) to improve revenues (Revenue be increased). These contributions are depicted through intentional Help links to Revenues be increased. However, some of these *softgoals* (i.e., Market access be gained, Risks be reduced [Relational], and Risks be reduced [Performance]) are not costless since they drive up costs for the focal organization. These contributions are depicted through incidental Hurt links to Costs be decreased.



a. Full catalog of cooperation goals

b. Top portion of cooperation goal catalog showing highest-level goals

c. Author information along with hyperlink to source in online bibliography

d. Source information in online bibliography

e. Bottom portion of cooperation goal catalog showing some of the relatively lower-level goals

Figure 5-8 A catalog of cooperation *goals* (Literature source of each *goal* can be identified and accessed via http://research.vikpant.com).

5.3.3 Knowledge Sharing

Our approach for assessment of knowledge sharing within a strategic relationship relies on a catalog of *goals* that are operationalized by *tasks* (Section 4.3) following the NFR framework (Chung et al., 2000). A catalog of knowledge-sharing *goals* between firms under coopetition is depicted in Figure 5-9.

Softgoal Type [Topic]	Description of *softgoal*
No Leakage [Knowledge Assets]	Assets should not be misappropriated by partners. [1, 2]
No Blocking [Knowledge Transfers]	Transfers should be seamless and frictionless. [9, 10]
Synergetic [Knowledge Assets]	Assets should be more valuable jointly than individually. [4, 5]
Leveragability [Knowledge Assets]	Assets should be useful and usable to generate benefits. [4, 5]
No Negative Cross Impact [A. Val.]	Sharing with partner should not reduce value of asset for self. [4, 5]
Interdependence [Bus. Partners]	Sharing should take place among co-dependent partners. [5]
Complementarity [Partner Assets]	Partner assets should enhance each other's' asset value. [6]
Transferability [Knowledge Assets]	Assets should be distributable to partners. [7]
Appropriability [Knowledge Assets]	Assets should be receivable by partners. [3]
Irreducible [Asset Value]	Benefits from asset should be indestructible and renewable. [12]
Protectable [Knowledge Assets]	Assets should be containable and isolatable. [8]
Mutuality [Partner Assets]	Sharing should encompass assets that are inter-reliant. [11]
Annotatable [Asset Ownership]	Identity of the owner of each asset should be discernible. [15]
Combinable [Partner Assets]	Assets should be integrable with other assets. [17]
Compatible [Knowledge Assets]	Assets should function normally in conjunction with other assets. [13]
Available [Partner Assets]	Assets should be easily reachable when needed. [14]
Absorbable [Partner Assets]	Assets should be easily consumable when needed. [3]
Dynamic [Knowledge Assets]	Content and functionality of asset should be changeable. [12]
Concealable [Asset Content]	Asset contents should be capable of being hidden from partners. [15]
Licensable [Knowledge Assets]	Assets should support deactivation and decommissioning. [16]
Balanced [Asset Sharing]	Quantity of contents transferred should be equal among partners. [24]
Reportable [Asset Sharing]	Quantity and quality of contents transferred should be auditable. [25]
Compliant [Knowledge Assets]	Assets should be consistent with knowledge management specification. [26]
Redundant [Knowledge Assets]	Copies of assets should be stored for safeguarding. [27]

Table 5-1 Softgoal types and topics in Figure 5-9

Task Type [Topic]	Description of *task*
Auditing [Knowledge Transfers]	Reviewing actions performed by users and processes. [15]
Processing [Asset Metadata]	Generating machine-readable metadata for each asset. [21]
Exposing [Asset Interface]	Registering input and output parameters of an asset. [18]
Documenting [Asset Schema]	Explaining types of entities and relationships in an asset. [7]
Integrating [Partner Assets]	Commingling content from disparate partner assets. [20]
Publishing [Asset Directory]	Advertising sharing of an asset via a repository. [18]
Modifying [Asset Behavior]	Reprogramming the content and functionality of an asset. [23]
Modularizing [Asset Boundary]	Setting perimeter of each asset specifying its scope. [22]
Reconfiguring [Knowledge Assets]	Asset should be packagable in many ways. [19]
Metering [Knowledge Transfers]	Measuring quantity of transfers between partners. [28]
External Tracking [Knowledge Transfers]	Surveilling content in transfers between partners. [29]
Canonical Template [Knowledge Model]	Establishing uniform format to be used by partners. [30]
Certifying [Asset Specification]	Attesting system specification by standards organization. [31]
Replicating [Knowledge Assets]	Creating multiple copies of asset. [32]

Table 5-2 Task types and topics in in Figure 5-9

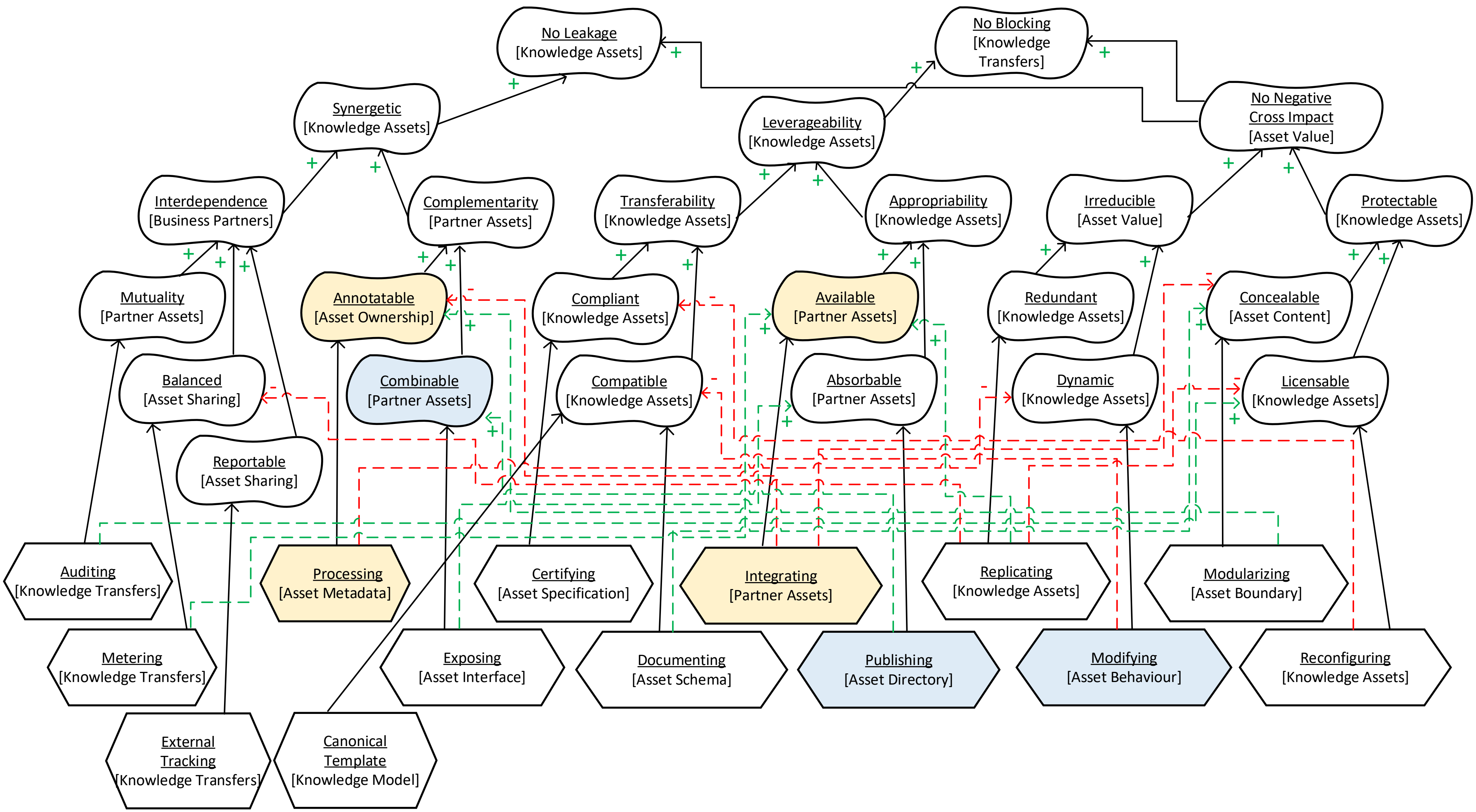


Figure 5-9 Softgoal graph of knowledge sharing objective and their potential operationalizations (Literature source of each *goal* or *task* can be identified and accessed via http://research.vikpant.com) [Some of the elements are highlighted in Yellow or Blue to faciliate explanation in the text].

Table 5-1 and Table 5-2 expand on the meanings of the *softgoals* and *tasks* in this catalog. Literature source of each *softgoal* and *task* in Table 5-1 and Table 5-2 is identified numerically. It is denoted within square brackets and listed in Section 12.2.

In this *softgoal* graph, the nodes or vertices are *softgoals* or *tasks* while the edges are *contribution links*. *Softgoals* are operationalized by *tasks* (bottom of Figure 5-9). For example, Processing involves generating machine-readable metadata for each knowledge asset. This makes it easier to link a knowledge asset with its owner. Therefore, Processing is a *task* that operationalizes the *softgoal* Annotatable asset ownership. Similarly, Integrating involves mixing partner knowledge assets. This makes it simpler for each firm to access partner knowledge. Therefore, Integrating operationalizes the *softgoal* Available partner assets.

This *softgoal* graph aids in detecting and analyzing trade-offs among different options for knowledge sharing among coopetitors. The *softgoal* graph shows that any *task* impacts one or more *softgoals* differently than other *tasks* (Figure 5-9). For instance, Publishing a knowledge asset into an asset directory *Helps* to make that knowledge asset more Combinable (i.e., easier to integrate) with other knowledge assets. Conversely, Modifying the behavior of a knowledge asset can make it less Compatible with knowledge assets with which it is already interoperable (i.e., *Hurts* link).

In an instantiation of this catalog, different combinations of *tasks* can be grouped into different policies such as Strict or Permissive. Trade-offs among policies can be assessed by identifying all the *softgoals* that are differently impacted by each policy.

Figure 5-10 adapts the *softgoal* graph in Figure 5-9 by mapping *tasks* to permissive policy and strict policy as appropriate. The inclusion of a *task* in a Strict or Permissive policy is indicated by inscribing an indicator within that *task*. A circle inscribed with an S and a numerical identifier in the top left corner of a task denotes the inclusion of that *task* in a Strict policy. A square inscribed with a P and a numerical identifier in the top right corner denotes the inclusion of that *task* in a Permissive policy. Note that this visual notation is specific only to this catalog and is not a visual notation extension in our framework to original *i**.

For instance, Auditing might be a *task* that is included in a Strict policy and operationalizes the *softgoal* Mutuality of partner assets. It also *Helps* the *softgoal* Licensable knowledge assets. Similarly, Reconfiguring of knowledge assets is a *task* that is a part of a Strict policy and operationalizes the *softgoal* Licensable knowledge assets. This *softgoal* Licensable knowledge assets is considered to be satisfied in such a Strict policy since multiple *tasks* that are part of a Strict policy make positive contributions to it.

Conversely, the *softgoal* Dynamic knowledge assets is only partially satisfied in a Strict policy due to the conflicting interaction of two *tasks* which are part of a Strict policy. These are Modifying asset behaviour and Processing asset metadata. While Modifying asset behavior operationalizes the *softgoal* Dynamic knowledge assets this *softgoal* is *Hurt* by Processing asset metadata.

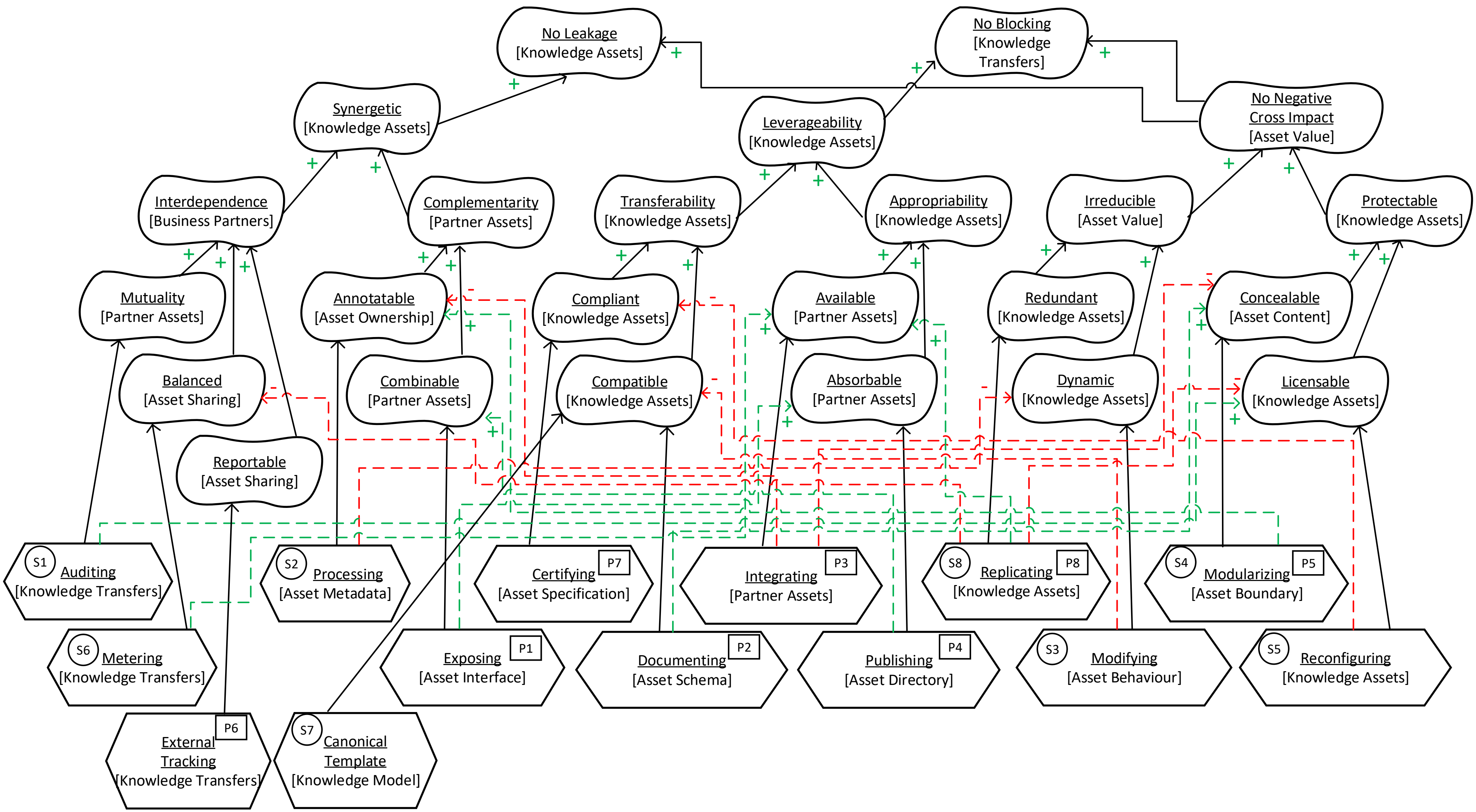


Figure 5-10 Softgoal graph of knowledge sharing objective and their potential operationalizations grouped into policies

A *task* can also be included simultaneously in Strict and Permissive policies while being implemented differently in each policy type. For instance, Modularizing the boundary of a knowledge asset is part of both Permissive as well as Strict policies even though modularization may be implemented differently in Strict and Permissive policies.

5.4 Method

We introduce a purpose-built method that is designed for identifying and developing win-win strategies. This method comprises three phases: Modeling, Evaluation, and Exploration. The flowchart in Figure 5-11 depicts this method. In the Modeling phase, an *i** model is instantiated and populated. In the Evaluation phase, the impacts of various choices on objectives are assessed to detect any extant win-win strategies with respect to *i* goal* satisfaction. In the Exploration phase, new alternatives are found by generating relational configurations that yield positive-sum outcomes drawing on the knowledge catalogs where applicable. This process can be repeated to generate as many win-win strategies as necessary. Loops in the process depicted in Figure 5-11 indicate that any step in the Exploration phase can trigger other steps in the Modeling phase.

Modeling phase: In this phase, the modeler develops an *i** model that covers the concepts needed to perform analysis of positive-sum outcomes and win-win strategies in coopetitive relationships. Intentional aspects of *actors* are modeled as *beliefs*, *goals*, *tasks*, *resources*, and *softgoals* while strategic relationships among *actors* are modeled as *dependencies*. This phase consists of eight steps that yield an *i** model:
M1. Identify focal *actors*.
M2. Identify additional *actors*.
M3. Identify *beliefs* for each *actor* (with 'Importance').
M4. Identify *goals* for each *actor* (with 'Importance').
M5. Identify *softgoals* for each *actor* (with 'Importance').
M6. Identify alternative *tasks* for achieving each *goal*. Depict the subsidiary parts of a *task*. Differentiate between strategic *resources* and generic *resources* to model only those *resources* that are strategic[18]. Depict the *resources*, typically information assets, that underlie *beliefs*. Portray impact of *tasks* on *softgoals*.
M7. Identify *contribution links* from *softgoals* to *softgoals*, *beliefs* to *beliefs*, *tasks* to *softgoals*, and *resources* to *beliefs*. *Contribution links* from *resources* to *beliefs* are supported via an extension to the metamodel. This metamodel extension is described in Section 5.1.
M8. Identify *dependencies* among *actors* (with 'Importance').
After completing this phase, the modeler should proceed to the Evaluation Phase.

[18] The rationale for making this distinction and identifying strategic *resources* is explained in Appendix 1.

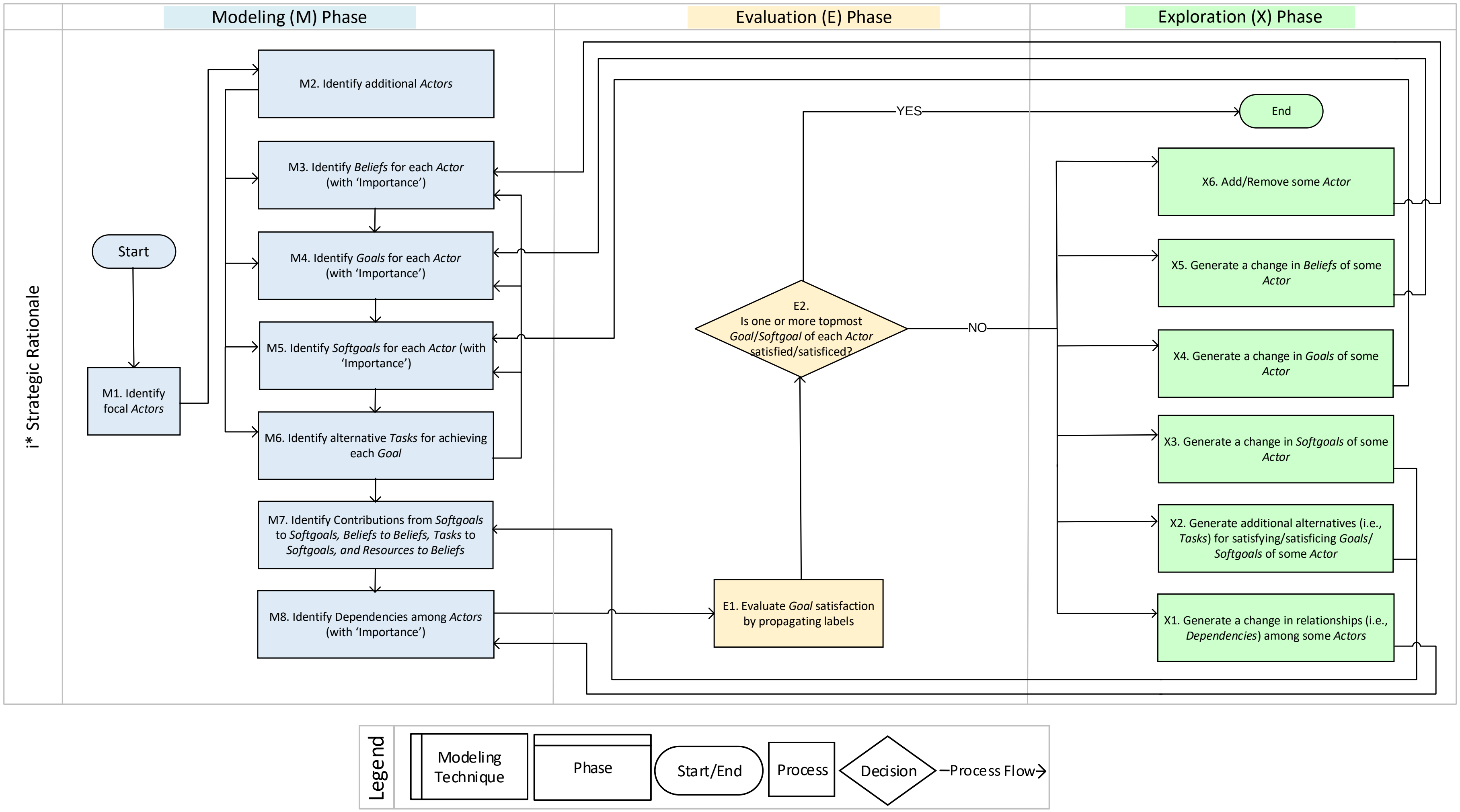


Figure 5-11 Process steps for using *i** modeling with *actors* and *goals* to get to win-win

Evaluation phase: In this phase, the modeler analyzes the *i** model that is developed in the Modeling phase. This phase consists of two sequential steps that result in the analysis of the *i** model:

E1. Evaluate *goal* satisfaction by propagating labels. Trace the impact of *tasks* on *goals*, *tasks* on *softgoals*, lower-level *softgoals* on higher-level *softgoals*, and *resources* on *beliefs*. As depicted in Section 5.5.2, *softgoals* and *goals* can either be: fully satisfied (denoted by a checkmark), partially satisfied (denoted by a dot underneath a checkmark), fully denied (denoted by a cross), or partially denied (denoted by a dot underneath a cross). In case the status of a *softgoal* or *goal* cannot be resolved then it can be marked as unknown (denoted by a dot above a question mark).

E2. Assess whether one or more topmost *goal*/*softgoal* of each *actor* are satisfied? Use the technique outlined by Horkoff & Yu (2009, 2011, 2013), that is summarized in Section 5.5.1, to evaluate the satisfaction or denial of top-level *softgoals* and *goals* for each *actor*. If topmost *goal*/*softgoal* of any *actor* is unfulfilled then it means that a win-win strategy is not known in this coopetitive relationship. In this case, the modeler should proceed to the Exploration Phase. If the top-level *softgoals* and *goals* of each *actor* are satisfied then it can be concluded that a win-win strategy exists in this relationship.

Exploration phase: In the Exploration phase, a modeler can investigate any of six lines of action iteratively in the pursuit of a win-win strategy. If a win-win strategy cannot be found initially then this method can be repeated to generate a strategy that results in win-win. A modeler can:

X1. Generate a change in *dependencies* among some *actors*.

X2. Generate additional *tasks* for satisfying *goals* and *softgoals* of some *actor*.

X3. Generate a change in *softgoals* of some *actor*.

X4. Generate a change in *goals* of some *actor*.

X5. Generate a change in *beliefs* of some *actor*. This will only happen if that *actor*, *agent*, or *role* thinks that the state of affairs in the world has changed or that its original *beliefs* were incorrect.

X6. Add/Remove some *actor*.

Each step in this phase affects a change in the *i** model that was developed in the Modeling phase and analyzed in the Evaluation phase. Therefore, completing any step in this phase leads the modeler to a corresponding step in the Modeling phase. This starts a new iteration of this method that leads to the performance of steps in the Modeling phase as well as the steps in the Evaluation phase and, if needed, an appropriate step of the Exploration phase.

During this phase, modelers can instantiate elements from knowledge catalogs (Section 5.3) in their *i** model. A modeler can start by instantiating relevant elements from these knowledge catalogs at appropriate points in their *i** model. The multi-level structure of these catalogs allows knowledge segments to be instantiated in an *i** model. This is possible because instantiation of a higher-level element from a catalog provides many ready-made choices for related lower-level elements to also be included in that *i** model.

5.5 Analysis Techniques

Identifying and creating win-win strategies necessitates the analysis of: (i) importance of each *goal* and *softgoal*, as well as, (ii) satisfaction of *goals* and *softgoals*.

5.5.1 Considering the Importance attribute of *Goals* and *Softgoals*

An *actor* assesses the advantages and disadvantages associated with any strategy by evaluating the impact of that strategy on each of its *goals* and *softgoals*. A strategy can be regarded as the source of a win for an *actor* if that strategy enables that *actor* to achieve all or some of its *goals* and *softgoals*. In many cases, multiple strategies may support the achievement of all or some *goals* and *softgoals* for an *actor*. However, those *goals* and *softgoals* may differ in importance from the perspective of that *actor*. Therefore, it is important to be able to assess the importance of *goals* and *softgoals* within an actor to facilitate trade-off analysis. The degree of *importance* attribute of a *goal* or *softgoal* can be evaluated to understand the significance of that intentional element for an *actor*. If a degree of *importance* is not provided with an intentional element then we regard it as undefined and consider it to be of lower *importance* than the least degree of *importance* specified for any intentional element within an *actor*.

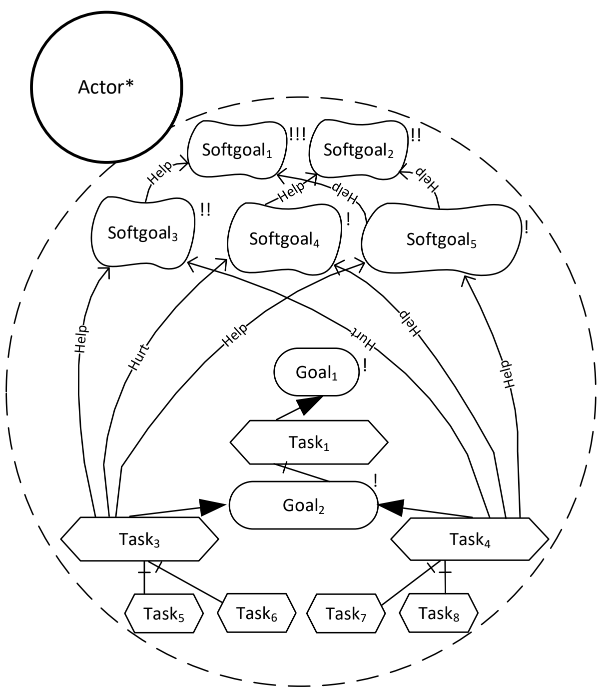


Figure 5-12 An actor with multi-level goal and softgoal hierarchies

An *i** model of an *actor* with *goals* and *softgoals* at multiple levels is presented in Figure 5-12

Figure 5-12. As noted in Section 5.1, the scope of *importance* attribute of an intentional element applies across an *actor* as a whole. This means that Softgoal$_3$, with an *importance* degree of 2, is more important for Actor than Softgoal$_4$, with an *importance* degree of 1. Similarly, Actor perceives Softgoal$_1$, with an *importance* degree of 3, as being more important than Softgoal$_2$, with an *importance* degree of 2. Section 5.1 also states that the relative position of an intentional element in the hierarchy of all intentional elements within an actor does not impact its importance. Therefore, Actor perceives Softgoal$_3$, with an *importance* degree of 2, to be just as important as Softgoal$_2$, also with an *importance* degree of 2, even though the former is at a lower-level in the *softgoal* hierarchy than the latter. For this reason, Goal$_1$, with an *importance* degree of 1, is as important for Actor as Goal$_2$, also with an *importance* degree of 1, even though Goal$_1$ is higher than Goal$_2$ in the *goal* hierarchy for Actor.

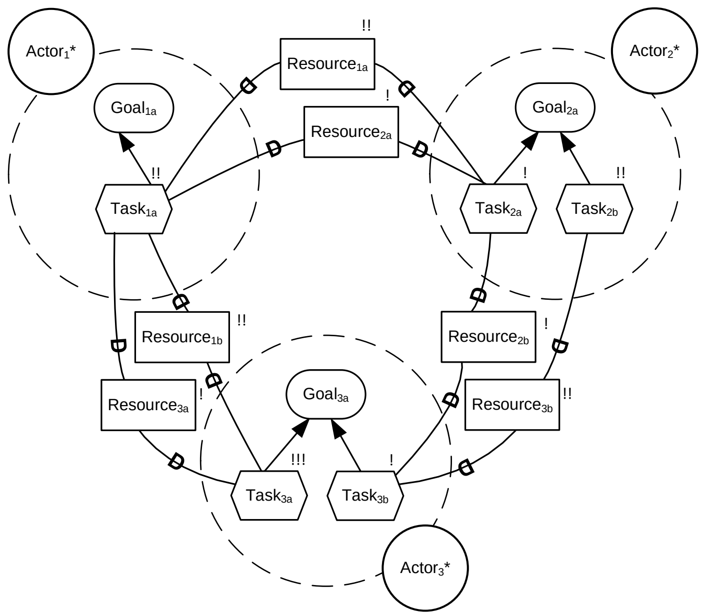


Figure 5-13 Three actors with bidirectional dependencies

Section 5.1 also states that in the case of dependencies, the scope of importance attribute of a *dependum* applies across all *dependums* for that *depender* irrespective of the *dependees* involved in those dependency relationships. An *i** model of three actors with bidirectional dependencies is depicted in Figure 5-13. Actor$_1$ depends on Actor$_2$ for Resource$_{2a}$ as well as on Actor$_3$ for Resource$_{3a}$, Actor$_2$ depends on Actor$_1$ for Resource$_{1a}$ as well as on Actor$_3$ for Resource$_{3b}$, and Actor$_3$ depends on Actor$_1$ for Resource$_{1b}$ as well as on Actor$_2$ for Resource$_{2b}$. The importance degrees associated with each *dependum* can be used to compare their relative significance for each *depender*. Actor$_1$ depends on Actor$_2$ just as much as it depends on Actor$_3$ because Resource$_{2a}$ and Resource$_{3a}$ have identical degrees of importance of 1. However, Actor$_3$ depends more on Actor$_1$ than it does on Actor$_2$ because Resource$_{1b}$ has 2 degrees of importance while Resource$_{2b}$ has a 1 degree of importance. Section 6.5.2 presents a technique for combining the degree of importance of a *dependum* with the degree of importance of the intentional element within a *depender* to which that *dependum* is connected. This yields a more practical understanding of the interdependence among actors. Section 6.5.2 includes a formula for calculating the relative dependence among *actors* in an *i** model.

5.5.2 *Goal* Satisfaction

Win-win strategies can be identified by evaluating the satisfaction of *goals* and *softgoals* of *actors* under analysis. Forward propagation of labels can be used to answer 'is this solution viable' type of questions. The process for forward propagation of satisfaction labels in goal models is explained in Horkoff & Yu (2013). This process involves the iterative and interactive application of propagation rules to attach current values from each offspring to its parent and then resolving labels at the parent level (Horkoff & Yu, 2013). We apply the rules for satisfaction analysis in goal models that are explained in Horkoff & Yu (2011) in step E2 of the Evaluation phase. A table from Horkoff & Yu (2011) is reproduced in Table 5-3.

Source Label		*Contribution Link* Type						
	Name	Make	Help	Some+	Break	Hurt	Some-	Unknown
✓	Satisfied	✓	✓•	✓•	✗	✗•	✗•	?
✓•	Partially Satisfied	✓•	✓•	✓•	✗•	✗•	✗•	?
⚡	Conflict	⚡	⚡	⚡	⚡	⚡	⚡	?
?	Unknown	?	?	?	?	?	?	?
✗•	Partially Denied	✗•	✗•	✗•	✓•	✓•	✓•	?
✗	Denied	✗•	✗•	✗•	✓•	✓•	✓•	?

Table 5-3 Propagation rules in *i** showing resulting labels for contribution links (Source: Horkoff & Yu (2011))

A modeler starts by assessing and labeling the satisfaction/denial of the lowest-level model elements within an *actor*. Then the modeler propagates labels "upward" from those lowest-level elements to relatively higher-level elements using the rules denoted in Table 5-3. The label for an element in an *actor* is impacted by two factors: (i) labels associated with immediately lower-level elements that are connected to that element within the same *actor*; as well as (ii) any *dependums* that are connected to that element from other *actors*. This process is repeated until the topmost *goals*/*softgoals* of all *actors* under analysis are labeled. A win-win strategy exists when at least one of the topmost *goals*/*softgoals* of each actor under analysis are *satisfied*.

5.6 Illustration of the Two Foundational Facets

In this illustration, we demonstrate the application of the modeling approach that is depicted in Figure 5-11 to generate a win-win strategy. This process comprises three phases: Modeling, Evaluation, and Exploration. In the Modeling phase, an *i** model is instantiated and populated. In the Evaluation phase, the impacts of various choices on objectives are calculated to detect the presence of any extant win-win strategies. In the Exploration phase, new alternatives are found by generating relational configurations that yield positive-sum outcomes. This process can be repeated to generate multiple win-win strategies.

5.6.1 Interorganizational knowledge-sharing in pharmaceutical industry

We use an example of knowledge sharing for drug discovery in the biopharmaceutical industry. Drug discovery is characterized by long innovation cycles and high capital requirements (Gupta et al, 2009). Pharmaceutical companies share knowledge with each other to accelerate "product development processes", "reduce costs", and increase "development productivity" (Baglieri et al., 2016). However, knowledge-sharing can also expose members of R&D alliances to the risk of knowledge expropriation through knowledge leakage (Lowman et al. 2012, and Diestre & Rajagopalan 2012). This is because R&D alliances can be among firms that are competitors in the marketplace. Such firms are coopetitors because they cooperate in the R&D domain but compete for customers in the marketplace.

Knowledge leakage occurs when a "focal firm's private knowledge is intentionally appropriated by or unintentionally transferred to partners beyond the scope of the alliance agreement" (Jiang et al. 2013). Knowledge expropriation is an opportunistic behavior (Heiman & Nickerson 2004, and Ritala et al. 2015) that is motivated by the desire of firms to engage in 'learning races' (Kale, Singh, & Perlmutter 2000, and Khanna, Gulati, & Nohria 1998) to 'learn faster' (Carayannis, Alexander, & Ioannidis 2000, and Petts 1997) than each other in the pursuit of 'competitive advantage'(Jashapara 1993, 2003). Knowledge management researchers refer to this as 'boundary paradox' and 'learning paradox' (Manhart & Thalmann 2015).

The potential for knowledge expropriation through knowledge leakage implies that knowledge-sharing under cooperation can lead to win-lose or lose-lose outcomes. In such scenarios, no immediate solutions might exist for the firms under coopetition to get to positive-sum outcomes. Subject matter experts (SMEs) and domain specialists in such firms might contemplate different pathways to generate win-win strategies.

For example, one option might be for coopeting firms to engage other actors into their relationship to reduce opportunities for exploitation. Another option might be for coopeting firms to jointly develop and operate knowledge-sharing systems in-house that mitigate the risks of knowledge misappropriation. Yet another option might be for the actors to change their motivations to disincentivize opportunistic behavior through rewards and penalties. The pathway selected by SMEs in coopeting firms will depend on the specifics of their firms as well as their relationships.

In the real-world, the process of generating and discriminating among such options is complex and nontrivial due to two main reasons (Pant & Yu 2017b, 2017c). First, the decision space of each actor is constrained or enlarged by interdependencies with potential actions of other actors. Second, trade-offs between multiple competing objectives lead to different prioritization of alternatives by each actor due to the unique preference structure of that actor.

5.6.2 As-Is Scenario: Discriminating Win-Win strategies with *i**

Modeling Phase: An *i** model depicting the As-Is scenario of the relationship between Generic Pharmaceutical Compounder (GPC) and Branded Pharmaceutical Company (BPC) is presented in Figure 5-14. This *i** model depicts the knowledge-sharing *goals* of two coopeting actors and shows that knowledge-sharing goals were not achieved by either actor in the As-Is scenario. The internal intentional structures of these actor are symmetrical (except for evaluation labels) because Figure 5-14 only depicts the knowledge-sharing aspects of this coopetitive relationship.

The *goal* structure underlying the *actor* model in Figure 5-14 is presented in Figure 5-15. The *actor* model in Figure 5-14 to shows a coopetitive relationship involving two *actors* by instantiating this *goal* model in Figure 5-15. The *softgoal* catalog for knowledge sharing in Figure 5-10 was derived from the source literature for this case.

The source literature for this case refers to knowledge sharing objectives that are applicable across a wide variety of industrial settings. It situates knowledge sharing intentions among organizations in the pharmaceutical industry with reference to motives for inter-organizational knowledge sharing in general. Therefore, it is an appropriate source of information for constructing the catalog of knowledge sharing *softgoals* in Figure 5-10.

The *goal* model in Figure 5-15 is based on the knowledge catalog in Figure 5-10 and only includes those *softgoals* and *tasks* that are applicable in the As-Is relationship between GPC and BPC. Some *softgoals* and *tasks* in Figure 5-10 are inapplicable in Figure 5-14 (e.g., those requiring intermediate *actors*) because they are not part of the As-Is relationship but rather are part of the To-Be relationship.

The technique of label propagation for assessing *softgoal* satisfaction (Section 5.5.2) is applied over the *goal* model in Figure 5-15 to assess satisfaction of each *softgoal* in S and P policies. As described below, even though BPC and GPC have *symmetrical* goal structures – their evaluation labels are different because BPC and GPC adopt different knowledge-sharing policies (i.e., strict or permissive).

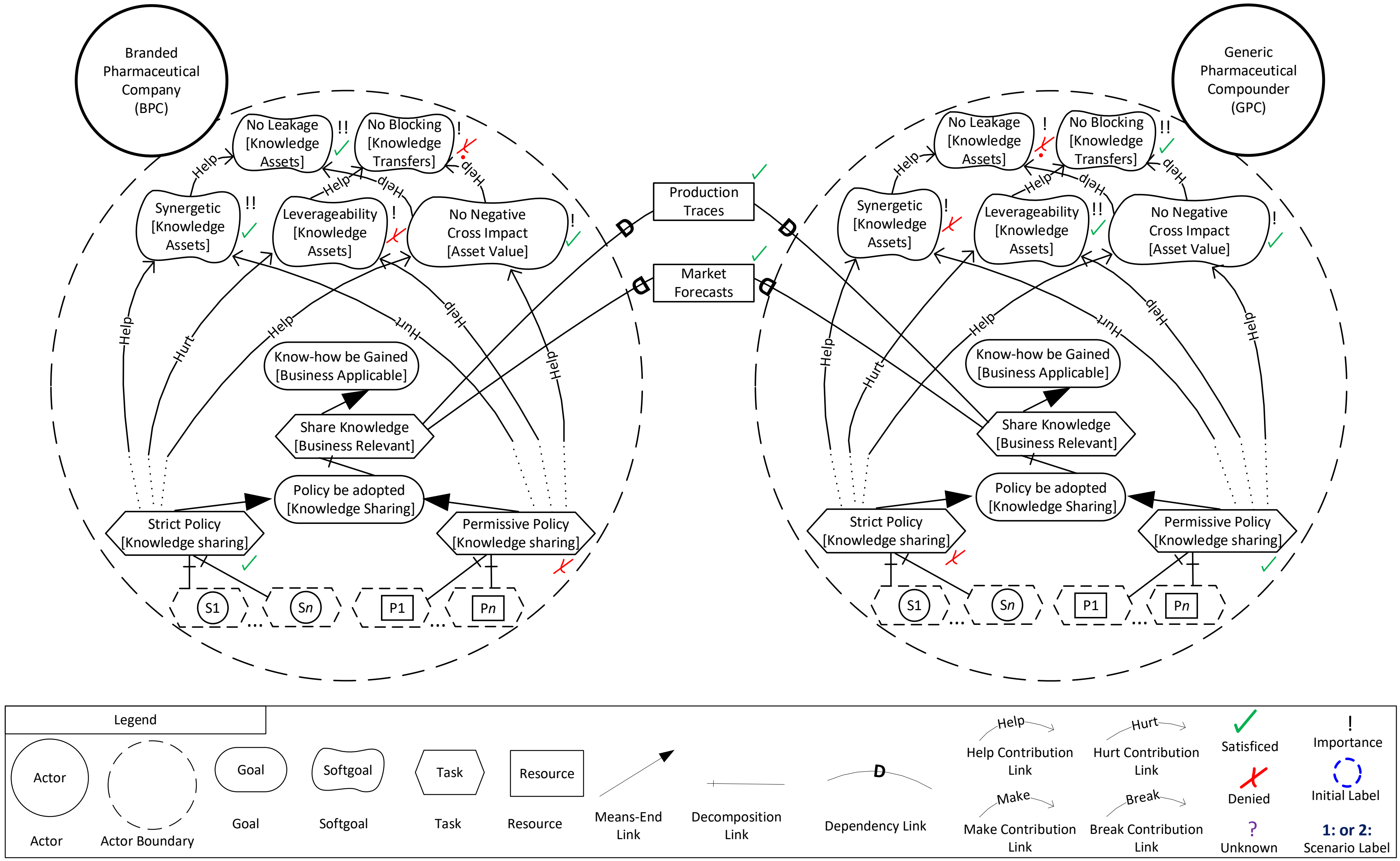


Figure 5-14 *i** model of knowledge-sharing goals of two coopeting actors showing knowledge-sharing goals were not achieved by either actor. Internal intentional structures of these actor are symmetrical (except for evaluation labels) because they only depict knowledge-sharing aspects of this coopetitive relationship.

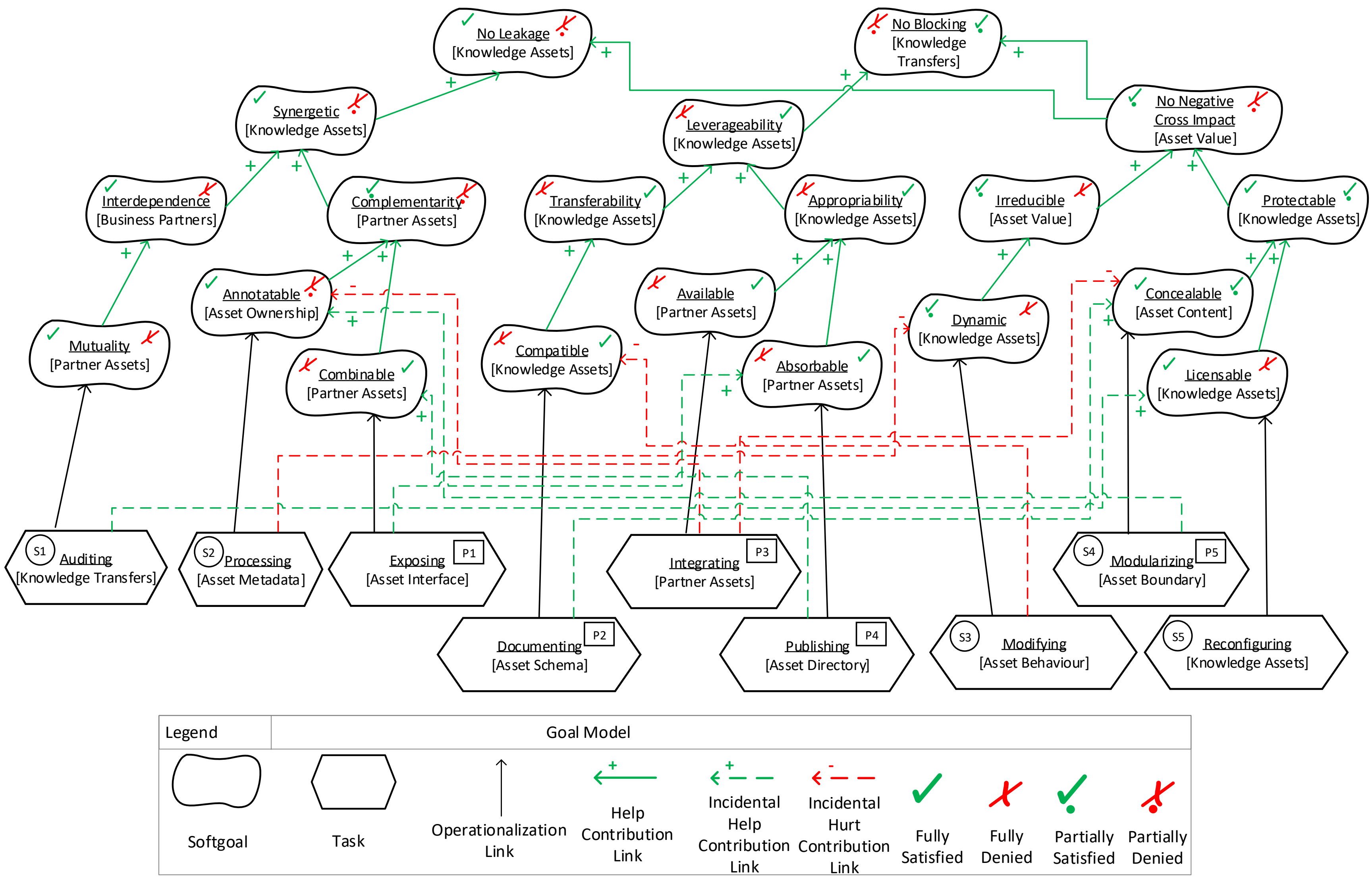


Figure 5-15 Goal model of As-Is scenario representing existing knowledge-sharing *goals* and potential *tasks* available to Generic Pharmaceutical Compounder (GPC) and Branded Pharmaceutical Company (BPC). This *goal* model is based on the knowledge-sharing catalog in Figure 5-10. It only includes those *softgoals* and *tasks* that are applicable in the As-Is relationship between GPC and BPC. An evaluation label in the top-left corner of an element denotes its satisfaction status in a Strict policy. An evaluation label in the top-right corner of an element denotes its satisfaction status in a Permissive policy.

In this *i** model, BPC and GPC are two *actors*. These two *actors* depend on each other to meet their respective *goals* pertaining to Know-how be Gained [Business applicable]. *Dependencies* among BPC and GPC are shown as *resources* because *dependers* rely on these informational entities to perform *tasks* (Share Knowledge [Business Relevant]). Both *actors* can achieve their respective *goals* of Know-how be Gained [Business applicable] by performing the *task* Share Knowledge [Business relevant]. Policy be adopted [Knowledge sharing] is a sub-*goal* of this *task* Share Knowledge [Business relevant]. This sub-*goal* is associated with two *tasks* which pertain to the adoption of either a Strict Policy [knowledge sharing] or a Permissive Policy [knowledge sharing].

The *tasks* labeled Strict Policy and Permissive Policy for knowledge sharing in Figure 5-14 map to the set of *tasks* in Figure 5-15 with the inscriptions of S and P respectively. This is shown in Figure 5-14 via the decomposition of two *tasks*, which are Strict Policy and Permissive Policy, into their respective sub-*tasks*, which are denoted by P1…Pn and S1…Sn. Contributions from the *tasks* labeled Strict Policy and Permissive Policy to *softgoals* labeled Synergetic knowledge assets, Leveregeability of knowledge assets, and No negative-cross impact of asset value are depicted indirectly via a partially dotted *contribution link*. This is done to hide the full intentional structure in the *i** model of the As-Is scenario (Figure 5-14) since the accompanying *goal* model in Figure 5-15 contains these details.

Potential benefits from knowledge sharing serve as incentives for BPC and GPC to adopt Permissive policies. However, the countervailing threat of opportunism serve as motivations for BPC and GPC to adopt Strict policies. Since BPC and GPC are independent *actors* they are free to select either Permissive or Strict knowledge-sharing policy in line with their preferences and proclivities. In this illustration, as shown in Figure 5-14, BPC prioritizes a Strict policy over a Permissive policy while GPC prioritizes a Permissive policy over a Strict policy.

Evaluation phase: In the Evaluation phase, *softgoal* satisfaction in the *i** model is analyzed to assess the presence of win-win strategies. A preliminary analysis of *softgoal* satisfaction in the *goal* model in Figure 5-15 reveals that neither Strict nor Permissive knowledge-sharing policies satisfy all top-level *softgoals* in the As-Is scenario. The *i** model in Figure 5-14 shows that neither BPC nor GPC satisfy every *softgoal* through their chosen policies. For example, BPC is not able to satisfy one of its top-level *softgoals* of No Blocking of knowledge transfers by choosing a Strict policy while GPC is not able to satisfy one of its top-level *softgoals* of No Leakage of knowledge assets by choosing a Permissive policy. This indicates that no win-win strategies are found in the As-Is scenario since neither Permissive nor Strict policies allow BPC and GPC to satisfy each of their top level *softgoals*. This motivates them to find new alternatives that result in positive-sum outcomes.

5.6.3 As-Is Scenario: Generating Win-Win strategies with *i**

In Section 5.6.2, we discussed the As-Is configuration of the knowledge sharing relationship between BPC and GPC from modeling and evaluation perspectives respectively. The evaluation phase shows that no win-win strategies were known by BPC and GPC in the As-Is configuration. In this section we discuss the exploration and finding of a new win-win strategy by BPC and GPC with the support of basic actor-modeling. This new strategy is predicated on the creation of additional quality objectives as well as new methods for addressing those requirements. The introduction of an intermediary *actor* in the relationship between BPC and GPC to realize methods for satisfying new quality requirements. Through modeling, we demonstrate the development of a win-win strategy for BPC and GPC in the To-Be configuration.

Exploration phase: In the Exploration phase, a modeler can pursue any of six lines of action incrementally and iteratively. As shown in Section 5.4, they can add/remove some *actor*, generate a change in some *actor's goals,* generate a change in some *actor's softgoals*, generate additional alternatives for achieving some *actor's goals*, or generate a change in relationships among some *actors*. For example, as shown in the *goal* model in Figure 5-17, new *softgoals* and *tasks* can be introduced that make a *Help* contribution to top-level *softgoals*. These new *softgoals* and *tasks* can be used to satisfy previously denied top-level *softgoals*. In this phase, a modeler can also generate a change in the *beliefs* of an *actor*. However, this will only happen if that *actor* thinks that the state of affairs in the world has changed or that its original *beliefs* were incorrect.

A *goal* model of a hypothetical To-Be knowledge-sharing scenario between businesses under coopetition is presented in Figure 5-17. Figure 5-17 extends Figure 5-15 by including *softgoals* and *tasks* from Figure 5-10 that are absent in Figure 5-15. Elements, from the As-Is scenario in Figure 5-15, that are unimpacted by new *softgoals* and *tasks* in Figure 5-17 are greyed-out. This improves the presentation by highlighting the To-Be scenario. New *softgoals* and *tasks* in Figure 5-17 are shown in blue while previously existing *softgoals* that are impacted by new *softgoals* and *tasks* are shown in black color. New *contribution links* are shown in green (Help) and red (Hurt) while previously existing *contribution links* are greyed-out.

Loops in the process depicted in Figure 5-11 indicate that any step in the Exploration phase of this modeling approach can trigger other steps. For example, in the pursuit of a win-win strategy, an SME may decide to generate new *tasks* to improve overall satisfaction of top-level *softgoals*. These new *tasks,* depicted in Figure 5-17, may trigger the generation of new *softgoals*. Collectively, these additional *tasks* and *softgoals* represent new system requirements in Figure 5-16 that expand the set of existing system requirements depicted in Figure 5-14. These new requirements can be fulfilled by performing certain activities in-house (i.e., generate additional alternatives for achieving goals of some actor). Alternatively, they can be fulfilled by including a new actor into the existing relationship (i.e., add/remove some actor). If needed, the pros and cons of each option in the Exploration phase can also be modeled with *i** separately.

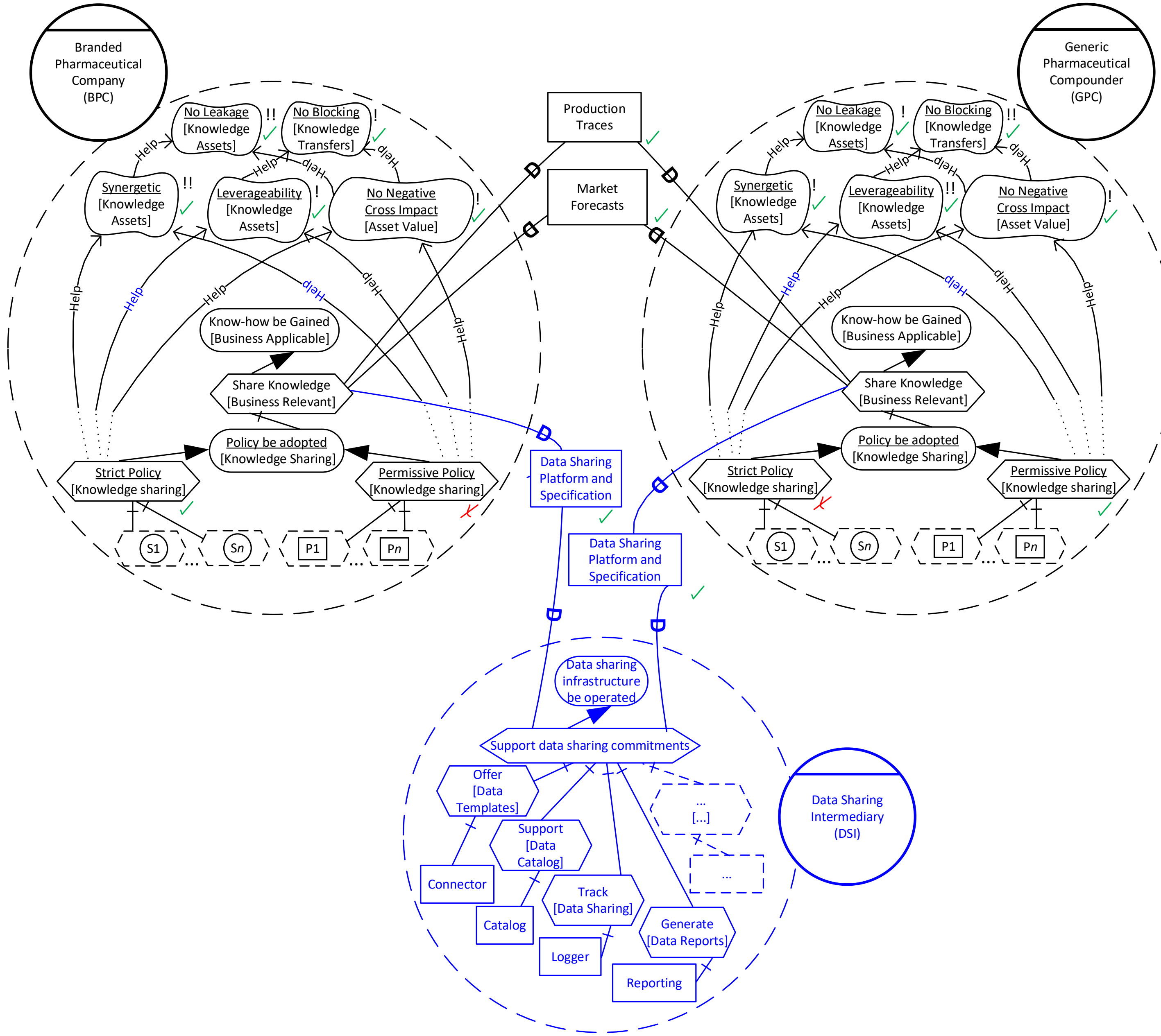


Figure 5-16 *i** model of knowledge-sharing *goals* of two coopeting *actors* (BPC, GPC) and a mediating *actor* (DSI) showing knowledge-sharing *goals* were achieved by both *actors* due to support by the mediating *actor*.

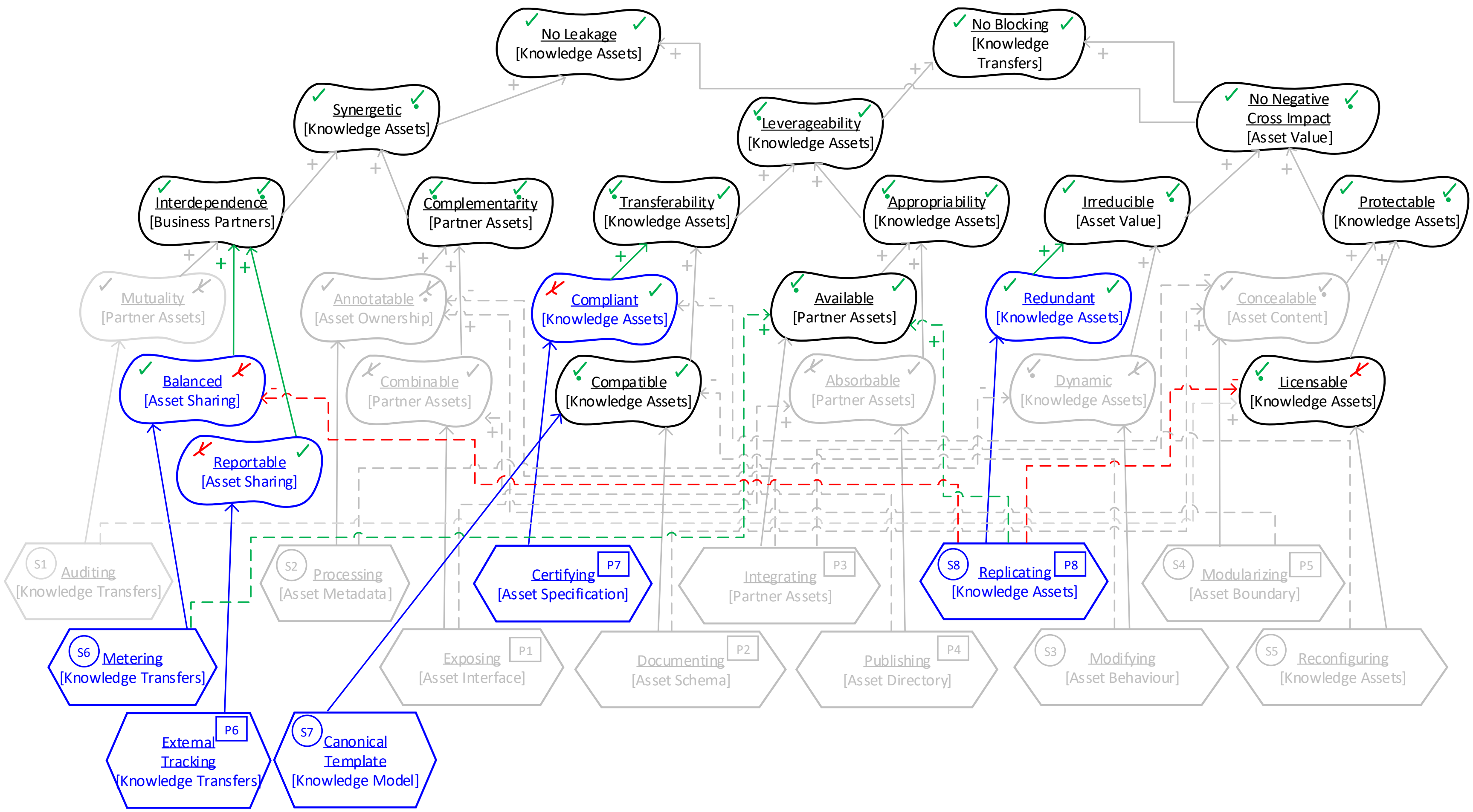


Figure 5-17 Goal model of To-Be scenario representing additional knowledge sharing goals and potential tasks available to Generic Pharmaceutical Compounder (GPC) and Branded Pharmaceutical Company (BPC). An evaluation label in the top-left corner of an element denotes its satisfaction status in a Strict policy. An evaluation label in the top-right corner of an element denotes its satisfaction status in a Permissive policy.

The *softgoals* and *tasks* that are included in Figure 5-17 (To-Be) and Figure 5-15 (As-Is) are described in Table 5-1 and Table 5-2. In comparison to the As-Is scenario (Figure 5-15), the To-Be (Figure 5-17) scenario contains new *softgoals* and *tasks* that are necessary for satisfying top-level *softgoals* in Strict and Permissive policies. New *softgoals* include Balanced [Asset Sharing], Reportable [Asset Sharing], Compliant [Knowledge Assets], and Redundant [Knowledge Assets]. New *tasks* include Metering [Knowledge Transfers], External Tracking [Knowledge Transfers], Canonical Template [Knowledge Model], Certifying [Asset Specification], and Replicating [Knowledge Assets].

Balanced [Asset Sharing] requires the quantity of contents transferred among partners to be equal. Reportable [Asset Sharing] necessitates quantity and quality of contents transferred to be auditable. Compliant [Knowledge Assets] mandates that assets should be consistent with knowledge management specification. Redundant [Knowledge Assets] involves storage of copies of assets for safeguarding. Metering [Knowledge Transfers] requires measuring quantity of transfers between partners. External Tracking [Knowledge Transfers] necessitates surveilling content in transfers between partners. Canonical Template [Knowledge Model] refers to establishing of a uniform format to be used by partners. Certifying [Asset Specification] mandates attesting of system specification by standards organization. Replicating [Knowledge Assets] involves the creation of multiple copies of asset.

A comparison of the As-Is and To-Be scenarios reveals a contrast between the *softgoals* and *tasks* in these scenarios. Each of the *softgoals* and *tasks* in the As-Is scenario can be achieved by BPC and GPC without requiring support from any other *actor*. However, certain *softgoals* and *tasks* in the To-Be scenario cannot be satisfied by BPC and GPC alone. These *softgoals* and *tasks* in the To-Be scenario require the involvement of an intermediary *actor* in the relationship between BPC and GPC. For example, the *softgoal* Compliant [Knowledge Assets] requires an intermediary *actor* to publish specifications as well as certify compliance of knowledge assets with those specifications. Similarly, the *task* External Tracking [Knowledge Transfers] requires an intermediary *actor*, that is external to BPC as well as GPC, for surveilling content transfers between BPC and GPC. Also, the *task* Certifying [Asset Specification] requires an intermediary actor, that is neither BPC nor GPC, for attesting specifications of system used by BPC and GPC.

Evaluation phase: The presence of a win-win strategy in the relationship between BPC and GPC can be detected using the *i** model in Figure 5-16. This *i** model of the To-Be scenario shows that all top-level *softgoals* of BPC and GPC are satisfied due to the addition of new *softgoals* and *tasks* as well as the introduction of an *actor* Data Sharing Intermediary (DSI). The presence of DSI is crucial for performing certain new *tasks* that are essential for achieving new *softgoals* in the To-Be scenario. Satisfaction of these new *softgoals* is necessary for achieving those existing top-level *softgoals* that were previously denied.

5.6.4 Discussion

An organization in the real-world that can play the role of DSI in the strategic relationship between BPC and GPC is Industrial Data Space (IDS). IDS is an initiative that comprises a reference architecture and specification to enable trusted and secure data-sharing among organizations (Jarke, 2017; Jarke & Quix, 2017). IDS provides a blueprint, standard, and model for data-sharing among member organizations in a reliable, transparent, and accountable manner (Otto & Jarke, 2019; Otto, ten Hompel & Wrobel, 2019).

IDS functions as an intermediary *actor* that enables member organizations to share knowledge in a fair and seamless manner by enabling the formation and enforcement of data-sharing commitments and obligations.

IDS affords its member organizations with an alternative to ad-hoc data-sharing arrangements. Ad-hoc data-sharing can expose partners to various risks including loss of competence and leakage of technology. Such risks can be mitigated by organizations using IDS for monitoring, regulating, and securing data transfers across organizational boundaries (Cappiello, 2019). IDS enables its member parties to enshrine the terms and conditions of their data-sharing agreements into assurances and commitments. These agreements can be inspected and audited by relevant *actors* thereby minimizing such risks and uncertainties.

IDS constitutes several component specifications that offer many features to its users (Eitel, 2017; Otto, 2019). IDS comprises a Connector specification that offers pre-defined data templates with mappings between heterogeneous data schemas. These templates can be used for meaningfully interconnecting disparate systems. If existing templates are unavailable for certain systems (e.g., legacy or proprietary) then users can develop custom templates by following the IDS blueprint for building templates. Such data templates can be shared for reuse because they are compatible with the IDS standard and specification.

IDS provides a Catalog specification that allows users to list their data catalog. A catalog serves as an index that can be searched or browsed to identify potential sources of data that are needed by users. This use case allows IDS users to operate data marketplaces wherein buyers and sellers of data can transact with each other in a trusted environment. Providers of data can advertise datasets that they are willing to transfer along with relevant terms and conditions. Consumers of datasets can find the datasets they need and then bargain and negotiate with prospective suppliers on the platform. The data catalog specification is a key component of this marketplace.

IDS includes a Logging specification that is necessary for tracking the sharing of data between *actors*. Details about content and scope of the datasets that are accessed as well as volume and variety of data that are transferred can be recorded. Monitoring of data sharing is necessary for ensuring that *actors* only obtain data they are authorized to access. Data are also encoded at the source with metadata to define their terms of use and specify their permitted use cases. Tracking the application of transferred data is needed to verify that data are only utilized for purposes that are agreed to by the relevant *actors*.

IDS consists of a Reporting specification that is useful for generating data reports to analyze compliance of the *actors* with their data-sharing commitments as well as obtain insights related to data transfers. Users can analyze metrics at the operational level, key performance indicators (KPIs) at the tactical level, and critical success factors (CSFs) at the strategic level. IDS users can generate data reports to perform historical analysis and they can also use the raw data in the logs to train predictive or prescriptive models.

5.6.4 Summary of Illustrative Example

We applied the foundational facets of our framework to create a win-win strategy in an industrial coopetition scenario where none was originally known to exist. Using an example of knowledge-sharing among two coopeting firms in the pharmaceutical industry (BPC and GPC) we showed that our framework and knowledge catalogs could be used to find a mutually beneficial arrangement.

We depicted the knowledge-sharing aspects of this coopetitive relationship using *i** modeling. These *i** models showed that the internal intentional structures of these firms were identical in the As-Is (Figure 5-14) and To-Be (Figure 5-16) except for evaluation labels. Application of knowledge catalog from Figure 5-9 in Figure 5-15 and Figure 5-17 were crucial for understanding the reasons for differences in evaluation labels since they depicted the causes for the changes in the evaluation labels within *i** models.

5.7 Summary

In this chapter, we developed and utilized a *goal* and basic *actor* modeling approach to create a win-win strategy by generating new alternatives for organizations under coopetition. This approach incrementally and iteratively elaborated and refined *i** models to go from an As-Is to a To-Be scenario. No win-win strategies were detected in the As-Is scenario due to threats related to knowledge leakage and knowledge blocking.

In the To-Be scenario, a win-win strategy was generated by applying this strategic modeling approach to the As-Is scenario. New *softgoals* and *tasks* were added that obviated the threats from knowledge leakage and knowledge blocking. These *softgoals* and *tasks* could be satisfied by the *actors* by themselves (e.g., by building a system that meets necessary requirements) or with the help of another *actor* (e.g., by using a software platform that meets necessary requirements).

In the illustration presented within this chapter, we depicted the latter option with reference to the Industrial Data Space serving an intermediary *actor*. The next chapter presents the first advanced facet in our modeling framework. It focuses on differentiated *actor* modeling which is relevant for understanding trustworthiness and interdependence in a multi-party economic relationship.

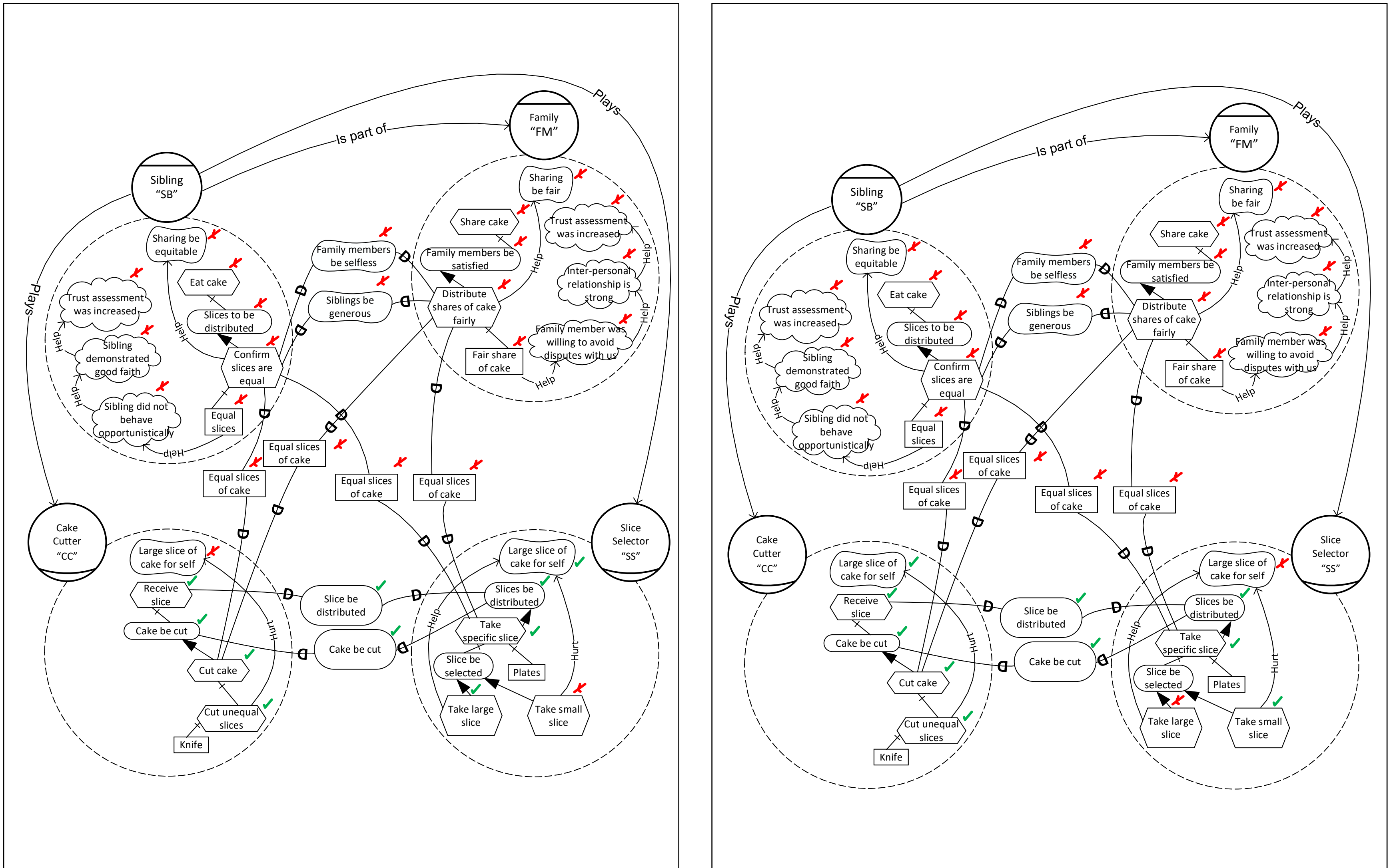
6. Advanced Facet 1: Differentiated Actors - Addressing Trustworthiness and Interdependence Requirements

In this chapter, we explain each component of the first advanced facet of our conceptual modeling framework for analyzing and designing strategic coopetition. We explained the importance of trustworthiness and interdependence for understanding strategic coopetition in Sections 3.2.4 and 3.2.5 respectively. The existence of trust is necessary for cooperation to be present in a strategic relationship (3.2.4). Interdependence is important for competition and cooperation to be balanced in a strategic relationship (3.2.5). In the first advanced facet of our modeling framework, we use a metamodel of *i**, that expands the metamodel in Section 5.1, to model and analyze differentiated *actors*. We described the significance of separating and separately analyzing roles from the entities that play those roles (Section 4.6). The intentional structure and *dependencies* of a *role* may differ from those of any *agents* that *play* that *role*. Understanding convergence/divergence between interest structures and *dependencies* of *roles* and the entities that play them is necessary for assessing viability and feasibility of those relationships.

In this chapter, we develop and apply approaches for modeling and analyzing: (6.5.1) trust assessment and (6.5.2) relative dependence. We include entities and links corresponding with differentiated *actors* from Yu (2011) to the basic *actor* metamodel that is presented in the preceding chapter. We use differentiated *actors* in *i** to meet these requirements from Section 3.2: Actor Abstraction (A2), Relative Dependence (I3), Types of Trust Assessment (T1), Determinants of Trust Assessment (T2), and Importance of Determinants (T3).

This chapter includes: (6.1) a metamodel of *i** to cover relevant concepts and semantics, (6.2) visual notation for utilizing this metamodel, (6.4) process description detailing construction steps and guidelines for developing and evaluating models based on this metamodel, (6.5) analysis techniques including approaches for evaluating models based on this metamodel, (6.6) illustrative representation of a real-world scenario to demonstrate expressiveness and analytical power of models based on this metamodel.

We continue the Cake Sharing example that was introduced in Section 5 to demonstrate the application of *i** for generating a win-win strategy between *actors*. This is a simplified example because it does not contain all the features in this facet. In this example, we incorporate the concepts of *role* and *agent* (i.e., entities that play *roles*) from original *i** (Yu, 2011) since they are specializations of the *actor* concept and are useful for differentiated *actor* modeling. We also demonstrate the expression and evaluation of Interdependence and Trustworthiness requirements from Section 3.2 in this example.



a. Scenario 1 ("SS" takes larger slice for itself and gives smaller slice to "CC")

b. Scenario 2 ("SS" takes smaller slice for itself and gives larger slice to "CC")

Figure 6-1 *i** model depicting As-Is relationship among "CC" and "SS" (Scenarios 1 and 2) showing win-win strategy is not found.

Compared to the models in Chapter 5, the models in Figure 6-1a and Figure 6-1b now depict Cake Cutter (CC) and Slice Selector (SS) as *roles*. A *role* is an abstract characterization of an *actor* in terms of particular behavioral attributes that are domain-specific or context-sensitive. Additionally, Siblings (SB) and Family (FM) are introduced as new *agents*. An *agent* represents a concrete *actor* that can play one or more *roles* and a *role* can be played by one or more *agents*. In our framework, like in original *i** (Yu, 2011), the concepts of *roles* and *agents* are related to strategic relationships. In *i**, dependencies associated with an *agent* apply irrespective of *roles* that are played by that *agent* and when an *agent* plays a *role* then the dependencies that apply to that *role* also apply to that *agent*.

Agents and *roles* were not considered in Figure 5-1, but now we need them for analyzing trust and interdependence. Separation of *agents* and *roles* is necessary because each type of differentiated *actor* supports coherent reasoning in a self-contained manner. An *agent* can take on multiple *roles* and a *role* can be played by multiple *agents* therefore *agents* and *roles* can be associated with each other differently. Some of the reasoning is self-contained in the *agent* part of the model and some of the reasoning is self-contained in the *role* part of the model. Therefore this separation of *agents* and *roles* is necessary for ensuring the stability of model elements within each *agent* and *role*. If we mix together model elements from *agents* and *roles* into undifferentiated *actors* then it will impair the stability of those model elements and hinder proper model analysis.

For example, the *agent* FM has a *softgoal* Sharing be fair and the *agent* SB has a *softgoal* Sharing be equitable. Similarly, the *role* CC has a *softgoal* Large slice of cake for self and the *role* SS also has a *softgoal* Large slice of cake for self. The *agent* SB is connected with *agent* FM via *is-part-of* link and the *agent* SB is connected with the *roles* CC and SS via *plays* links. This means that from the vantage point of FM, its own *goals* and *softgoals* need to be satisfied as well as those of SB, CC, and SS. If the intentional elements of these *agents* and *roles* are mixed together within undifferentiated *actors* then this conclusion cannot be drawn. However, with separation of *agents* and *roles*, a modeler can depict relationships among *agents* and *roles* using *plays*, *is-part-of*, and *is-a* links thereby leading to greater expressiveness and analytical power.

The *agent* SB wishes to perform the *task* Eat cake and this *task* consists of a sub-*goal* Slices to be distributed. This sub-*goal* can be achieved through the performance of a *task* Confirm slices are equal. This *task* makes help contribution to the *softgoal* of SB, which is Sharing be equitable. The completion of this *task* requires the *resource* Equal slices. The *agent* FM wishes to perform the *task* Share cake and this *task* consists of a sub-*goal* Family members to be satisfied. This sub-*goal* can be achieved through the performance of a *task*

Distribute shares of cake fairly. This *task* makes help contribution to the *softgoal* of SB, which is Sharing be fair. The achievement of this *task* requires the *resource* Fair share of cake.

The *agent* SB is connected to the *roles* CC and SS using *plays* link. This connection between SB with CC as well as SS indicates that SB wishes to achieve its own objectives in addition to the objectives of CC and SS. The *agent* FM is connected to the *agent* SB using *is part of* link. An *actor*, *agent*, or *role* can be composed of parts that are other intentional entities of the same type. The aggregation of an *actor*, *agent*, and *role* from its parts can be depicted using the *is part of* link.

SS depends on CC for the *goal dependum* Cake be cut while CC depends on SS for the *goal dependum* Slice be distributed. Therefore, the *roles* CC and SS have mutual dependencies on each other. Next we consider dependencies between the whole and its parts. FM depends on SB for *softgoal* Siblings be generous while SB depends on FM for *softgoal* Family members be selfless. Therefore, the *roles* FM and SB also have mutual dependencies on each other. FM and SB depend on CC and SS for the *resource* Equal slices of cake to perform the *task* Distribute shares of cake fairly and the *task* Confirm slices are equal respectively.

As explained above, for the *goals* and *softgoals* of the *agent* FM to be satisfied, the *goals* and *softgoals* of the *agent* SB and therefore those of the *roles* CC and SS must also be satisfied. If *agents* and *roles* were not separated in this way, and these intentional elements were mixed together in undifferentiated *actors*, then the modeler would not be able to show this aspect of their relationships thereby obscuring analytical insights. Separation of *agents* and *roles* allows coherent reasoning, related to each *agent* and *role*, to be performed in a self-contained manner. For instance, Chapter 5 included modeling constructs related to undifferentiated *actors* but not differentiated *actors* (i.e., *agents* and *roles*). Therefore, the analysis described here would not be possible using modeling constructs from Chapter 5.

To explore potential coopetition between CC and SS, we now consider two possible As-Is scenarios between CC and SS are depicted in Figure 6-1a and Figure 6-1b – in Scenario 1 (Figure 6-1a) SS chooses the large slice for itself and offers the small slice to CC while in Scenario 2 (Figure 6-1b) SS chooses the small slice for itself and offers the large slice to CC. As explained in Section 5, neither Scenario 1 nor Scenario 2 represent a win-win strategy because in Scenario 1 SS wins and CC loses while in Scenario 2 CC wins and SS loses. Moreover, in both scenarios, the *softgoals* of SB and FM are denied because their respective *dependencies* from CC and SS are not fulfilled.

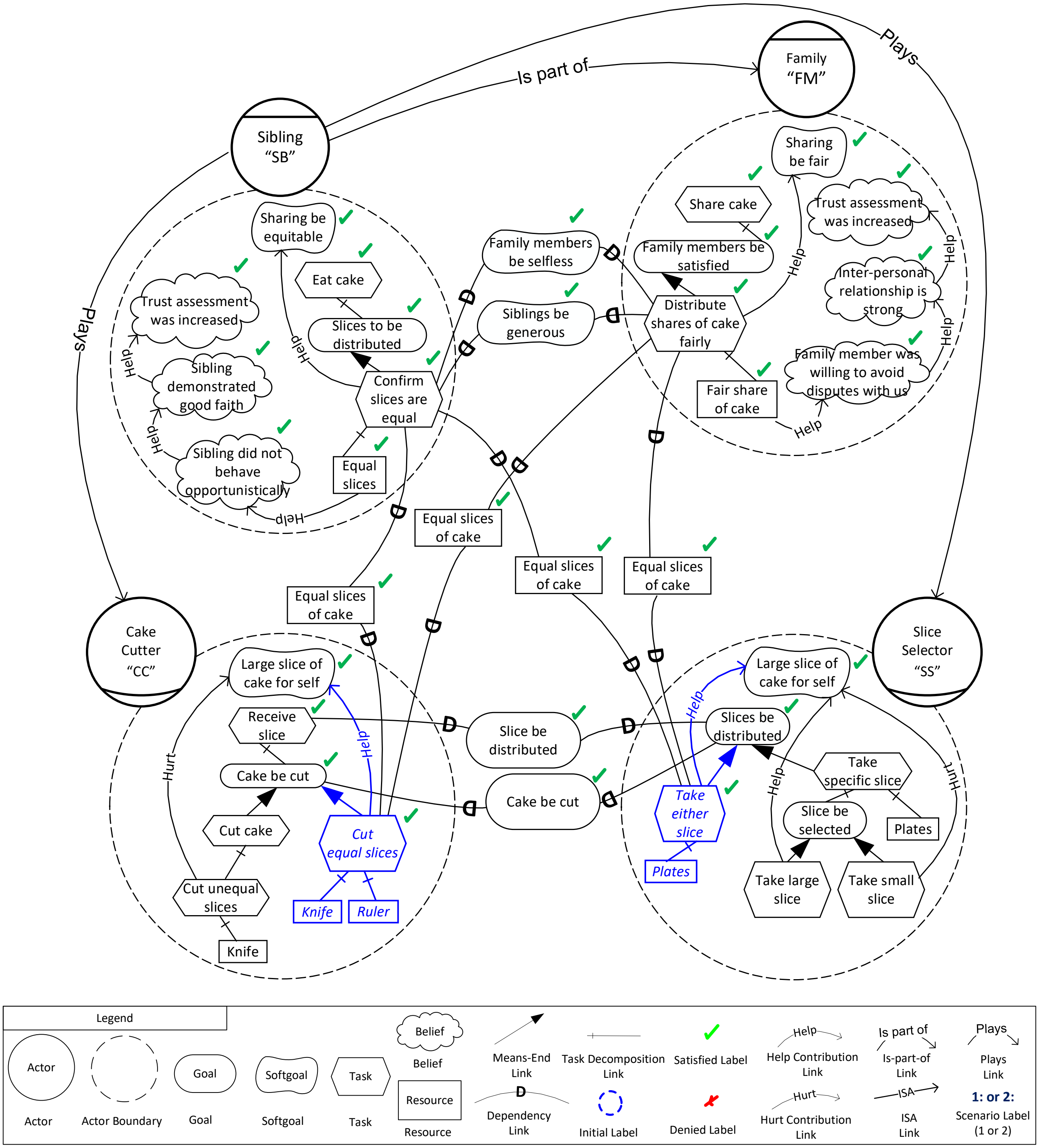


Figure 6-2 i* model depicting To-Be relationship among "CC" and "SS" showing win-win strategy is found.

The agents FM and SB assess each other's trustworthiness based on the resources Fair share of cake and Equal slices respectively. In FM, the *resource* Fair share of cake makes a help contribution to *belief* Family member was willing to avoid disputes with us. This *belief* makes a help contribution to the *belief* Interpersonal relationship is strong and this *belief* makes a help contribution to the *belief* Trust assessment was increased. In SB, the *resource* Equal slices makes a help contribution to *belief* Sibling did not behave opportunistically. This *belief* makes a help contribution to the *belief* Sibling demonstrated good faith and this *belief* makes a help contribution to the *belief* Trust assessment was increased. The *beliefs* of SB and FM are contradicted meaning that trust assessment was not increased in Figure 6-1a and Figure 6-1b.

In our example, we suppose that the relationship between CC and SS is changed to generate a win-win strategy (To-Be). This is done because the As-Is relationship does not consist of any win-win strategies. We evaluate Figure 6-1a and Figure 6-1b to understand the reasons for the absence of any win-win strategy in the As-Is scenario. As noted in Chapter 5, the As-Is strategy of CC involves cutting the cake into unequal slices and this is disadvantageous for CC because SS will always take the large slice of that cake for itself to satisfy SS's *softgoal* Large slice of cake for self.

An i* model that depicts To-Be relationship among CC and SS is presented in Figure 6-2. Model elements with black color represent existing model elements from Figure 6-1a and Figure 6-1b while model elements with blue color represent new model elements in Figure 6-2. In our framework, we provide guidance for generating win-win strategies however, for this introductory example, we skip ahead directly to a To-Be solution. To create a win-win strategy, we ideated a new alternative that can enable CC to achieve its *softgoal* Large slice of cake for self. However, this alternative must also help SS to satisfy its *softgoal* Large slice of cake for self. Moreover, this alternative should enable *dependums* Equal slices of cake to be fulfilled for the *dependers* SB and FM so that their objectives can be achieved, and trust assessments can be increased.

This new strategy (To-Be) can only exist if CC cuts the cake into equal slices because with unequal slices only one of the *roles* (CC or SS) will get the large slice of that cake. If CC cuts the cake into equal slices then both slices will be equally large. This new alternative for CC will also change the space of alternatives available to SS. This is because by cutting the cake into equal slices CC will require a new alternative to be generated for SS so that it can Take either slice.

This new strategy (To-Be) represents a win-win for *agents* SB and FM as well as *roles* CC and SS. From the viewpoint of CC, since it's played by SB, which is part of FM, a modeler would want all *goals* and *softgoals* in CC, SB, and FM satisfied. Similarly, from the viewpoint of SS, since it's played by SB, which is part of FM, a modeler would want all *goals* and *softgoals* in SS, SB, and FM satisfied.

In this To-Be scenario, the previously balanced dependencies between CC and SS will not be impacted as SS will continue to depend on CC for the *dependum* Cake be cut (*goal*) while CC will continue to depend on SS for the *dependum* Slice be distributed (*goal*). Similarly, the previously balanced dependencies between SB and FM will not be impacted as SB will continue to depend on FM for the *dependum* Family members be selfless (*softgoal*) while FM will continue to depend on SB for the *dependum* Siblings be generous (*softgoal*). Additionally, this alternative will enable the *dependums* Equal slices of cake to be fulfilled for the *dependers* SB and FM resulting in increased trust assessments.

In this simplified example we motivated the need for using differentiated *actor* modeling. We showed that each type of differentiated *actor* supports coherent reasoning in a self-contained manner therefore separation of *agents* and *roles* is useful for achieving greater expressiveness and analytical power. A *role* can be played by multiple *agents* and an *agent* can take on multiple *roles* therefore *roles* and *agents* can be related with one another differently. We demonstrated that some of the reasoning is self-contained in the *role* part of the model and some of the reasoning is self-contained in the *agent* part of the model. Therefore this separation of *roles* and *agents* is needed to ensure the stability of model elements within each *role* and *agent*. If we mixed model elements together into undifferentiated *actors* from *roles* and *agents* then it would have harmed the stability of those model elements and would have impeded proper model analysis.

6.1 Modeling Ontology

In this first advanced facet of our modeling framework, we model and analyze differentiated *actors* using a metamodel of *i** that expands the metamodel in Section 5.1. This metamodel of *i** for modeling differentiated *actors* is based on Yu (2011) and is presented in Figure 6-3.

It extends the metamodel in Figure 5-4 by adding elements that are necessary for representing differentiated *actors*. Elements that are included in Figure 6-3, but not in Figure 5-4, are shown within purple boxes.

Extensions to the original *i** metamodel were introduced in Section 5.1 and are depicted with red font in in Figure 5-4.

The same extensions to the original *i** metamodel in Figure 5-4 are also included in Figure 6-3. No new extensions to the original *i** metamodel are introduced in Figure 6-3.

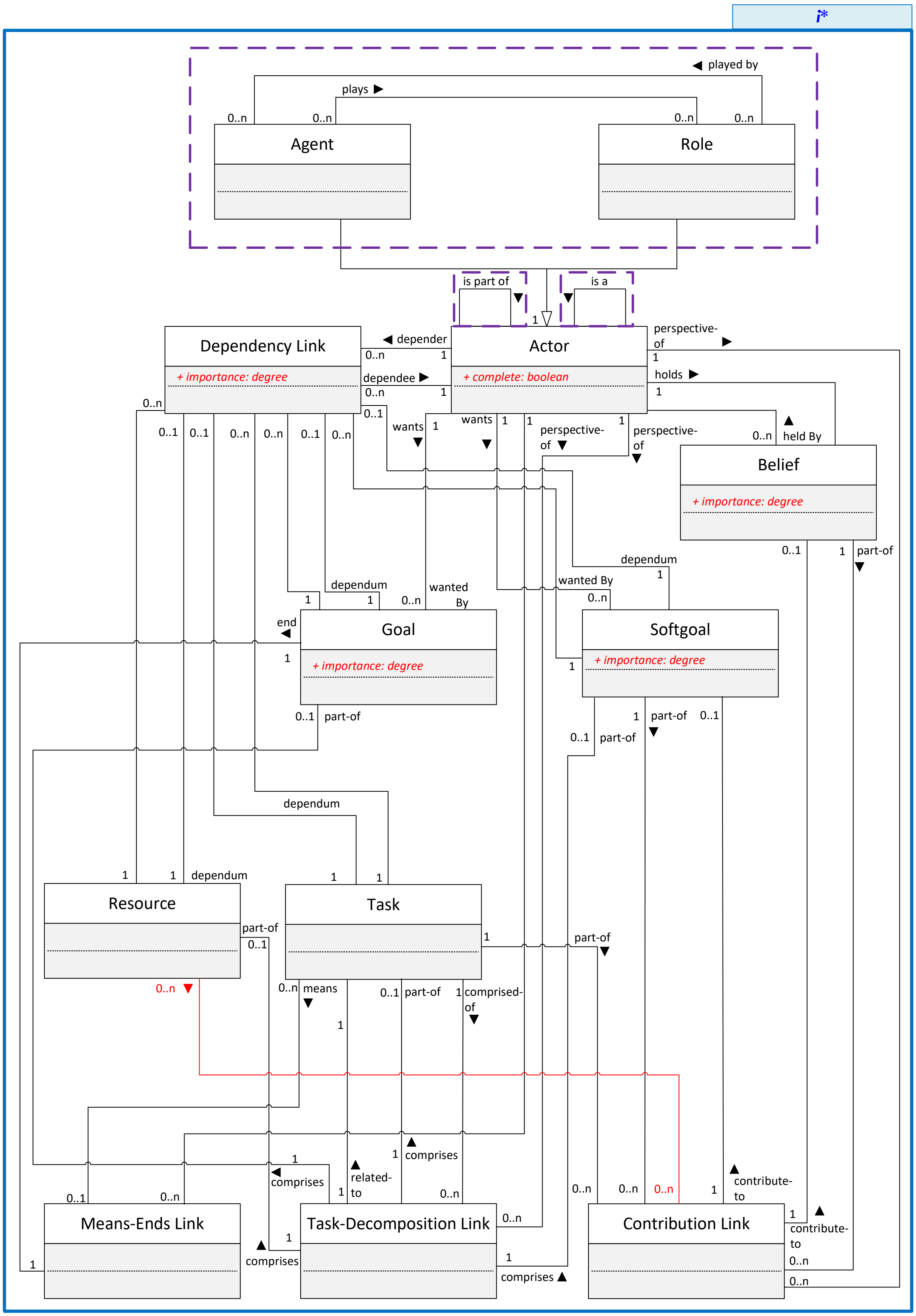


Figure 6-3 Metamodel of *i** for modeling differentiated actors (based on Yu (2011)).
Additions to Figure 5-4 in terms of entities and relationships are shown within purple boxes.

6.2 Visual Notation

Original *i** includes visual notation for expressing entities and relationships associated with differentiated *actors*. Symbols and icons corresponding with *i** elements, that are described in Section 6.1, are depicted in Figure 6-4. They add to the set of notations and symbols in Figure 5-5 by adding elements that are necessary for expressing differentiated *actors*. The entities and relationships that are shown within purple boxes in Figure 6-3 are expressed using these notations and symbols. Details about these notation and syntax rules of *i** can be found in Yu (2011). No extensions to original *i** notation are introduced.

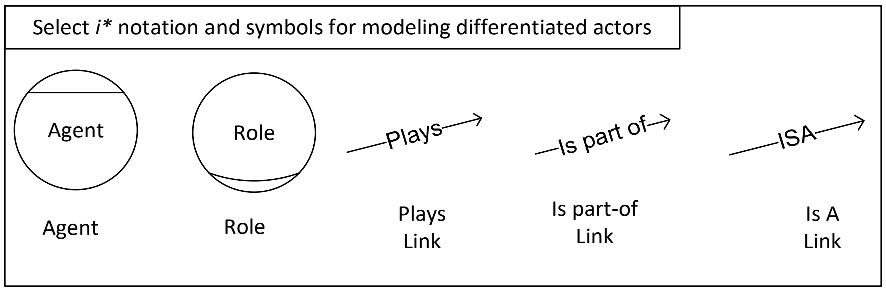


Figure 6-4 Notations and symbols corresponding with abstract actors in *i** (based on Yu (2011))

6.3 Knowledge Catalog for Assessment of Trustworthiness

We offer a knowledge catalog to assist with the identification and generation of trust in a coopetitive relationship. This catalog presents codified knowledge from published literature. The rationale for infusing knowledge from such a catalog within strategic decision-making processes is described in Section 4.3.

6.3.1 Trustworthiness

In Section 4.6, we explained that our approach for trustworthiness assessment benefits from a catalog of *beliefs* that are predicated on informational *resources*. A catalog of *beliefs* that can be instantiated to assess trust between organizations under coopetition is depicted in Figure 6-5. It also includes informational *resources* that support or undermine each *belief*. In this *belief* graph, the nodes are *beliefs* or *resources* while the edges are *contribution links*. The meanings of the *beliefs* and informational *resources*, that are included as content in these catalogs, are described in Tables 6-1 and 6-2. *Contribution links* from *resources* to *beliefs* are supported via an extension to the *i** metamodel that is described in Section 5.1.

An informational resource can be used to confirm or contradict a belief. Confirmation of a *belief* leads to its continuation while contradiction of a *belief* leads to its discontinuation. For example, according to Figure 6-5, an *actor* can demand Inventory of activities from partner from its partner to substantiate its *belief* that the Partner disclosed relevant activities. The partner can refuse to furnish its inventory of activities to that *actor*. The absence of this informational *resource* will contradict that *actor's* belief that its Partner disclosed relevant activities. Conversely, if the partner furnishes its inventory of activities to that *actor* then this will confirm that *actor's* belief that its Partner disclosed relevant activities.

Belief	Description of *belief* and source
Calculative Trust assessment was increased	Expectation-based trust with partner was improved compared to past [10]
Knowledge Trust assessment was increased	Understanding-based trust with partner was improved compared to past [22]
Bonding Trust assessment was increased	Values-based trust with partner was improved compared to past [11]
Partner fulfilled their agreements	Partner fulfilled objectives that they had promised to us [39]
Partner demonstrated good faith	Partner conducted their affairs towards us in a scrupulous manner [1]
Personnel shared values with each other	Partner staff and our staff had common values and ethics [21]
Partner activities were transparent	Partner explained their activities as well as rationales to us [28]
Partner honored contribution commitments	Partner expended their resources in line with their promises to us [4]
Partner did not behave opportunistically	Partner did not engage in conduct that was harmful or injurious to us [35]
Partner was flexible in dealings with us	Partner abided by spirit, rather than letter, of our agreement [31]
Inter-personal relationships were strong	Partner staff and our staff maintains healthy relationships [16]
Beliefs of personnel were compatible	Partner staff ideals and mental models aligned with those of our staff [38]
Partner disclosed relevant activities	Partner declared and exposed their activities to us [32]
Partner invested in relationship-specific resources	Partner allocated certain resources exclusively for our relationship [34]
Partner refrained from alliances with our competitors	Partner did not enter into cooperative relationships with our rivals [37]
Partner was willing to compromise with us	Partner was comfortable to interpret our contract leniently [2]
Professional interactions were seamless	Partner engagements with us were predictable and frictionless [24]
Informal understandings were shared with partner management	Partner leadership and our leadership enjoy genuine rapport [14]
Partner permitted regular external audits	Partner allowed auditors appointed by us to inspect their records [6]
Partner allowed investments to be customized	Partner allowed us to influence their investment decisions [33]
Partner avoided learning race against us	Partner did not usurp our knowledge while hoarding their own knowledge [5]
Partner was willing to avoid disputes with us	Partner was willing to defuse and deescalate disagreements with us [12]
Collaboration among staff was spontaneous	Partner staff and our staff cooperated without instruction or compulsion [36]
Organizational cultures were aligned	Partner staff and our staff shared common norms and principles [17]
Partner allowed recurring monitoring of activities	Partner allowed us to inspect their activities on a regular basis [13]
Partner made irreversible investments	Partner permanently allocated certain resources to our relationship [40]

Table 6-1 Beliefs in Figure 6-5

Resource	Description of *resource* and source
Inventory of activities from partner	Roster of historical as well as planned activities by partner [8]
Schedule of regular audits of partner activities	Agreement authorizing our audits of partner activities [20]
Schedule of recurring inspections of partner activities	Agreement sanctioning our inspections of partner activities [15]
Statement of investments made by partner	Ledger detailing historical investments by partner [19]
Roadmap of investments made by partner	Plans describing future investments by partner [26]
Immutability terms in contract with partner	Contractual terms prohibiting partner from changing our agreement [9]
Exclusivity terms in contract with partner	Condition disallowing partner from cooperating with our rivals [29]
Non-compete terms in contract with partner	Condition prohibiting partner from competing with us [30]
Selective non-enforcement terms in contract with partner	Condition waiving certain non-compliance penalties for us [23]
Renegotiation terms in contract with partner	Contractual terms permitting us to change our agreement [27]
Membership of staff in communities of practice involving partner staff	Access to professional networks for knowledge sharing [3]
Unofficial arrangements among partner staff	Relaxed co-working and work-sharing practices [18]
List of informal deals with partner executives	Casual business understandings between decision-makers [25]
Overlapping boundaries of organizations	Inter-organizational teams and workflows to support joint projects [7]

Table 6-2 Resources in Figure 6-5

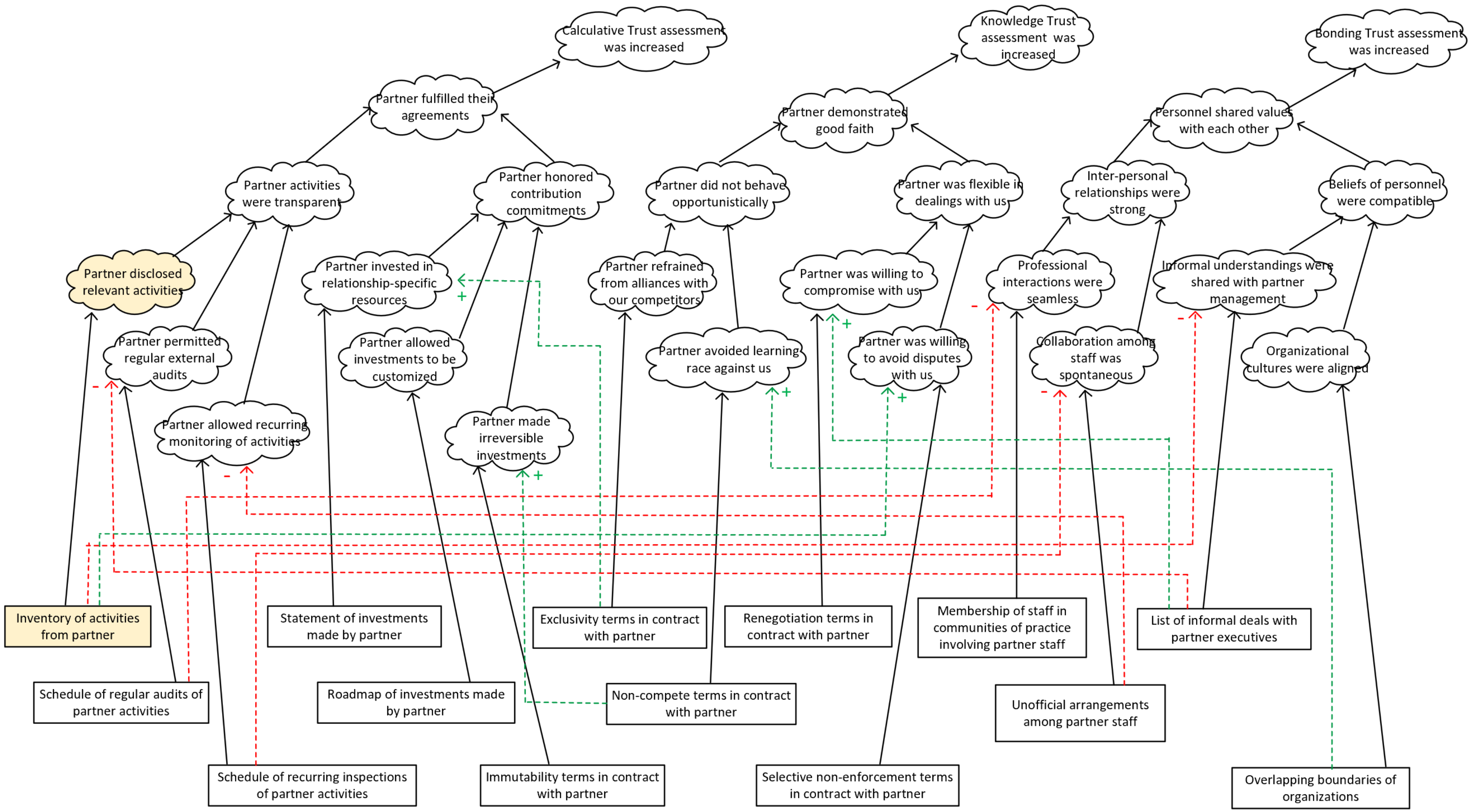


Figure 6-5 Catalog of beliefs that underlie assessments of trustworthiness between organizations under coopetition (Source of each goal can be identified and accessed via http://research.vikpant.com). [To improve explainability, one *belief* and one *resource* that are mentioned in accompanying text are shown in Yellow].

6.4 Method

We extend the method for identifying and developing win-win strategies, first introduced in Section 5.4, by adding support for differentiated *actors*. This method comprises three phases: Modeling, Evaluation, and Exploration (Figure 6-6). In the Modeling phase, an *i** model is instantiated and populated. In the Evaluation phase, the impacts of various choices on objectives are assessed to detect any extant win-win strategies with respect to *goal* satisfaction. Additionally, if needed then assessments of relative dependence and trust are also performed. In the Exploration phase, new alternatives are found by generating relational configurations that yield positive-sum outcomes. This process can be repeated to create one or more win-win strategies.

Modeling phase: In this phase, the modeler develops a rich enough *i** model that covers the concepts needed to perform analysis of positive-sum outcomes and win-win strategies in coopetitive relationships. In this phase, intentional aspects of *actors* are modeled in terms of *beliefs*, *goals*, *tasks*, *resources*, *softgoals*, and strategic relationships among *actors* are modeled as *dependencies* among them. This phase consists of eight steps and yields an *i** model:

M1. Identify focal *actors* that are: concrete as *agents*, and, abstract as *roles*.

M2. Identify additional *actors*, *agents*, and *roles*[19]. *Agents* and *roles* should be modeled when it is important to separate and separately analyze behaviors (i.e., *roles*) from the entities that carry out those behaviors (i.e., *agents*). If this differentiation does not improve the analysis then undifferentiated *actors* can be used.

M3. Identify *beliefs* for each *actor*, *agent*, and *role* (with 'Importance').

M4. Identify *goals* for each *actor*, *agent*, and *role* (with 'Importance').

M5. Identify *softgoals* for each *actor*, *agent*, and *role* (with 'Importance').

M6. Identify alternative *tasks* for achieving each *goal*. Depict the subsidiary parts of a *task*. Differentiate between strategic *resources* and generic *resources* to model only those *resources* that are strategic[20]. Depict the *resources*, typically information assets, that underlie *beliefs*. Portray impact of *tasks* on *softgoals*.

M7. Identify *contribution links* from *softgoals* to *softgoals*, *beliefs* to *beliefs*, *tasks* to *softgoals*, and *resources* to *beliefs*.

M8. Identify dependencies among *actors*, *agents*, and *roles* (with 'Importance').

After completing this phase, the modeler should proceed to the Evaluation Phase.

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[19] We adopt the *i** *actor* specialization technique described by López, Franch, & Marco (2012) to represent specializations of *actors*, *agents*, and *roles* using *is-a* links.
[20] The rationale for making this distinction and identifying strategic *resources* is explained in Appendix 1.

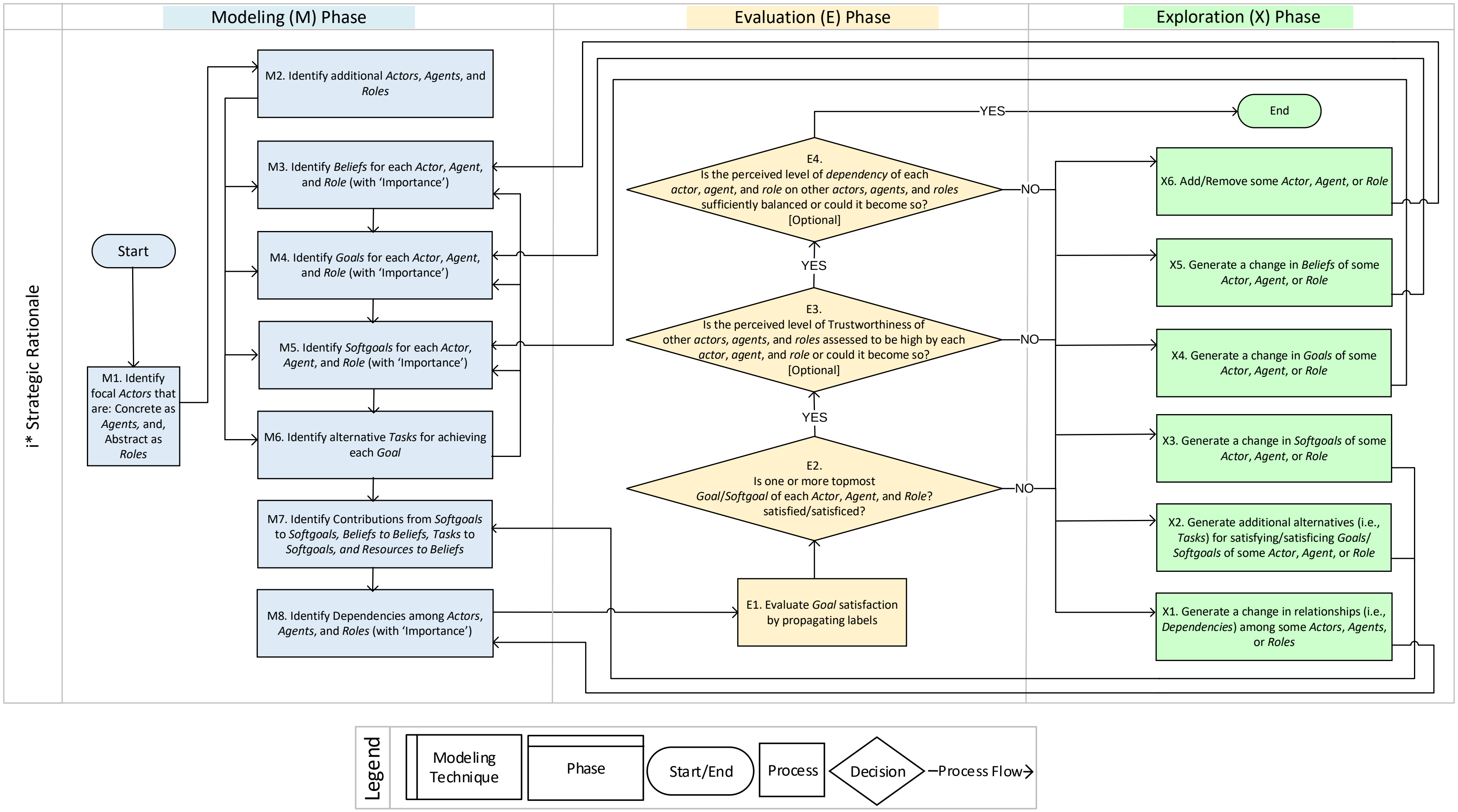


Figure 6-6 Process steps for using *i** modeling with differentiated *actors* to get to win-win

Evaluation phase: In this phase, the modeler analyzes the *i** model that is developed in the Modeling phase. This phase consists of four sequential steps and results in the analysis of the *i** model. Of these four steps, the former two are mandatory while the latter two are optional depending upon the scope of analysis:

E1. Evaluate *goal* satisfaction by propagating labels. Trace the impact of *tasks* on *goals*, *tasks* on *softgoals*, lower-level *softgoals* on higher-level *softgoals*, and *resources* on *beliefs*. As depicted in Section 5.5.2, *softgoals* and *goals* can either be: fully satisfied (denoted by a checkmark), partially satisfied (denoted by a dot underneath a checkmark), fully denied (denoted by a cross), or partially denied (denoted by a dot underneath a cross). In case the status of a *softgoal* or *goal* cannot be resolved then it can be marked as unknown (denoted by a dot above a question mark).

E2. Assess whether one or more topmost *goal*/*softgoal* of each *actor*, *agent*, and *role* are satisfied? Use the technique outlined by Horkoff & Yu (2009, 2011, 2013), that is summarized in Section 5.5.1, to evaluate the satisfaction or denial of top-level *softgoals* and *goals* for each *actor*, *agent*, and *role*. If topmost *goal*/*softgoal* of any *actor*, *agent*, and *role* is unfulfilled then it means that a win-win strategy does not exist in this coopetitive relationship. In this case, the modeler should proceed to the Exploration Phase. If the top-level *softgoals* and *goals* of each *actor*, *agent*, and *role* are satisfied then it can be concluded that a win-win strategy can exist in this relationship. If the top-level *softgoals* and *goals* of each *actor*, *agent*, and *role* are satisfied then the modeler should continue to optional steps E3 and E4 as needed.

E3. If needed, evaluate the level of trustworthiness of all other *actors*, *agents*, and *roles* as perceived by each *actor*, *agent*, and *role*. A technique for assessing the perceived trustworthiness of an *actor*, *agent*, or *role* by another *actor*, *agent*, or *role* is described in Section 6.5.1. This technique can be repeated to cover trustworthiness assessments of each *actor*, *agent*, and *role* by all other *actors*, *agents*, and *roles*. The modeler can proceed to the next step in this phase if the perceived level of trustworthiness of other *actors*, *agents*, and *roles* is assessed to be high by each *actor*, *agent*, and *role* or could become so.

E4. If needed, evaluate the level of interdependence among *actors*, *agents*, and *roles* by assessing the perceived level of *dependency* that an *actor*, *agent*, or *role* has on all other *actors*, *agents*, and *roles*. A technique for assessing the perceived *dependency* of an *actor*, *agent*, or *role* on another *actor*, *agent*, or *role* is described in Section 6.5.2. This technique can be repeated to cover *dependency* assessments of each *actor*, *agent*, and *role* by all *actors*, *agents*, and *roles*. The modeler can advance from this step if the perceived level of dependency of each *actor*, *agent*, and *role* on other *actors*, *agents*, and *roles* is sufficiently balanced or could become so.

If the evaluations of E2, E3, and E4 are positive then it can be concluded that a win-win strategy exists in this coopetitive relationship. If any of those evaluations are negative, then it means that a win-win strategy does not exist in this relationship. In this case, the modeler should proceed to the Exploration Phase.

Exploration phase: In the Exploration phase, a modeler can investigate any of six lines of action iteratively in the pursuit of a win-win strategy. If a win-win strategy cannot be discriminated initially then this method can be repeated to generate a strategy that results in win-win. A modeler can:

X1. Generate a change in relationships (i.e., *dependencies*) among some *actors, agents,* or *roles*.

X2. Generate additional alternatives (i.e., *tasks*) for satisfying *goals* and *softgoals* of some *actor, agent,* or *role*.

X3. Generate a change in *softgoals* of some *actor*, *agent*, or *role*.

X4. Generate a change in *goals* of some *actor*, *agent*, or *role*.

X5. Generate a change in *beliefs* of some *actor*, *agent*, or *role*. This will only happen if that *actor*, *agent*, or *role* thinks that the state of affairs in the world has changed or that its original *beliefs* were incorrect.

X6. Add/Remove some *actor*, *agent*, or *role*.

Each step in this phase effects a change in the *i** model that was developed in the Modeling phase and analyzed in the Evaluation phase. Therefore, completing any step in this phase leads the modeler to a corresponding step in the Modeling phase. This starts a new iteration of this method that leads to the performance of steps in the Modeling phase as well as the steps in the Evaluation phase and, if needed, an appropriate step of the Exploration phase.

6.5 Analysis Techniques

Trust and interdependence between actors impact the viability of their strategies in coopetitive relationships. A coopetitive relationship that lacks trust among actors is likely to devolve into pure competition. This is because trust is positively correlated with the probability of benevolent behavior and negatively correlated with the likelihood of opportunistic behavior by relational partners. This is described in Section 3.2.4. Similarly, relationships with imbalanced dependence between actors can also devolve into pure competition. This is because such imbalance can lead to power asymmetries that yield disproportionate distribution of surplus from the relationship among relational partners. This is described in Section 3.2.5. In this section we describe techniques for: (i) analyzing trustworthiness assessments among actors; and (ii) relative dependence between actors.

6.5.1 Considering Trust Assessments Between Actors

The knowledge catalog presented in Section 6.3 can aid the assessment of an *actor's* trustworthiness by another *actor*. A typology of interorganizational trust that was proposed by Child, Faulkner, and Tallman (2006) is outlined in Section 3.2.4. They note the existence of three types of interorganizational trust –

calculative trust, knowledge-based trust, and bonding trust (Child, Faulkner, and Tallman, 2006). Each trust type is substantiated by certain *beliefs* that are themselves predicated on specific information. A mapping of *beliefs* to informational *resources* that underlie them is presented in Figure 6-5. Highest level *beliefs,* in Figure 6-5, are Calculative trust assessment was increased, Knowledge trust assessment was increased, and Bonding trust assessment was increased. Each top-level belief in Figure 6-5 is refined into progressively lower-level beliefs and lowest-level *beliefs* are connected to specific informational *resources*.

An *actor* can update its trust assessments about other *actors* based on access to these *resources* as well as the content of these *resources*. For example, in terms of access to information, a decision-maker may request the Inventory of activities from any of its partner organizations. If any partner refuses to furnish this information, then it may indicate to the requesting *actor* that this partner did not Disclose relevant activities. This will undermine the requesting *actor's* confidence in their own belief that this Partner's activities were transparent. Consequently, this will make the requesting *actor* suspicious that this partner is unlikely to have Fulfilled its agreements. Overall, this will decrease the requesting *actor's* Calculative trust assessment about this partner organization. Conversely, any partner that furnishes its inventory of activities to the requesting *actor* can expect its Calculative trust assessment to be increased in the mind of the decision-maker. However, this is only possible if the content of its activity inventory does not convey a track record of opportunism. If the requesting *actor* deems a partner to have behaved unscrupulously then it will undermine the requesting *actor's* confidence in its own belief that Partner activities were transparent and this will reduce Calculative trust assessment about this partner.

6.5.2 Considering Relative Dependence Among Actors

There can be different ways for approximating relative dependence among actors. For example, Scheer, Miao, & Palmatier's (2015) technique considers resource value and switching cost. We outline one way, with its attendant assumption that the modeler can obtain quantitative estimates. The interdependence between a *depender* and a *dependee* can be calculated by examining the impact of each of their *dependencies* on their overall degree of dependence. We present a formula for calculating degree of dependency between a *depender* and a *dependee*. This formula can automate calculation as each *dependency* link is evaluated with reference to three components that can be obtained programmatically from an *i** model. The interdependence among a pair of *actors* is based on three components which are:

(i) importance of *dependum* in *dependency* links among *depender* and *dependee actors* in that pair
(ii) importance of each intentional element within a *depender* to which *dependums* are connected
(iii) the importance of substitutes for each intentional element within a *depender* to which *dependencies* are connected.

$$\sum_{i=1}^{count(deps(dpr,dpd))} \left(imp(i) * imp(din(i)) * \left(\frac{imp(din(i))}{\sum_{j=1}^{count(dit(i))} imp(din(j))} \right) \right)$$

Given a pair of actors X and Y, this technique can be used to calculate the degree of dependence of a *depender* actor (e.g., X) on a *dependee* actor (e.g., Y) first. This yields the degree of dependence of X on Y. Then, the original *depender actor* (e.g., X) can be switched to *dependee* and the original *dependee actor* (e.g., Y) can be switched to *depender*. This yields the degree of dependence of Y on X. The results from these two calculations can be combined to understand the relative dependence between those two *actors*. We acknowledge that other techniques, as well as variants of this technique, can be used to assess interdependence between *actors*.

#	Compact notation	Extended notation	Meaning
1	i	i	Iterator for all *dependums* between a specific *depender* and a specific *dependee*
2	count(deps(dpr,dpd))	count(dependums_from(depender,dependee))	Count of *dependums* between that *depender* and that *dependee*
3	imp(i)	importance(i)	Importance degree of a specific *dependum* (from 2)
4	imp(din(i))	importance(depender_intentional_element(i))	Importance degree of specific intentional element within *depender* to which that *dependum* (from 3) is connected
5	count(dit(i))	count(depender_intentional_elements(i))	Count of that intentional element (from 4) within *depender* and other intentional elements that are its substitutes
6	j	j	Iterator for intentional element (from 4) within *depender* to which that *dependum* is connected as well as all intentional elements that are its substitutes
7	imp(din(j))	importance(depender_intentional_element (j))	Importance degree of specific intentional element (from 4) within *depender* to which that *dependum* is connected or importance degree of another intentional element within *depender* that is a substitute of that intentional element (from 4)

Table 6-3 Components of formula for calculating dependency degree between a *depender* and a *dependee*

The first step in this technique involves selecting a pair of *actors* and identifying the *dependencies* between them as well noting the importance of each *dependum*. An *i** model showing two *actors* with bidirectional *dependencies* is presented in Figure 6-7. Actor_1 depends on Actor_2 for a Resource_{2a} to perform Task_{1a} in order to achieve its Goal_{1a} and Actor_2 depends on Actor_1 for a Resource_{1a} to perform Task_{2a} in order to achieve its Goal_{2a}. In this example, Actor_1 ascribes an importance of 1 to its *dependum* and this is represented by a single exclamation mark above Resource_{2a} while Actor_2 ascribes an importance of 2 to its *dependum* and this is represented by two exclamation marks above Resource_{1a}.

The next step in this technique involves identifying the intentional elements within *dependers* to which *dependums* are connected as well as noting the importance of those intentional elements. These intentional elements are Task_{1a} within the *depender* Actor_1 for *dependum* Resource_{2a} and Task_{2a} within the *depender* Actor_2 for *dependum* Resource_{1a}. Actor_1 ascribes an importance of 2 to Task_{1a} and Actor_2 ascribes an importance of 1 to Task_{2a} respectively. This information, from the first and second steps, can be used to determine weighted sums that represent the importance of the dependence of $Actor_1$ on $Actor_2$ as well as the dependence of $Actor_2$ on $Actor_1$. The degree of dependence of $Actor_1$ on $Actor_2$ is 2 (i.e., 2 * 1) and the degree of dependence of $Actor_2$ on $Actor_1$ is also 2 (i.e., 1 * 2).

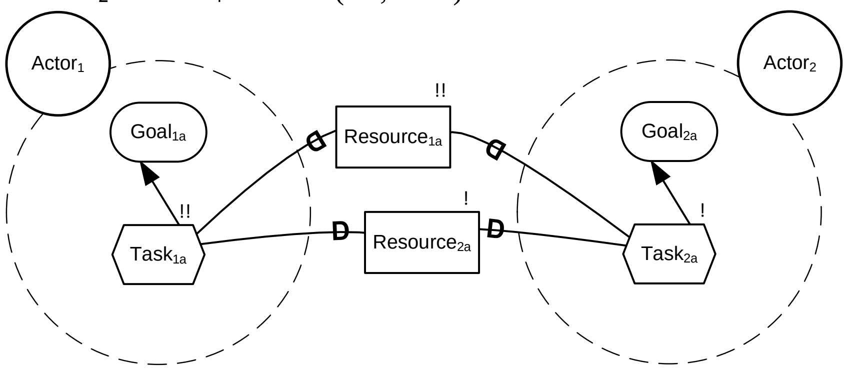


Figure 6-7 Two actors with bidirectional dependencies

The third step in this technique involves discounting the degree of dependence, that is determined in the previous step, by identifying substitutes to the intentional elements within *dependers* to which *dependums* are connected. An *i** model showing two *actors* with bidirectional *dependencies* is presented in Figure 6-8. This figure extends Figure 6-7. In Figure 6-7, $Actor_2$ only has one option ($Task_{2a}$) for achieving $Goal_{2a}$ but in Figure 6-8, $Actor_2$ has an additional option ($Task_{2b}$) for achieving this same goal ($Goal_{2a}$).

$Actor_2$ does not depend on $Actor_1$ for performing $Task_{2b}$ therefore the degree of dependence of $Actor_2$ on $Actor_1$ is lower in Figure 6-8 than in Figure 6-7. The presence of a substitute for $Task_{2a}$ that does not depend on $Actor_1$ means that the degree of dependence of $Actor_2$ on $Actor_1$ from Figure 6-7 can be discounted in Figure 6-8. This is done by multiplying degree of dependence of $Actor_2$ on $Actor_1$ with a discount factor.

This discount factor is calculated by dividing the importance of the focal intentional element (i.e., $Task_{2a}$) by the total importance of all options (i.e., $Task_{2a}$ and $Task_{2b}$) for achieving the same goal ($Goal_{2a}$). In this case, the discount factor can be found by dividing 1 (i.e., importance of $Task_{2a}$) by 2 (i.e., sum of importance of $Task_{2a}$ and importance of $Task_{2b}$) resulting in 0.5. Then, the discounted degree of dependence of $Actor_2$ on $Actor_1$ can be determined by multiplying the degree of dependence from Figure 6-7 (i.e., 2) with this discount factor of 0.5. This yields a discounted degree of dependence of 1 (i.e., 2 * 0.5).

This technique allows us the degree of discounting to be based on the relative importance of the focal intentional element vis-à-vis its substitute intentional elements. In Figure 6-8, $Task_{2a}$ and $Task_{2b}$ are equally important because each has an importance of 1. However, if $Task_{2b}$ is twice as important as $Task_{2a}$ then the discount factor will be 0.33 (i.e., 1/3) and the discounted degree of dependence will be 0.67 (i.e., 2 * 1/3). Alternatively, if $Task_{2a}$ is twice as important as $Task_{2b}$ then the discount factor will be 0.67 (i.e., 2/3) and the discounted degree of dependence will be 1.33 (i.e., 2 * 2/3).

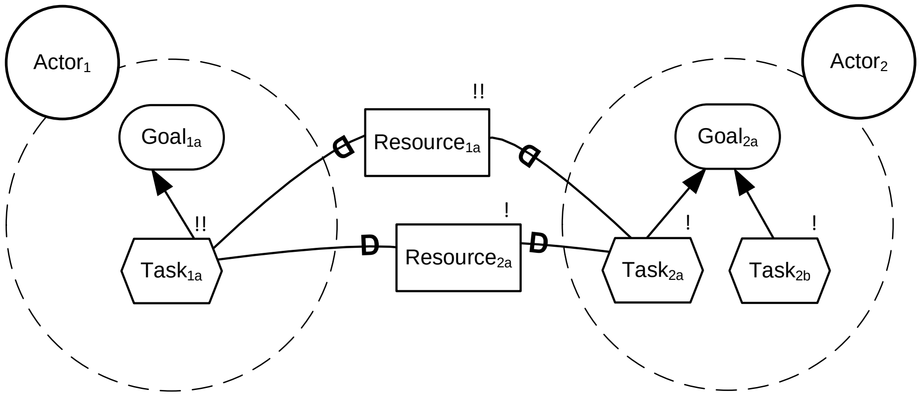


Figure 6-8 Two actors with bidirectional dependencies

The overall dependence of a focal *actor* on another *actor* is determined by summing each of the discounted degrees of dependence in which the focal *actor* is the *depender* and the other *actor* is the *dependee*. This step is repeated by switching the focal and other *actor* with each other to assess the overall degree of interdependence among those *actors*. We say that interdependence between two actors is balanced if the overall degrees of dependence between the *actors* are equal.

For example, the interdependence relationship between the *actors* in Figure 6-7 is balanced (i.e., $Actor_1$: $Actor_2$ is 2:2) as both actors depend on each other equally. However, the interdependence relationship between the *actors* in Figure 6-8 is imbalanced (i.e., $Actor_1$: $Actor_2$ is 2:1) as $Actor_1$ depends on $Actor_2$ twice as much as $Actor_2$ depends on $Actor_1$. The magnitude of difference in overall degrees of dependence between the *actors* indicates the level of imbalance and this impacts the relative bargaining power and negotiating leverage of the *actors*.

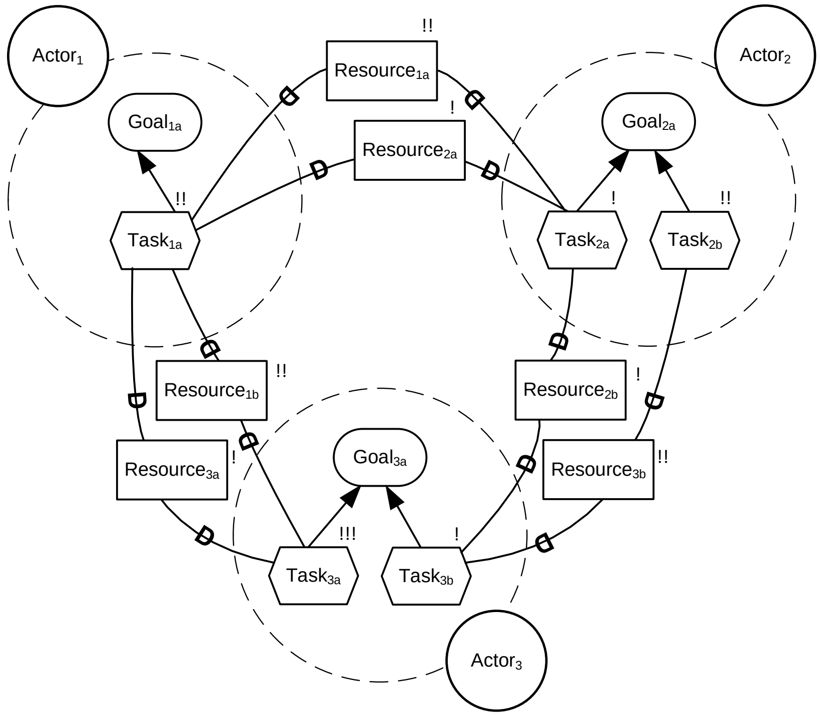


Figure 6-9 Three actors with bidirectional dependencies

This technique can be applied to measure the interdependence among actors in a relationship with any number of *actors* and *dependencies*. An *i** model that extends and adapts the relationship depicted in Figure 6-8 by adding a third *actor* is presented in Figure 6-9. Step-by-step calculations for determining the discounted degrees of dependence among $Actor_1$, $Actor_2$, and $Actor_3$ in Figure 6-7 are shown in Table 6-4. The discounted degrees of dependence are – $Actor_1$:$Actor_2$::2:0.66, $Actor_1$:$Actor_3$::2:4.5, and $Actor_2$:$Actor_3$::2.68:0.25. The balance/imbalance in degree of dependence between *actors* in each pair can be used to inform strategic decision-making within those bilateral relationships.

Depender	Dependee	Dependum	Intentional Element in Depender	Importance of Dependum (D)	Importance of Intentional Element (I)	D * I	Discount Factor	Discounted Degree of Dependence
$Actor_1$	$Actor_2$	$Resource_{2a}$	$Task_{1a}$	1	2	2	(1/1) = 1	2
$Actor_1$	$Actor_3$	$Resource_{3a}$	$Task_{1a}$	1	2	2	(1/1) = 1	2
$Actor_2$	$Actor_1$	$Resource_{1a}$	$Task_{2a}$	2	1	2	(1/3) = 0.33	0.66
$Actor_2$	$Actor_3$	$Resource_{3b}$	$Task_{2b}$	2	2	4	(2/3) = 0.67	2.68
$Actor_3$	$Actor_1$	$Resource_{1b}$	$Task_{3a}$	2	3	6	(3/4) = 0.75	4.5
$Actor_3$	$Actor_2$	$Resource_{2b}$	$Task_{3b}$	1	1	1	(1/4) = 0.25	0.25

Table 6-4 Discounted degrees of dependency among three actors with bidirectional dependencies

6.6 Illustration of Modeling and Analysis of Coopetition with Differentiated Actors

In this illustration, we demonstrate the application of the modeling approach that is depicted in Figure 6-6 to generate a win-win strategy in a coopetitive relationship by considering *roles* and the *agents* that play those *roles*. The illustration in Chapter 5 demonstrated the application of the methodology in Figure 5-11 to generate a win-win strategy among undifferentiated *actors*. Recall from Section 4.6 that undifferentiated *actors* are not conducive to represent or reason about trustworthiness or interdependence among *actors* under coopetition. As noted in Sections 6.5.1 and 6.5.2 respectively, *roles* and *agents* are necessary to model and analyze trustworthiness and interdependence aspects of coopetitive relationships.

The simplified example at the beginning of Chapter 6 was used explain the creation of a win-win strategy for *roles* and *agents* under coopetition. However, in the interest of simplicity, that simplified example did not apply the modeling approach that is depicted in Figure 6-6. Rather it skipped ahead to a To-Be solution. That example also elided trustworthiness and interdependence aspects of that coopetitive relationship. This illustration shows the application of the modeling approach that is depicted in Figure 6-6. Consequently, it also includes models and analyses related to trustworthiness and interdependence aspects of that coopetitive relationship. In this illustration we are using a real-world setting that is much richer and is based on literature that has many more details compared to the simplified example in the beginning of Chapter 6.

6.6.1 Market for Storage Capacity: On-Premise Devices and Cloud-Based Services

We use a case study of coopetition among vendors of on-premise devices and providers of cloud-based services in the market for storage capacity. Trustworthiness and interdependence are relevant considerations in this coopetitive relationship therefore we have chosen it to demonstrate the application of the methodology in Figure 6-6. The modeling and analysis of this case study requires the separation of *roles* and *agents* however this is not supported in the Foundational Facets that are presented in Chapter 5. Hence, modeling and analysis of differentiated *actors* is needed to understand the strategic aspects of this case.

The advent of big data has enabled organizations to base their decisions on insights that are derived from datasets rather than on intuition that is driven by instinct. Organizations use tools for managing big data to support the collection, storage, integration, processing, and application of ever-growing datasets. The imperative for organizations to collect and create data rapidly fuels their demand for data storage tools. This burgeoning demand for data storage tools has created a vibrant market for storage systems and services[21].

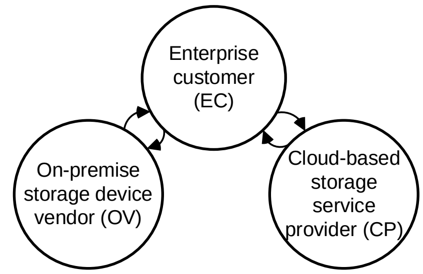
This case study focuses on the relationship between On-premise storage device vendor, Cloud-based storage service provider, and Enterprise customer. Initially, On-premise storage device vendor and Cloud-based storage service provider competed to conduct business with Enterprise customer. This resulted in a zero-sum outcome for On-premise storage device vendor and Cloud-based storage service provider because a win for one meant a loss for the other.

To avoid this outcome, On-premise storage device vendor and Cloud-based storage service provider stopped competing over the same Enterprise customer and started targeting non-overlapping market segments (i.e., On-premise device customer and Cloud-based service subscriber respectively). By serving distinct and unconnected market segments, On-premise storage device vendor and Cloud-based storage service provider were able to eschew competition. However, this also meant that they were unable to serve the market segment for their combined solutions. To overcome this limitation, On-premise storage device vendor and Cloud-based storage service started offering joint value propositions in this market segment.

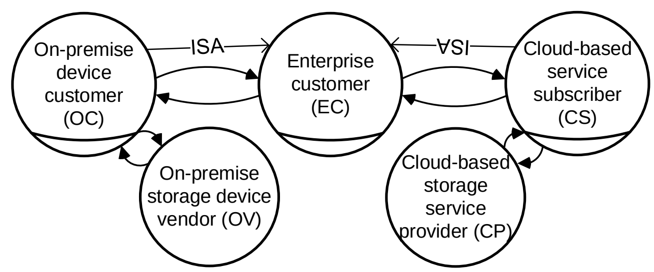
The evolution of stages in the strategic relationship between On-premise storage device vendor and Cloud-based storage service provider is depicted in Figure 6-10. In Figure 6-10, a node represents an *actor*, *agent*, or *role*, while an edge represents a *dependency* with the base of an arrow connected to the *dependee* and the tip of the arrow connected to the *depender*.

[21] Research papers that describe this market and its participants include: Azumah, et al. (2018), Surianarayanan, & Chelliah (2019), Wang, et al. (2016), Wu, et al. (2010), and Zeng, et al. (2009).

Stage: As-Is
Diagnostic: OV and CP engaged in intense competition over same stakeholder (EC).
Impact: Mutual impairment of business performance for OV and CP.
Objective: Create conditions for OV and CP to explore strategies that avoid non win-win (i.e., win-lose or lose-lose) outcomes.
Activities: Identify common stakeholder (EC) targeted simultaneously by OV and CP to identify points of competition.



Stage: Intermediate
Diagnostic: OV and CP enter co-existence status by targeting different stakeholders (OC and CS respectively).
Impact: Mutual independence of business performance for OV and CP.
Objective: Create conditions for OV and CP to explore strategies leading to win-win outcomes.
Activities: Find opportunities for OV and CP to disengage from competition over same stakeholder (EC) by targeting different stakeholders (OC and CS respectively).



Stage: To-Be
Diagnostic: OV and CP enter coopetitive status by cooperatively serving stakeholders (OC and CS) collectively through RL while competing over control of RL.
Impact: Mutual dependence of OV and CP for achieving business success.
Objective: Create strategies for OV and CP leading to win-win outcomes.
Activities: Cooperate to serve stakeholders collectively through RL and concomitantly compete to gain control over RL.

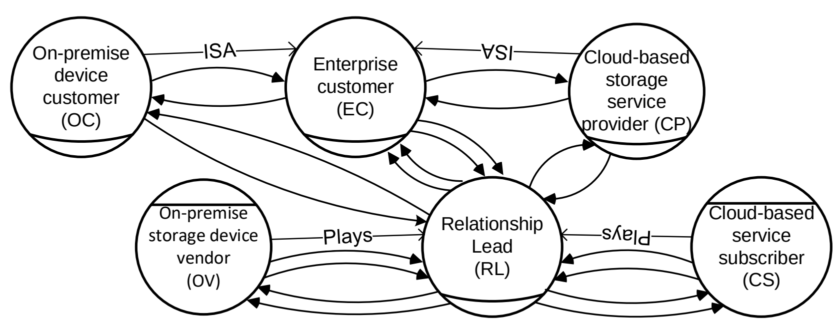


Figure 6-10 Evolution of stages in strategic relationship between OV and CP

In the As-Is configuration, we treat On-premise storage device vendor, Cloud-based storage service provider, and Enterprise customer as undifferentiated *actors*.

Then, in the Intermediary configuration, we treat Enterprise customer as a *role* and introduce On-premise device customer as well as Cloud-based service subscriber as *roles* that specialize the *role* Enterprise customer.

In the To-Be configuration, we introduce the *role* Relationship lead and treat On-premise storage device vendor as well as Cloud-based storage service provider as *agents* that *play* the *role* Relationship lead.

Progression from each stage to the next in Figure 6-10 yields insights about this case that lead to the generation of a win-win strategy for On-premise storage device vendor and Cloud-based storage service.

6.6.2 As-Is Scenario: Discriminating Win-Win strategies with *i**

Modeling Phase: The *i* actor* model presented in Figure 6-11 depicts three *actors* in the storage solutions market – On-premise storage device vendor (OV), Cloud-based storage service provider (CP), and Enterprise customer (EC).

EC has a need for a system to store data that are needed for supporting organizational decision-making using software applications (Applications be deployed). It needs to Acquire storage capacity and to do this it must select a system (Storage solution be chosen). These model elements within EC, the actor in the middle of Figure 6-11, are highlighted in green color.

When OV and CP adopt a purely competitive stance towards each other then they regard all customers in the storage solutions market (EC) as undifferentiated. In a competitive framing, OV and CP consider EC to have two mutually exclusive choices: (1) Purchase on-premise storage appliance (Scenario 1), or (2) Subscribe to cloud-based storage service (Scenario 2).

The two *actors* on the left and right in Figure 6-11, OV and CP respectively, have the same top-level *goal* (Market valuation be increased) but they have different options for achieving this *goal* because they offer dissimilar products and services. OV attempts to Position on-premise storage devices to EC to achieve its top-level *goal* Market valuation be increased while CP tries to Offer cloud-based storage services to EC to achieve its top-level *goal* Market valuation be increased. These model elements within OV and CP, are highlighted in green color.

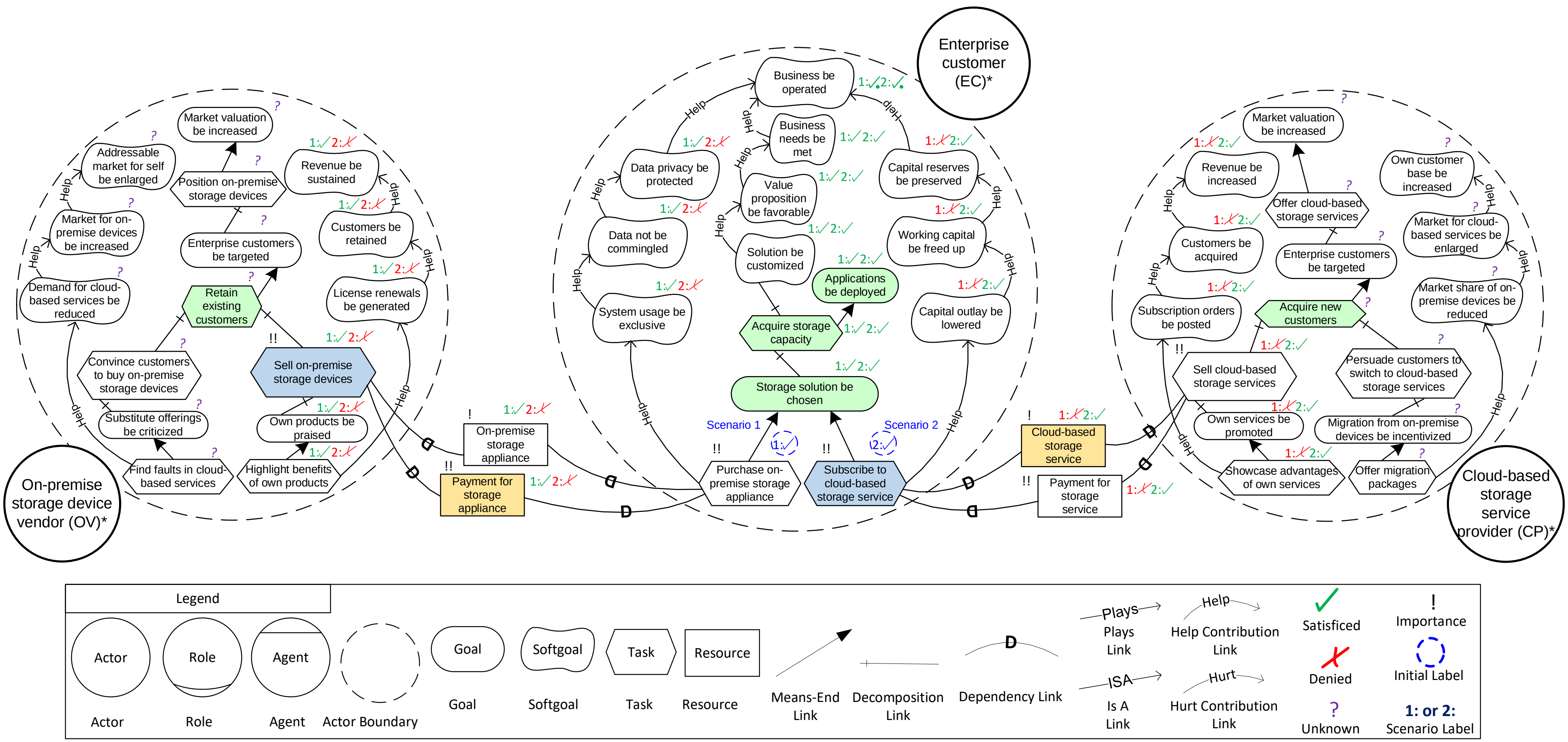


Figure 6-11 As-Is diagram of competitive relationship between On-premise Storage Device Vendor (OV) and Cloud-based Storage Service Providers (CP). OV and CP adopt competitive stance towards each other. Customers either "Purchase on-premise storage appliance" (Scenario 1) or "Subscribe to cloud-based storage service" (Scenario 2)

Depender	Dependee	Dependum	Intentional Element in Depender	Importance of Dependum (D)	Importance of Intentional Element (I)	D * I	Discount Factor	Discounted Degree of Dependence
OV	EC	PFSA	SOSD	2	2	4	(1/1) = 1	4
EC	OV	OPSA	POSA	1	2	2	(1/2) = 0.5	1
CP	EC	PFSS	SCSS	2	2	4	(1/1) = 1	4
EC	CP	CBSS	SCSS	1	2	2	(1/2) = 0.5	1

Table 6-5 Data for calculating degrees of relative dependence among *actors* OV and EC as well as CP and EC

Both wish to perform these *tasks* so that Enterprise customers be targeted (i.e., EC). To meet this *goal* (Enterprise customers be targeted), OV attempts to Retain existing customers while CP tries to Acquire new customers. These model elements within OV and CP are highlighted in green color. OV and CP perform different tasks because the On-premise storage appliance segment is mature while the Cloud-based storage service segment is newer in the storage solutions market (not shown*[22]). To complete these tasks, OV must Convince customers to buy on-premise storage devices as well as Sell on-premise storage devices to EC while CP must Persuade customers to switch to cloud-based storage services as well as Sell cloud based storage services to EC. In a competitive milieu, OV can Convince customers to buy on-premise storage devices in a way that Substitute offerings be criticized (e.g., badmouth Cloud-based storage service).

It can do so by identifying weaknesses (Find faults in cloud-based services) as this will lead to Demand for cloud-based services be reduced which will result in Market for on-premise devices be increased and ultimately Addressable market for self be enlarged (i.e., for OV). These details are depicted as *softgoal* contributions on the left side within OV. OV can try to Sell on-premise storage devices in a way such that its Own products be praised and it can do so by Highlight benefits of own product. This will lead to License renewals be generated resulting in Customers be retained so that its Revenue be sustained (i.e., for OV). These details are depicted as *softgoal* contributions on the right side within OV.

Similarly, CP can persuade customers to switch to Cloud-based storage services in a way that Migration from on-premise devices be incentivized (i.e., promote shift to Cloud-based storage service). It can do so by simplifying transition for customers (Offer migration packages) as this will result in Market share of on-premise devices be reduced which will lead to Market for cloud-based services be enlarged and finally Own customer base be increased (i.e., for CP). These details are depicted as *softgoal* contributions on the right side within CP. CP can try to Sell cloud-based storage services in a way such that its Own services be promoted and it can do so by Showcase advantages of own services. This will result in Subscription orders be posted leading to Customers be acquired and in turn Revenue be increased. These details are depicted as *softgoal* contributions on the left side within CP.

To summarize, in the As-Is configuration (Figure 6-11), the *actors* (i.e., OV, CP, and EC) do not perceive potential differentiation. EC depends on OV for the *resource* On-premise storage appliance while OV depends on EC for the *resource* Payment for storage appliance. EC depends on CP for the *resource* Cloud-based storage service while CP depends on EC for the *resource* Payment for storage service.

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[22] In this instance, and in the remainder of this chapter, certain aspects of the relationship between *actors* are not shown to declutter visual presentation of models. These details are provided in-text only to explain the context of the models.

Evaluation Phase: To determine whether the *goals* of each *actor* are satisfied, we apply the technique of label propagation for assessing *softgoal* satisfaction, that is described in Section 5.5.2, is applied over the *actor* model in Figure 6-11 to ascertain the satisfaction of each intentional element. This technique entails the application of propagation rules to attach current values from each offspring to its parent and then resolving labels at the parent level iteratively and interactively (Horkoff & Yu, 2013).

We depict two scenarios in the same *i** model (Figure 6-11) using the scenario labelling technique that is described in Section 5.2. We present the satisfaction label corresponding to a specific scenario alongside the identifier of that scenarios (i.e., 1 for Scenario 1 and 2 for Scenario 2). In this format, multiple satisfaction labels, one for each scenario, are depicted in a side-by-side manner.

Satisfaction labels attached to scenarios 1 and 2 demonstrate the impact of EC choosing Purchase on-premise storage appliance option (i.e., Scenario 1) or Subscribe to cloud-based storage service (i.e., Scenario 2).

From a customer's perspective (EC in Figure 6-11), either of the options available satisfies some *softgoals* but neither option satisfies all *softgoals*. Therefore EC must perform trade-off analysis between procurement of On-premise storage appliance from OV on the one hand and leasing of Cloud-based storage service from CP on the other hand.

The top-most *softgoal* of EC is Business be operated and this can be partially achieved through either of these options. Irrespective of the specific option chosen by EC, it can obtain a tailored system (Solution be customized in the middle of EC in Figure 6-11) that offers features and functions (Value proposition be favorable in the middle of EC) to meet organizational objectives (Business needs be met in the middle of EC). These details are depicted as satisfied *softgoals* for scenarios 1 and 2 in the middle within EC.

However, EC can only be certain that it will have sole access to its storage system (*softgoal* System usage be exclusive on left side) if it chooses the on-premise option (*task* Purchase on-premise storage system). Sole access will ensure that data belonging to EC will not be mixed in with data of other customers (*softgoal* Data not be commingled on left side) and this will improve privacy protections on EC data (*softgoal* Data privacy be protected on left side). These details are depicted as satisfied *softgoals* for Scenario 1 within EC.

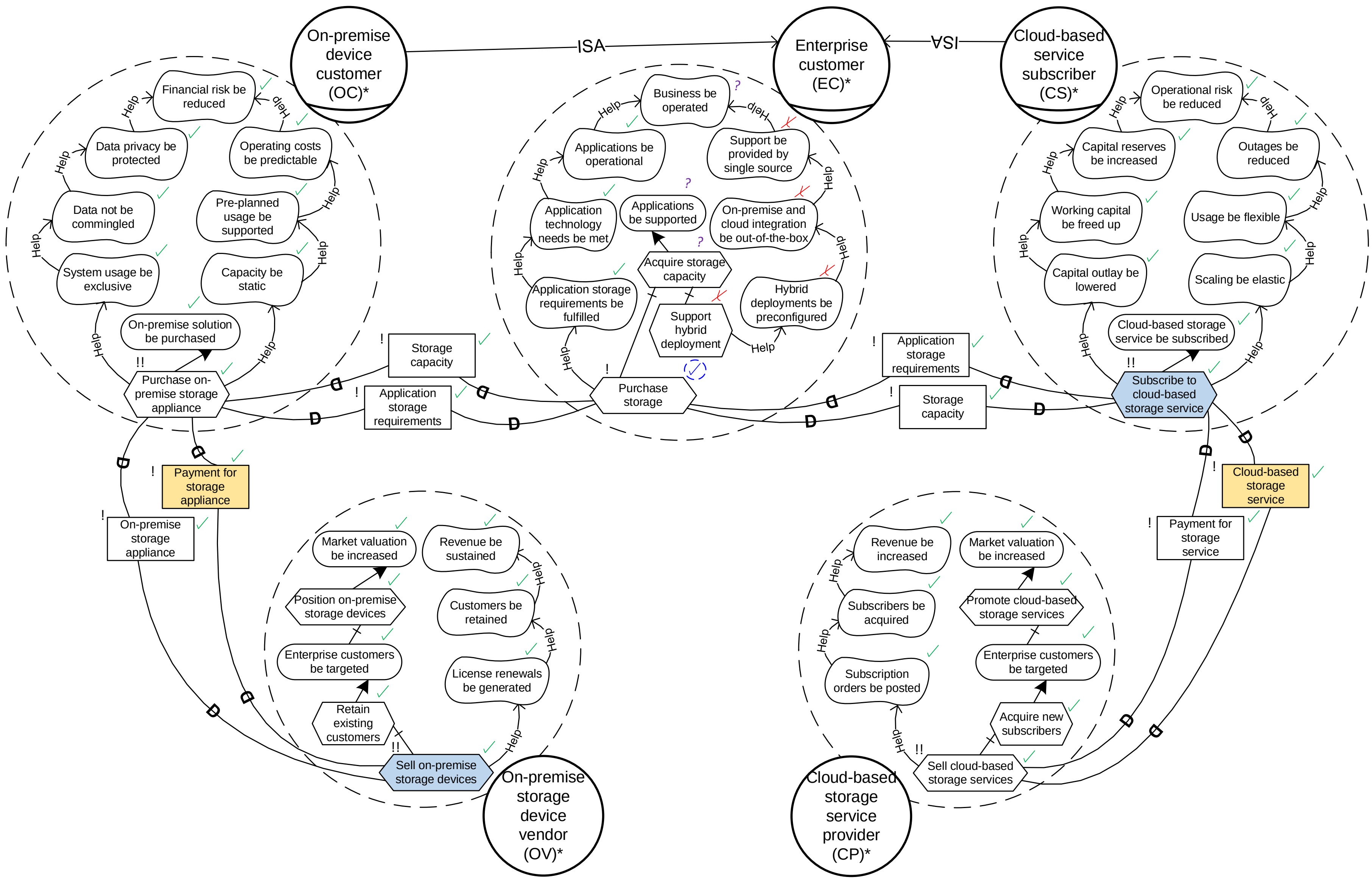

Figure 6-12 Intermediate diagram of pre-coopetitive relationship between On-premise storage device vendor (OV) and Cloud-based storage service providers (CP). OV and CP enter co-existence status by targeting different stakeholders (On-premise device Customer (OC) and Cloud-based service subscriber (CS) respectively). This creates conditions for OV and CP to explore strategies leading to win-win outcomes.

Depender	Dependee	Dependum	Intentional Element in Depender	Importance of Dependum (D)	Importance of Intentional Element (I)	D * I	Discount Factor	Discounted Degree of Dependence
OV	OC	PFSA	SOSD	1	2	2	(1/1) = 1	2
OC	OV	OPSA	POSA	1	2	2	(1/1) = 1	2
EC	OC	SC	PS	1	1	1	(1/1) = 1	1
OC	EC	ASR	POSA	1	2	2	(1/1) = 1	2
EC	CS	SC	PS	1	1	1	(1/1) = 1	1
CS	EC	ASR	SCSS	1	2	2	(1/1) = 1	2
CP	CS	PFSS	SCSS	1	2	2	(1/1) = 1	2
CS	CP	CBSS	SCSS	1	2	2	(1/1) = 1	2

Table 6-6 Data for calculating degrees of relative dependence among *actors* OV and OC, CP and CS, OC and EC, as well as CS and EC.

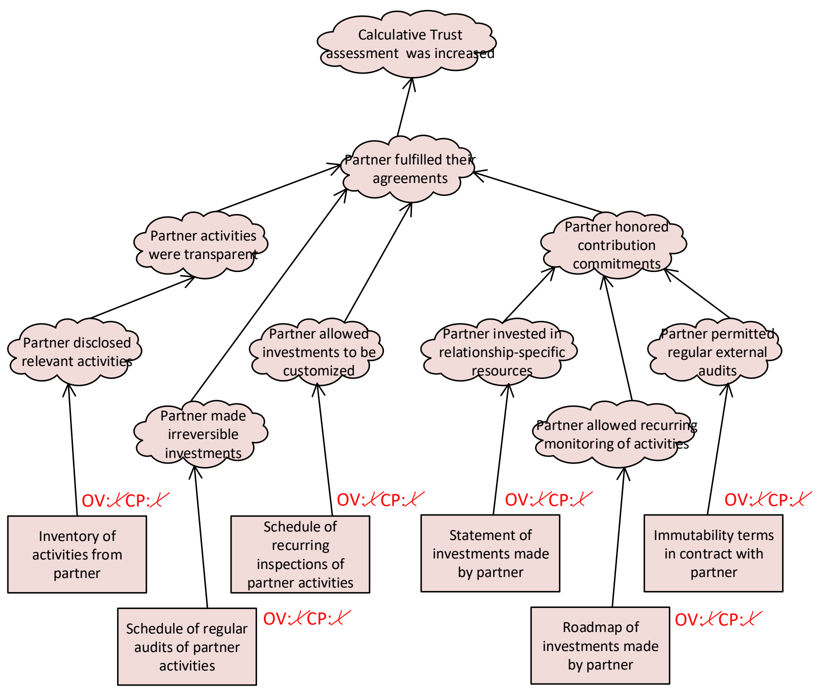

Figure 6-13 Perceived Trust Assessment between OV and CP in As-Is Scenario

Nevertheless, procuring on-premise storage appliance entails relatively large up-front financial investment and this leads to the denial of the *softgoal* Capital outlay be lowered (on right side). Avoiding a large front-loaded investment is necessary for improving liquidity (*softgoal* Working capital be freed up on right side) and this is necessary to maintain financial safety buffer for EC (*softgoal* Capital reserves be preserved on right side). These details are depicted as denied *softgoals* for Scenario 1 within EC. Therefore, if EC buys On-premise storage appliance then only some of its *softgoals* will be satisfied.

Conversely, if EC chooses to lease access (*task* Subscribe to cloud-based storage service) to *resource* Cloud-based storage service then it can avoid incurring a large purchase cost up-front. Charges for Cloud-based storage service are paid on a monthly basis and, by choosing this option, EC can satisfy its *softgoal* Capital outlay be lowered (on right side). This means that, with this option, EC can also satisfy related higher-level *softgoals* which are Working capital be freed up (on right side) and Capital reserves be preserved (on right side). These details are depicted as satisfied *softgoals* for Scenario 2 within EC.

However, some *softgoals* of EC are also denied with this option. CP (Cloud-based storage service provider) utilizes multi-tenancy in its storage solution to support multiple customers on the same system. This means EC will need to share system usage with other users and this might lead to the commixing of its data with other customers' data. This will result in the denial of the *softgoal* System usage be exclusive (on left side) as well as its related higher-level *softgoals* which are Data not be commingled (on left side) and Data privacy be protected (on left side). These details are depicted as denied *softgoals* for Scenario 2 within EC.

At this stage of the analysis, EC regards each of these options as equally important (!!). Recall, according to Section 5.2, that *importance* is depicted by the use of none or many exclamation marks (!) with more exclamation marks signifying greater importance. This is because OV and CP construe EC as a homogenous market with indistinguishable customers. In such a market some individual customers will prefer On-premise storage appliance while other individual customers will prefer Cloud-based storage service. Therefore, overall, a generic customer (i.e., EC) will think of both options as equally important (!!).

We consider the relative degrees of *dependence* and levels of trust among *actors* to further distinguish the options presented in scenarios 1 and 2. Data for calculating degrees of relative dependence among *actors* in Figure 6-11 are presented in Table 6-5. Due to page width limitations, entries in the first four columns of Table 6-5 are abbreviated. Each abbreviation includes the first letter of each word in the relevant model element. Some *dependums* are colored yellow and their corresponding intentional elements within *dependers* are colored blue as examples in Table 6-5 as well as Figure 6-11.

This is done for visual clarity so that the reader can follow the naming pattern that we have adopted in Table 6-5 due to page width constraints. For example, OV refers to On-premise Storage Device Vendor, PFSA refers to Payment for storage appliance, and SOSD refers to Sell on-premise storage devices.

We apply the formula in Section 6.5.2 to calculate perceived relative *dependence*. The data in Table 6-5 indicate that perceived relative dependence between OC: EV::4:1 and CP:EV::4:1. This means that both OC and CP depend four times as much on EV than EV does on either of them.

The reason for this imbalance in perceived relative dependence is that EC can satisfy most of its needs from either OV or CP. However, as the satisfaction labels in Figure 6-11 demonstrate, based on the choice of EC either: (1) OV will be successful and CP will be unsuccessful, or (2) CP will be successful and OV will be unsuccessful. If OV and CP do not change their purely competitive relationship with respect to EC then it will intensify their rivalry.

Moreover, a past track record solely of competition means that OV and CP do not even have the most basic kind of trust in each other (Figure 6-13). All their dealings in the past focused on competing to win business from EC. Therefore, their relationship lacks even calculative or contract-based trust. We have shown this trust *belief* graph as standalone to simplify model visualization.

We discussed the As-Is configuration of the competitive relationship between OV and CP with respect to EC from modeling and evaluation perspectives respectively in Section 6.6.2. The evaluation phase shows that there are no win-win strategies available to OV and CP in the As-Is configuration.

In the next section we discuss the exploration and generation of a new win-win strategy by OV and CP with the support of differentiated *actor* modeling. This new strategy is predicated on the creation of additional *goals* and *softgoals* as well as new methods to meet those *goals*.

Realization of these methods for satisfying new quality requirements necessitates the introduction of intermediary *actors* in the relationship between OC, CP and EC. Through modeling, we demonstrate the development of a pre-coopetitive relationship between OC and CP in the Intermediate configuration as that is a precursor to a win-win strategy.

6.6.3 Intermediate Scenario: Generating Precursors to Win-Win strategies with *i**

Exploration phase: In the Exploration phase, a modeler can pursue any of six lines of action incrementally and iteratively, as defined in the Methodology section (6.4). They can add/remove some *actor*, *agent*, or *role*; generate a change in *beliefs* of some *actor*, *agent*, or *role*; generate a change in *goals* of some *actor*, *agent*, or *role;* generate a change in *softgoals* of some *actor*, *agent*, or *role*; generate additional alternatives for achieving *goals* of some *actor*, *agent*, or *role*; or generate a change in relationships among some *actors*, *agents*, or *roles*.

Our conceptual modeling methodology allows OV and CP to create specialized types of *actors* based on generic types of *actors*. This enables OV and CP to think about different types of stakeholders that specialize EC. We followed the *i** *actor* specialization technique described by López, Franch, & Marco (2012) to represent specializations of the EC entity using *is-a* links.

Application of domain knowledge about storage solutions market to analyze *roles* in Figure 6-11 reveals that the generic *role* EC can be specialized into three *roles*: Enterprise customer (EC), On-premise device customer (OC), and Cloud-based service subscriber (CS).

An intermediate To-Be diagram of pre-coopetitive relationship between OV and CP is shown in Figure 6-12. It shows OC and CS as specializations of EC. They are connected with EC using the *is-a* link to show that EC is a general class of OC and CS. Relevant internal intentional elements from EC in Figure 6-11 are transferred to OC and CS in Figure 6-12.

Loops in the process depicted in Figure 6-4 indicate that any step in the Exploration phase of this modeling approach can trigger other steps. Therefore, additional internal intentional elements are introduced in each of the *actors* and *roles* in Figure 6-12. They enable the inclusion of pertinent details that can be exhibited using differentiated actors (e.g., by using *role* generalization/specialization).

Modeling phase: In the Intermediate configuration (Figure 6-12), the *actors* OV and CP do not compete any longer but they are not cooperating with each other either. Therefore, their relationship can be regarded as a coexistence arrangement.

A comparison of Figure 6-11 and Figure 6-12 reveals that OC and CS include each of the *softgoals* from EC that are relevant for the customer segments represented by those *roles*.

OC contains the *softgoals* System usage be exclusive, Data not be commingled, and Data privacy be protected. These *softgoals* are within OC on the left side.

CS contains the *softgoals* Capital outlay be lowered, Working capital be freed up, and Capital reserves be increased. These *softgoals* are within CS on the left side.

However, these *roles* also contains new softgoals that are pertinent only for the customer segment that is represented by that *role*.

OC contains the *softgoals* Capacity be static, Pre-planned usage be supported, Operating costs be predictable, and Financial risk be reduced. These *softgoals* are within OC on the right side.

CS contains the *softgoals* Scaling be elastic, Usage be flexible, Outages be reduced, and Operational risk be reduced. These *softgoals* are within CS on the right side.

Evaluation phase: Evaluation of Figure 6-12 indicates that OV and CP enable OC and CS to satisfy all their *softgoals* respectively. This is shown via green checkmarks above each element within OC and CS.

However, the preceding exploration phase introduced new *softgoals* in the *role* EC that are not supported by OV or CP. These are *softgoals* Hybrid deployments be preconfigured, On-premise and cloud integration be out-of-the-box, and Support be provided by single source. These *softgoals* are within EC on the right side. Inability of EC to satisfy these *softgoals* leads to the denial of its top-level *softgoal* (Business be operated). The denial of these *softgoals* is shown via red crosses above these model elements

These *softgoals* represent the requirement for EC to acquire blended data solutions that combine functionality from on-premise storage appliances as well as cloud-based storage services through a common vendor. EC typically have functioning on-premise storage appliances and their subscription of cloud-based storage services is to supplement, rather than substitute, their on-premise storage systems. Since neither OV nor CP can support EC to meet this objective, OV and CP need to undertake another round of Exploration to generate a win-win strategy.

6.6.4 To-Be Scenario: Generating Win-Win strategies with *i**

Exploration phase: In this Exploration phase, we focused on the *softgoals* that were denied in Figure 6-12 to comprehend the causes for those denials. An understanding of those causes is useful for developing solutions that can enable the achievement of those *softgoals*.

Two main causes can be ascertained for the denial of EC's *softgoals* in Figure 6-12: (1) lack of an integrated solution offering by OV and CP; and (2) absence of a relationship manager (i.e., OV and CP deal with EC separately and individually). A collaborative solution by OV and CP that addresses these causes can be used to support the satisfaction of all of EC's *softgoals*.

The To-Be configuration, resulting from the Exploration phase, showing a win-win strategy is presented in Figure 6-14. First, we addressed the lack of a shared relationship manager to serve as the common point of contact for EC with OV and CP. A new *role* titled Relationship Lead (RL) is created to mediate the relationship of EC with OV and CP. RL is shown in the bottom half of Figure 6-12 at the center. OV and CP are connected with RL using the *plays* link to indicate that OV serves as the RL for certain ECs while CP serves as the RL for other ECs. These links are shown in the bottom half of Figure 6-12.

Within the scope of our model, a common sense way for OV and CP to decide which of them plays the RL role with respect to a specific EC can depend on many factors such as duration of time that each has conducted business with that EC, the volume of business that each has conducted with that EC, or the preference of the EC in terms of their RL. We acknowledge that there can be other factors that influence which *agent plays* the *role* RL. We acknowledge that some *agent* other than the *agents* OV or CP can also play this *role* RL, in which case, the *agents* OV and CP will need to compete with that *agent*.

RL serves the single point of contact for EC, and its specializations (i.e., OC and CS), with respect to OV and CP. This is shown in Figure 6-14 via many *dependencies* between RL with OC, CS, and EC but none between OV and CP with OC, CS, and EC. RL is the conduit through which OV and CP deliver their storage solutions to EC, OC, and CS. In return, EC, OC, and CS compensate[23] RL which then distributes the proceeds to OV and CP. This is shown via dependencies between RL with OV and CP.

Next, we address the absence of an integrated solution offering by OV and CP. We consulted the cooperation *goal* catalog (Section 5.3.2) to contemplate possible options for OV and CP. The cooperation *goal* catalog identifies three specific *softgoals* that are relevant: Pool technology, Share market access, and Exchange knowledge. EC requires On-premise device integrated with cloud-based service and Cloud-based service integrated with on-premise device from RL. This aspect of the relationship is shown as *dependencies* and these dependencies allow EC to satisfy its *task* Support hybrid deployments (located near bottom of EC).

To provide this, RL depends on OV for On-premise storage appliance as well as Integration adapters and on CP for Cloud-based storage service as well as Integration connectors. This aspect of the relationship is shown as *resource dependencies* between RL with OV and CP. With these *resources*, RL is able to perform the *task* Sell integrated on-premise and cloud-based solutions (located near the top within RL) that is necessary for EC to fulfill its *softgoal* Support hybrid deployment (located near the bottom within EC).

To summarize this phase, we referred to the Cooperation goal catalog (Section 5.3.2) to identify pathways for collaboration between OV and CP. We found three options that were relevant (Pool technology, Share market access, and Exchange knowledge) and incorporated them into the To-Be model by introducing the *role* RL in Figure 6-14. This *role* RL is required by OV and CP for cooperation. However, the criticality of RL for OV and CP to conduct business with EC, OC, and CS means that OV and CP will compete over control of RL. This indicates the concomitance of cooperation and competition. Next, we evaluate the impact of the introduction of this *role* RL in the To-Be model.

[23] Four types of payments are involved: "Payment for storage device" ("OC" to "RL" to "OV"), "Payment for on-premise integration" ("EC" to "RL" to "OV"), "Payment for storage service" ("CS" to "RL" to "CP"), and "Payment for cloud-based integration" ("EC" to "RL" to "CP").

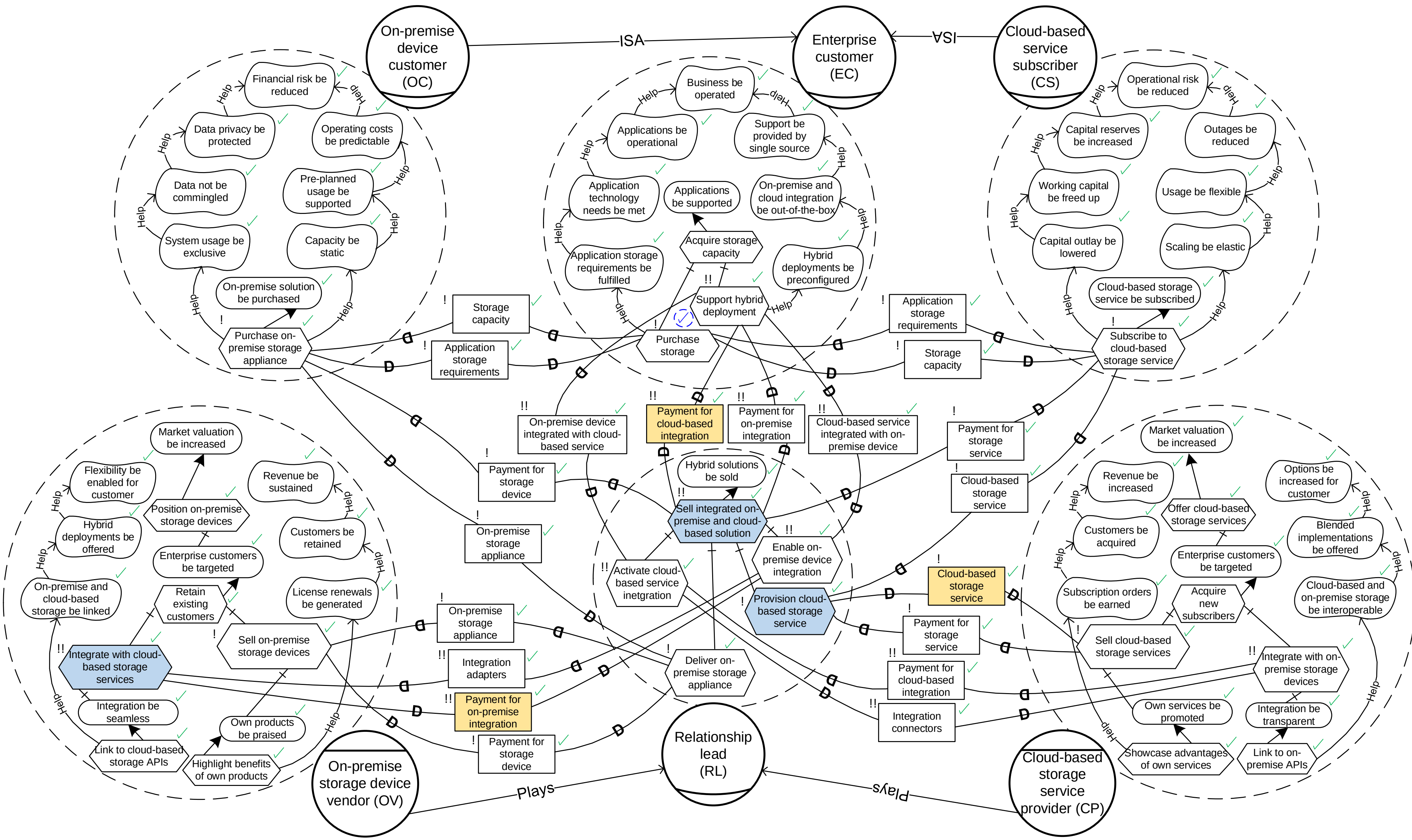

Figure 6-14 Final To-Be diagram of coopetitive relationship between On-premise Storage Device Vendor (OV) and Cloud-based Storage Service Providers (CP)

Depender	Dependee	Dependum	Intentional Element in Depender	Importance of Dependum (D)	Importance of Intentional Element (I)	D * I	Discount Factor	Discounted Degree of Dependence
RL	EC	PFCI	SIOCS	2	2	4	(1/1) = 1	4
RL	EC	PFOI	SIOCS	2	2	4	(1/1) = 1	4
RL	OC	PSD	SIOCS	1	2	2	(1/1) = 1	2
RL	CS	PSS	SIOCS	1	2	2	(1/1) = 1	2
RL	OV	OSA	DOSA	1	1	1	(1/1) = 1	1
RL	OV	IA	EPDI	2	2	4	(1/1) = 1	4
RL	CP	CSS	PCSS	1	1	1	(1/1) = 1	1
RL	CP	IA	ACSI	2	2	4	(1/1) = 1	4
EC	OC	SC	PS	1	1	1	(1/1) = 1	1
EC	CS	SC	PS	1	1	1	(1/1) = 1	1
EC	RL	ODICS	SHD	2	2	4	(1/1) = 1	4
EC	RL	CSIOD	SHD	2	2	4	(1/1) = 1	4
OC	EC	ASR	POSA	1	1	1	(1/1) = 1	1
OC	RL	OSA	POSA	1	1	1	(1/1) = 1	1
OV	RL	POI	ICSS	2	2	4	(1/1) = 1	4
OV	RL	PSD	SOSD	1	1	1	(1/1) = 1	1
CS	EC	ASR	SCSS	1	1	1	(1/1) = 1	1
CS	RL	CBSS	SCSS	1	1	1	(1/1) = 1	1
CP	RL	PCI	IOSD	2	2	4	(1/1) = 1	4
CP	RL	PSD	SCSS	1	1	1	(1/1) = 1	1

Table 6-7 Data for calculating degrees of relative dependence among actors in Figure 6-14

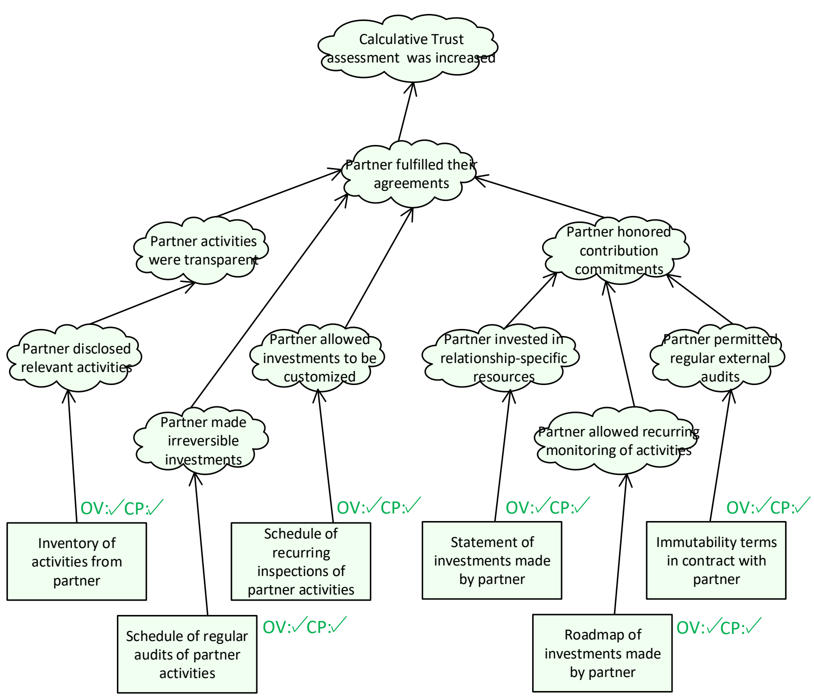

Figure 6-15 Perceived Trust Assessment between OV and CP in Ideal To-Be Scenario

Evaluation phase: Evaluation of the To-Be configuration (Figure 6-14) indicates that the new RL *role* allows EC to achieve all of the *softgoals* that were denied in the Intermediate configuration (Figure 6-12). The data for calculating degrees of relative dependence among *actors*, *agents*, and *roles* in Figures 6-12 and 6-14 are presented in Tables 6-6 and 6-7 respectively. Due to page width limitations, entries in the first four columns of Tables 6-6 and 6-7 are abbreviated.

Each abbreviation includes the first letter of each word in the relevant model element. Some *dependums* are colored yellow and their corresponding intentional elements within *dependers* are colored blue as examples in Tables 6-6 and 6-7 as well as Figures 6-12 and 6-14 respectively. This is done for visual clarity so that the reader can follow the naming pattern that we have adopted in Tables 6-6 and 6-7 due to page width constraints. For example, RL refers to Relationship Lead, PFCI refers to Payment for cloud-based integration, and SIOCS refers to Sell integrated on-premise and cloud-based solution.

We apply the technique outlined in Section 6.5.2 to calculate the degrees of relative dependence among these *actors*, *agents*, and *roles*. It must be noted that these degrees of relative dependence are nominal and relative but not absolute or universal since they are meant to support the contrasting of *strategies* vis-à-vis the reliance among *actors*, *agents*, and *roles*.

The degree of relative dependence among OV and EC in Figure 6-12 favors EC with OV depending on EC twenty five percent more than EC depends on OV. The degree of relative dependence among CP and EC is similar with CP depending on EC twenty five percent more than EC depends on CP.

This indicates an imbalance in their relationship. The degree of relative dependence among OV and EC in Figure 6-14 is almost the same with OV depending on EC only ten percent more than EC depends on OV.

The degree of relative dependence among CP and EC is similar with CP depending on EC only ten percent more than EC depends on CP. This shows that the To-Be configuration is more balanced than the Intermediate configuration.

The catalog of trust assessment in Section 6.3.1 offers guidance on the attainment of ideal calculative trust assessment between OV and CP in the To-Be configuration. This is depicted in Figure 6-15 by including elements within the Calculative trust assessment segment of that *belief* catalog for trust assessment. It expresses the ideal relationship between OV and CP in terms of perceptions of calculative trust assessment. This is necessary for OV and CP if they wish to also develop Knowledge trust and Bonding trust through repeated ties.

Checkmarks above each informational *resource*, and green coloration of those resources as well as hierarchy of *beliefs* indicates that, they ought to strive for a high degree of calculative trust assessment among themselves.

To simplify visual presentation of our model, we have shown this trust *belief* graph as a standalone in Figure 6-15 rather than integrating it with the *actor* model in Figure 6-14. It could be integrated in the *actor* model in Figure 6-14 by including the relevant elements from Section 6.3.1 by following the methodology, for adding elements in the *i** model, that is detailed in Section 6.4.

OV and CP co-exist in the present and their ability to support their targeted customers segments is predicated on their cooperation. To benefit from cooperation, they will need to explore collaborative arrangements to support each other in their common market. This will require sharing of the informational *resources* that are listed in Figure 6-15. However, as stated in Section 5.3.3, this will also create opportunities for OV and CP to compete with each other – thus leading to the cooccurrence of competition and cooperation.

6.6.5 Summary of Illustrative Example

We applied the first foundational facet of our framework to create a win-win strategy in an industrial coopetition scenario where none was originally known to exist. Using an example of sales and marketing among two coopeting firms in the software industry (OV and CP) we showed that our framework and knowledge catalogs could be used to find a mutually advantageous configuration. We depicted the sales and marketing aspects of this coopetitive relationship using *i** modeling. These *i** models showed that OV and CP were better off by analyzing their market in terms of differentiated *actors* (i.e., *roles* and *agents*) rather than as undifferentiated homogeneous *actors*. In so doing, the method uncovered opportunities for OV and CP to grow their addressable market by cooperating to offer joint value propositions. It also showed opportunities for OV and CP to compete at the same time to maximize their share of this enlarged addressable market. Analyses of interdependence and assessments of trustworthiness between OV and CP also showed better outcomes in relationships comprising differentiated *actors* in comparison to undifferentiated *actors*. Knowledge catalogs for competition (Figure 5-7) and cooperation (Figure 5-8) were useful for creating strategies for OV and CP within *i** models.

6.7 Summary

In this chapter, we developed and utilized a modeling approach involving differentiated *actors* to systematically search for win-win strategies and generate new alternatives for coopeting organizations. This approach iteratively, interactively, and incrementally refined and elaborated *i** models to go from an As-Is to a To-Be scenario through an intermediate scenario.

7. Advanced Facet 2: Value Modeling - Addressing Complementarity Requirements

In the second advanced facet of our modeling framework, we analyze complementarity among actors using *i** and e3value in combination. Recall that this facet for value modeling is necessary to analyze complementarity, which is a key motivator of coopetition. Complementarity exists when certain entities are perceived to be more valuable together than separately and, according to Brandenburger & Nalebuff (1996), complementarity underpins the logic of coopetition which entails organizations cooperating to grow the pie (i.e., collective value) and competing to split it up (i.e., individual shares).

A combined metamodel of *i** and e3value, for modeling complementarity, is presented in Figure 7-7. This combined metamodel adds entities and relationships from e3value to the *i** metamodel[24] in Figure 6-3. The e3value part of this metamodel is based on the e3value ontology in Gordijn, Akkermans, & Van Vliet (2001). The combined *i** and e3value metamodel is based on the joint usage of *i** and e3value in Gordijn, Yu, & van der Raadt (2006). We combine *i** and e3value to meet these requirements from Section 3.2: C1 (Resource/Asset/Object), C2 (Value Added), and C3 (Added Value).

In this chapter, we explain each component of the second advanced facet of our conceptual modeling framework for analyzing and designing strategic coopetition: (7.1) a metamodel that combines extended *i** with e3value to cover relevant concepts and semantics, (7.2) visual notation for utilizing this combined metamodel, (7.3) process description detailing construction steps and guidelines for developing and evaluating models based on this combined metamodel, (7.4) analysis techniques including approaches for evaluating models based on this combined metamodel, (7.5) illustrative representation of a real-world scenario to demonstrate expressiveness and analytical power of models based on this combined metamodel.

We continue the Cake Sharing example that was first introduced in Section 5 to demonstrate the joint application of extended *i** with e3value. This is a simplified example because it does not contain all the features in this facet. In e3value terms, the example in Chapter 5 can be referred to as a *value constellation*. A *value constellation* is a system for value co-production by actors (Normann & Ramirez, 1993)[25]. In the example from Chapter 5, CC and SS are *i* actors* and we can treat each *i* actor* as an e3value *actor* because an *actor*[26] is "an independent economic (and often legal) entity" (Gordijn, & Akkermans, 2001).

For ease of reading, Figure 5-1 and Figure 5-2 (from Chapter 5) are reproduced here as Figure 7-1 and Figure 7-2 respectively. *i** models that portray two possible As-Is scenarios between CC and SS are

[24] We include the extended *i** metamodel from chapter 6 (section 6.1).
[25] A value constellation typically includes many actors but its idea of value co-production also applies to two actors.
[26] In e3value, an *actor* is the generalization of two specialized classes: (i) elementary *actor*, and (ii) composite *actor*. A composite *actor* can be aggregated from elementary *actors* and other composite *actors*.

presented in Figure 7-1 and Figure 7-2. To recall, in Scenario 1 (Figure 7-1), SS chooses the large slice for itself and offers the small slice to CC. In Scenario 2 (Figure 7-2), SS chooses the small slice for itself and offers the large slice to CC. As explained in Section 5, using only *i** models, neither Scenario 1 nor Scenario 2 represents a win-win strategy because in Scenario 1 SS wins but CC loses while in Scenario 2 CC wins but SS loses.

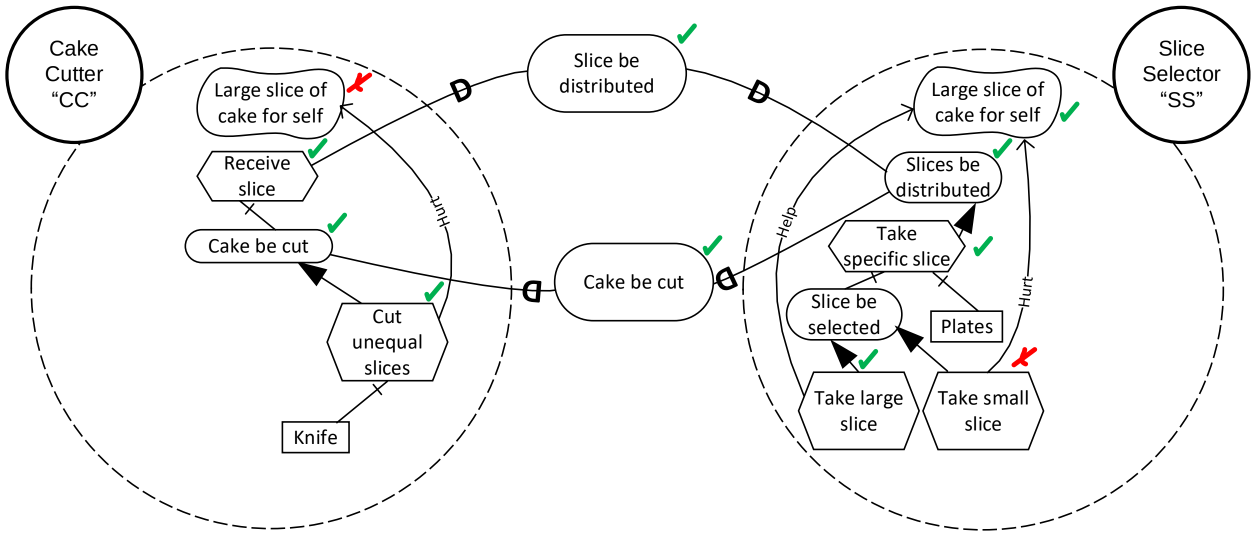

Figure 7-1 *i** model depicting As-Is relationship among "CC" and "SS" (Scenario 1).

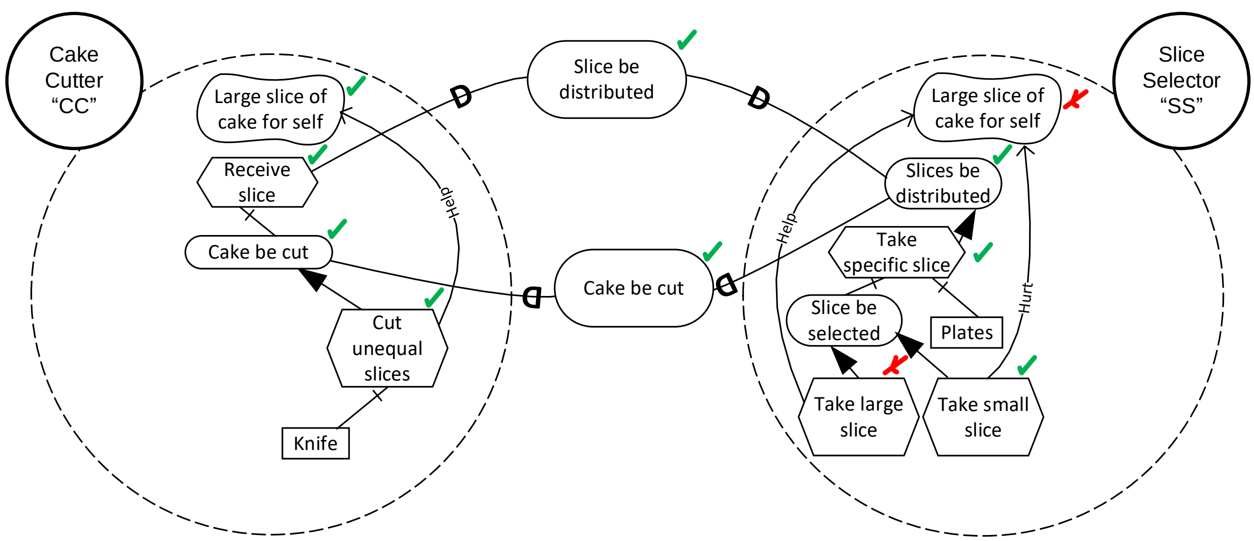

Figure 7-2 *i** model depicting As-Is relationship among "CC" and "SS" (Scenario 2).

In this advanced facet, we complement *i** modeling with e3value modeling to model *value objects* that are exchanged between *actors* as well as to analyze these *value exchanges* because *value* cannot be expressed in *i** directly. e3value models corresponding with *i** models in Figure 7-1 (Scenario 1) and Figure 7-2 (Scenario 2) are depicted in Figure 7-3 (Scenario 1) and Figure 7-4 (Scenario 2) respectively. Adopting the concepts and terminology of e3value, these e3value models show the worth of *value objects* exchanged between CC and SS. A *value object* delivers benefit or utility to *actors* that receive it. In this example, Small slice and Large slice are *value objects* that are associated with different degrees of benefit or utility for the *actors*. Actors perform *value activities* to create or consume *value objects*. CC must Cut unequal slices and SS must Take small slice or Take large slice to participate in this *value constellation*.

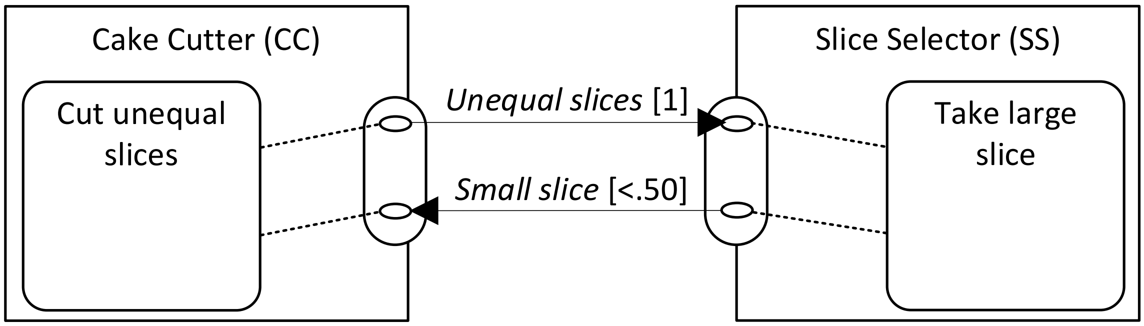

Figure 7-3 e3value model depicting As-Is relationship among “CC” and “SS” (Scenario 1).

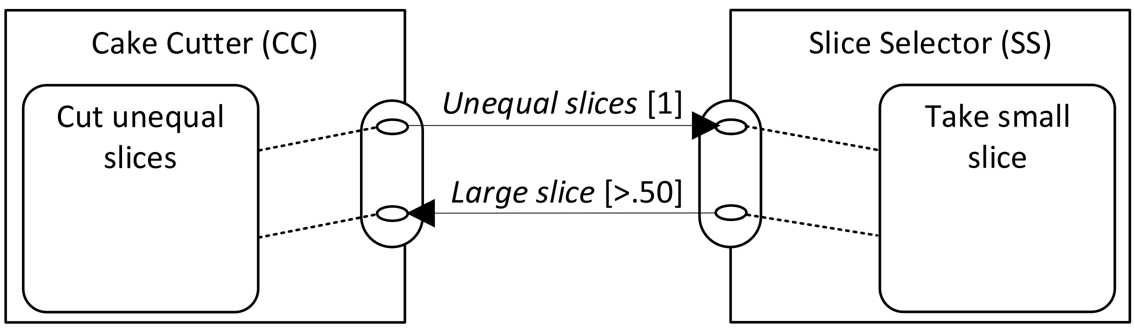

Figure 7-4 e3value model depicting As-Is relationship among “CC” and “SS” (Scenario 2).

Actors exchange *value objects* through *value ports* and CC has a *value port* to deliver Unequal slices to SS as well as another *value port* to obtain Small slice or Large slice from CC. SS has corresponding *value ports* to get Unequal slices from CC and to give Small slice or Large slice to CC. An *actor* offers or demands *value objects* from other *actors* using *value interfaces.*

Value interfaces are groupings of *value ports* that represent economic reciprocity such that all the *value ports* in a *value interface* exchange *value objects* or none of them do. CC gives Unequal slices to SS and SS gives a Small slice or Large slice to CC in Figure 7-1 and Figure 7-2 respectively. If CC thinks that SS will not give any slice to CC then it will not provide Unequal slices to SS.

Value transfers are used to connect two *value interfaces* and can be used to show the relationship between CC and SS. If CC does not provide Unequal slice to SS then SS will be unable to give Small slice or Large slice to CC because SS will not have any slices to take or give.

In Section 4.7, we noted that reasoning about *actor* intentionality as well as analysis of *value exchanges* are essential requirements for understanding complementarity. Recall from Section 3.3.2 that none of the conceptual modeling languages meet these requirements individually but they can be combined to meet these requirements collectively. Recall that we use *i** and e3value jointly because *i** supports the analysis of *actor* intentionality but does not support analysis of *value exchanges* while e3value supports analysis of *value exchanges* but does not support the analysis of *actor* intentionality.

To complement e3value modeling, we can refer to *i* goal* satisfaction analysis in *i** (Figure 7-1 and Figure 7-2) to calculate the worth of the *value objects* for each *actor* in e3value models (Figure 7-3 and Figure 7-4). Let us suppose that the utility of both slices together is 1 (i.e., sum of these *value objects* is 1). It is reasonable to consider the worth of Large slice to be >0.5 and Small slice to be <0.5.

In Scenario 1, SS decides to Take large slice and gives Small slice to CC. In this case, SS keeps a *value object* worth >0.5 and CC gets a *value object* worth <0.5.

In Scenario 2, SS decides to Take small slice and gives Large slice to CC. In this case, SS keeps a *value object* worth <0.5 and CC gets a *value object* worth >0.5. These scenarios show that CC and SS are not equally advantaged by participating in this *value constellation*. Moreover, SS will always choose Scenario 1 over Scenario 2 because, in this *value constellation*, it will attain a higher-utility *value object*.

This will result in CC always benefiting less than SS and will trigger exploration by CC for a relationship in which, at a minimum, it does not lose.

For ease of reading, Figure 5-3 is reproduced here as Figure 7-5 with new elements added. Model elements in black represent existing model elements from Figure 7-1 and Figure 7-2 while model elements in blue represent new model elements in Figure 7-5.

To create a win-win strategy CC explores a new alternative that can help it to achieve its only *softgoal* Large slice of cake for self. However, this alternative must also help SS to satisfy its sole *softgoal* Large slice of cake for self.

This new To-Be strategy can only exist if the cake is cut into equal slices by CC because only one of the *actors* (i.e., CC or SS) will get the large slice of that cake if the cake is cut into unequal slices.

If the cake is cut into equal slices by CC then both slices will be equally large. This new alternative for CC will also change the choices available to SS. This is because if CC cuts the cake into equal slices then SS will need a new option so that it can Take either slice.

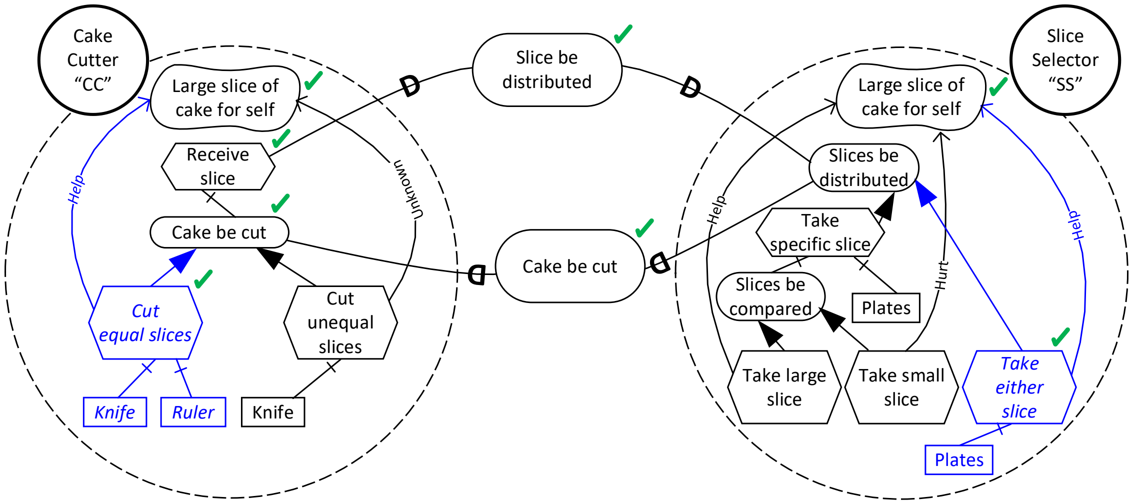

Figure 7-5 *i** model depicting To-Be relationship among "CC" and "SS"

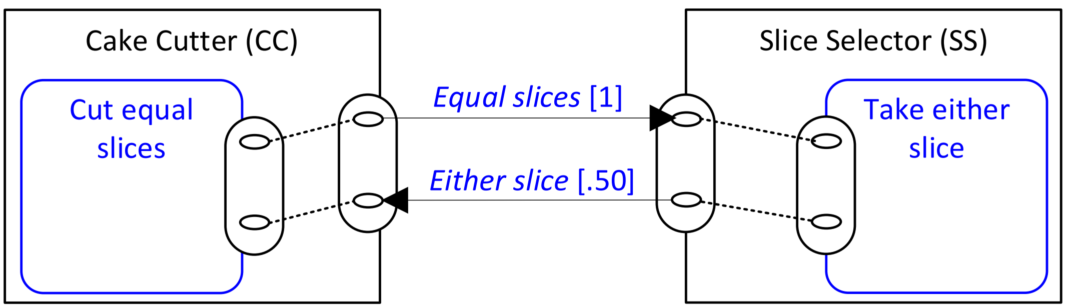

Figure 7-6 e3value model depicting To-Be relationship among "CC" and "SS".

An e3value model that includes new *value activity* for CC (Cut equal slices) and SS (Take either slice) as well as their resulting *value objects* is presented in Figure 7-6. This leads to a new *value transfer* in which CC offers Equal slices to SS and SS offers Either slice to CC. We can refer to *i* goal* satisfaction analysis in Figure 7-5 to assess the worth of the *value objects* for each *actor* in the *value constellation* (Figure 7-6). If the combined worth of both slices of cake is 1 and the cake is cut into equal slices then each slice will be worth 0.5. By generating this new alternative, via the *i** model of Figure 7-5, the e3value model (Figure 7-6) shows that CC eliminates the possibility for an imbalanced distribution of value caused by SS acting opportunistically or altruistically. This analysis of e3value model in Figure 7-6 indicates that the To-Be relationship between CC and SS represents a win-win outcome.

7.1 Modeling Ontology

In the second advanced facet our modeling framework, we use two modeling languages, *i** and e3value, in combination to analyze complementarity between *actors*. A combined metamodel of *i** (Yu, 2011) and e3value (Gordijn, Akkermans, & Van Vliet, 2001), that is useful for modeling complementarity, is presented in Figure 7-1. This combined metamodel includes the *i** metamodel in Figure 6-3 and adds entities and relationships from e3value (based on Gordijn, Yu, & van der Raadt, 2006). No new extensions to standard e3value metamodel are introduced in Figure 7-7[27].

We connect the ontologies of e3value and *i** by linking: (i) e3value *actors* to *i* actors*, and (ii) e3value *value objects* to *i* dependums*. e3value *actors* are mapped to *i* actors* with a 1:1 cardinality and e3value *value objects* are mapped to *i* dependums* with a 1:1 cardinality. 1:1 cardinality ensures that mapping between instances of entities in corresponding *i** and e3value models is straightforward and unambiguous. However, this one-to-one mapping does not require each element in an *i** model to be represented in its corresponding e3value model and vice versa. The only elements that appear in corresponding *i** and e3value models are those which are necessary for analyzing complementarity. We acknowledge that other researchers may connect the ontologies of *i** and e3value in other ways.

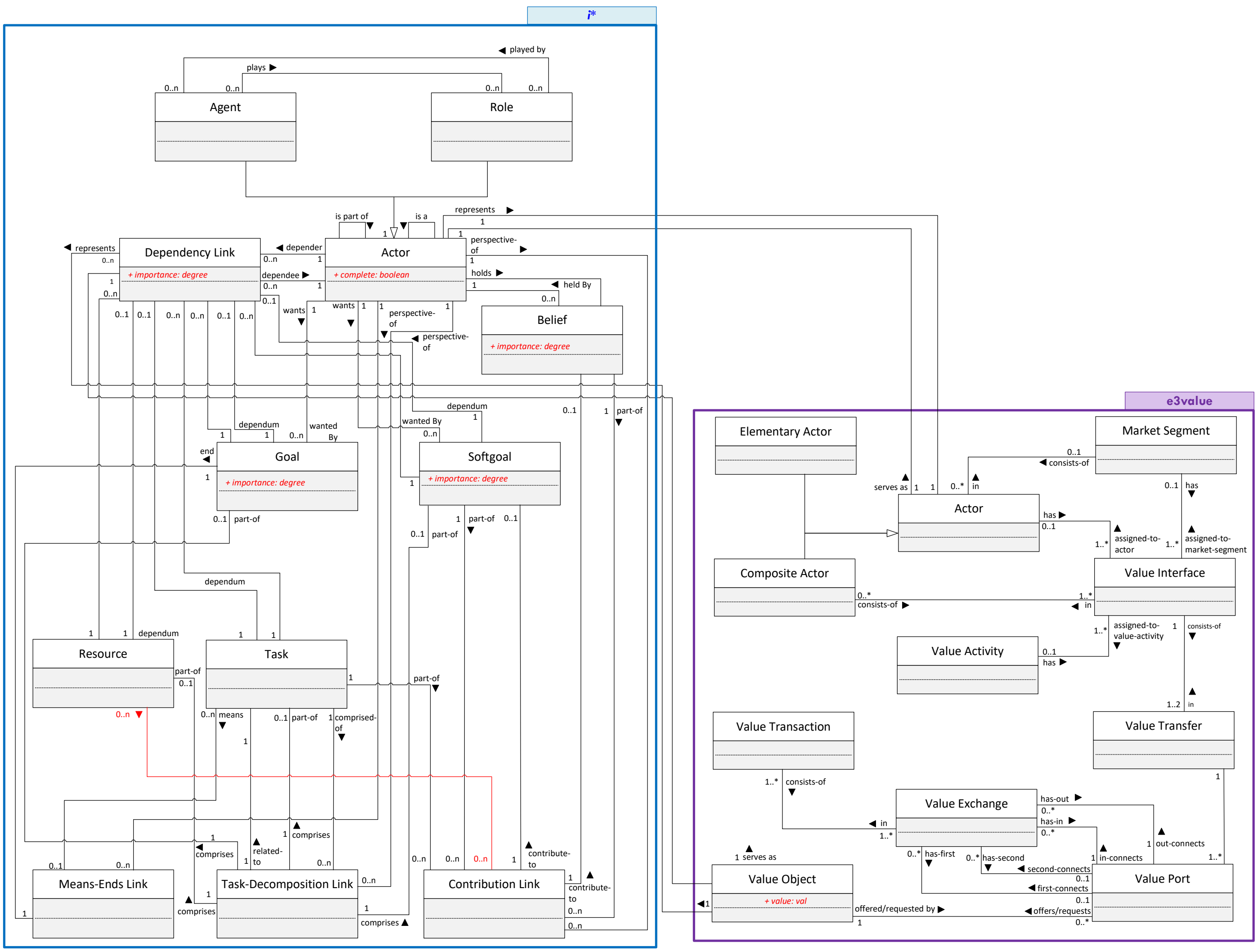

Figure 7-7 Metamodel of *i** and e3value (Source: Gordijn, Akkermans, & Van Vliet, 2001; Gordijn, Yu, & van der Raadt, 2006).

[27] We include the extended *i** metamodel from Chapter 6 (Section 6.1).

7.2 Visual Notation

e3value includes visual notation for expressing entities and relationships associated with value (Gordijn, Akkermans, & Van Vliet, 2001). Standard notations and symbols corresponding with e3value elements that are included in Section 7.1 are presented in Figure 7-8. Details about the notation and syntax rules of e3value can be found in Gordijn, Yu, & van der Raadt (2006).

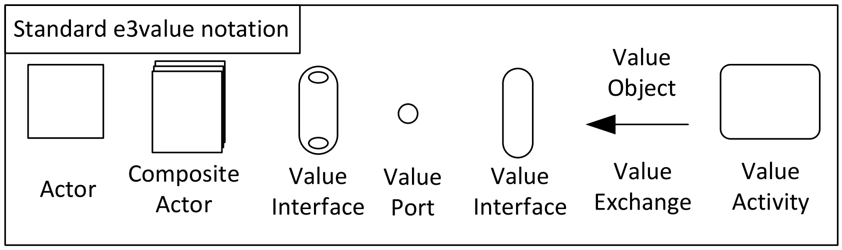

Figure 7-8 Notations and symbols in e3value (based on Gordijn, Akkermans, & Van Vliet (2001))

Figure 7-9 presents the schematic of a *value exchange* in which a *value object* is received by an *actor*.

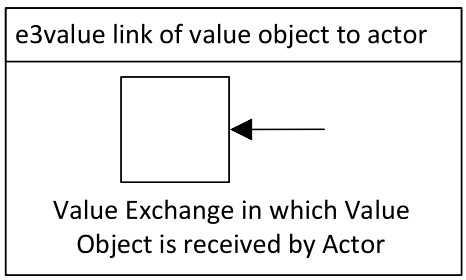

Figure 7-9 Schematic from original e3value showing value exchange in which an value object is received by an actor

We have extended the standard e3value notation slightly by inscribing the identifiers of actors, market segments, and value activities within their respective boundaries. Figure 7-10 shows these extensions.

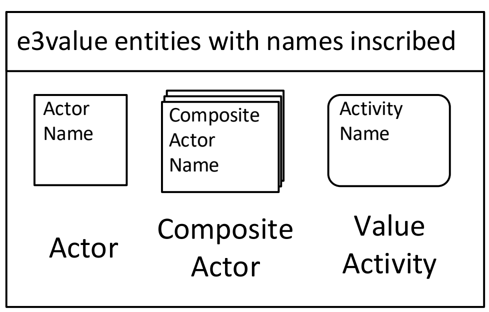

Figure 7-10 Extended e3value notation with names of select entities inscribed

*i** and e3value models are visually depicted in separate diagrams. *i* actors* and e3value *actors* with the same names are treated as corresponding actors. Similarly, *i* dependums* and e3value *value objects* with identical names are treated as corresponding entities. No other visual links are used to show correspondence.

7.3 Method

We extend the method, for identifying and developing win-win strategies that is introduced in Section 5.4 by adding support for modeling of complementarity. A flowchart in Figure 7-11 depicts phases in this method: Modeling, Evaluation, and Exploration. In the Modeling phase, an *i** model and its corresponding e3value model are instantiated and populated. In the Evaluation phase, the impacts of various choices on objectives are calculated to detect the presence of any extant win-win strategies with reference to *i** goal and softgoal satisfaction as well as assessment of value-added (by each activity) and added-value (of every actor) in e3value. In the Exploration phase, new alternatives are found by generating relational configurations that yield positive-sum outcomes. This process can be repeated to generate as many win-win strategies as needed.

As discussed in Section 4.7, we distinguish between the concepts of *value added* by an actor and *added value* of an actor in a multi-party economic relationship (Brandenburger & Stuart, 1996). Reasoning about strategic complementarity between actors requires the ability to analyze three main factors which are resources/assets/objects, value added by each actor, and added value of each actor. A resource/asset/object refers to an entity associated with some value, benefit, or utility for a stakeholder. Value added by an actor refers to the incremental addition of some value, benefit, or utility by that actor. Added value of an actor refers to the worth of that actor in terms of value, benefit, or utility creation in a multi-party economic relationship. In analyzing complementarity, the notions of value added and added value are viewed from the perspective of the stakeholder that is the beneficiary of synergy.

Modeling phase: In this phase, the modeler develops an *i** model as well as its corresponding e3value model that covers the concepts needed to perform analysis of positive-sum outcomes and win-win strategies in coopetitive relationships. In this phase, intentional aspects of *actors* are modeled using *i** in terms of *beliefs*, *goals*, *tasks*, *resources*, *softgoals*, and strategic relationships among *actors* are modeled as *dependencies* among them. Additionally, value aspects of their relationship are modeled using e3value in terms of actors, value objects, value ports, value interfaces, value exchanges, and value transfers. This phase consists of eleven sequential steps and yields an *i** model as well as its corresponding e3value model:

M1. Identify focal *actors* that are: concrete as *agents*, and, abstract as *roles*.

M2. Identify additional *actors*, *agents*, and *roles*. *Agents* and *roles* should be modeled when it is important to separate and separately analyze behaviors (i.e., *roles*) from the entities that carry out those behaviors (i.e., *agents*). If this differentiation does not improve the analysis then undifferentiated *actors* can be used.

M3. Identify *beliefs* for each *actors*, *agents*, and *roles* (with ‘Importance’).

M4. Identify *goals* for each *actors*, *agents*, and *roles* (with ‘Importance’).

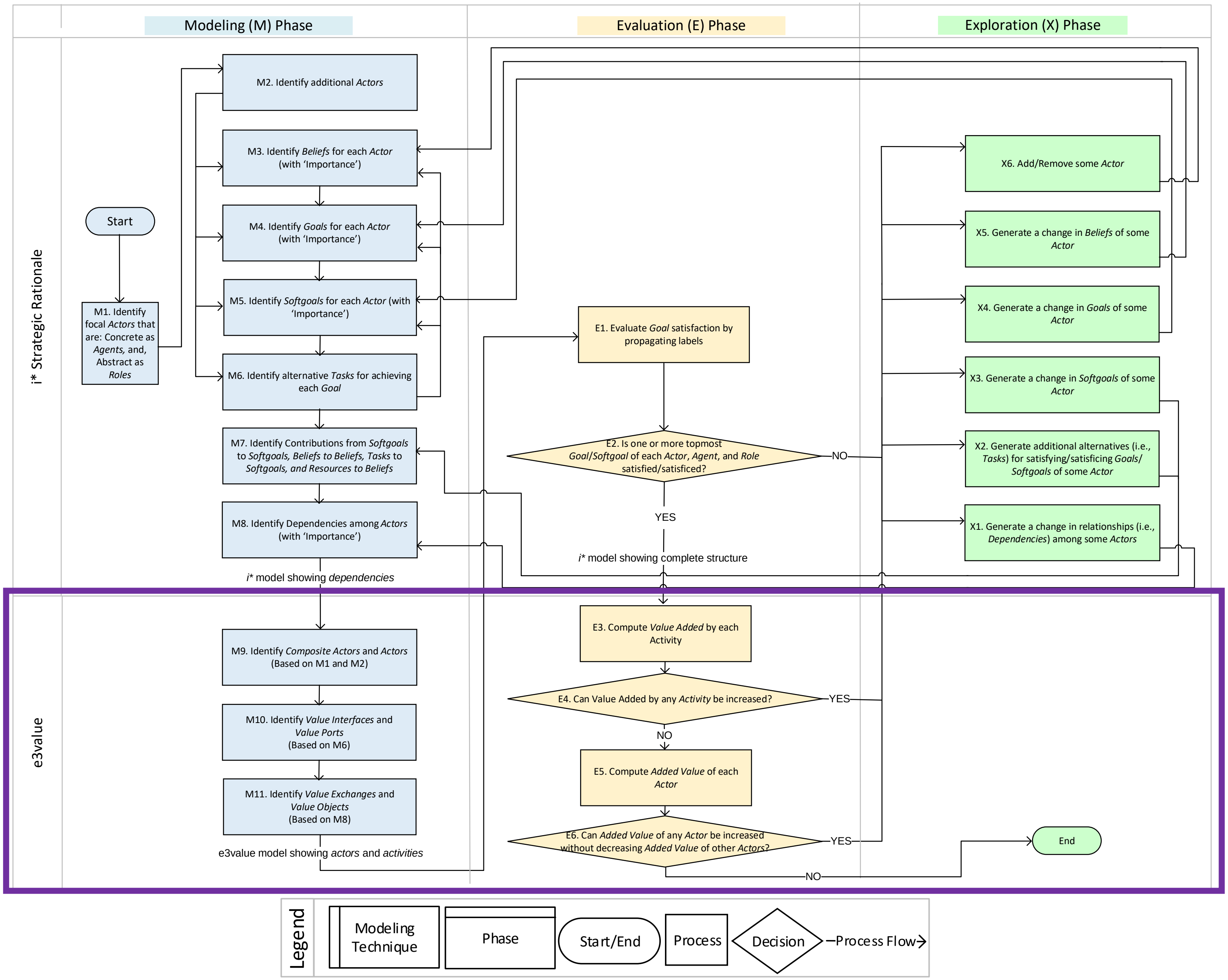

Figure 7-11 Process steps for using *i** modeling with e3value to get to win-win (new steps that are added to Section 5.4 are enclosed in purple box)

M5. Identify *softgoals* for each *actors*, *agents*, and *roles* (with 'Importance').

M6. Identify alternative *tasks* for achieving each *goal*. Depict the subsidiary parts of a *task*. Differentiate between strategic *resources* and generic *resources* to model only those *resources* that are strategic[28]. Depict the *resources*, typically information assets, that underlie *beliefs*. Portray impact of *tasks* on *softgoals*.

M7. Identify *contribution links* from *softgoals* to *softgoals*, *beliefs* to *beliefs*, *tasks* to *softgoals*, and *resources* to *beliefs*.

M8. Identify dependencies among *actors*, *agents*, and *roles* (with 'Importance').

The conclusion of M8 yields an *i** model showing *dependencies* and this *i** model is used to develop a corresponding e3value model.

M9. Identify *Composite Actors* and *Actors* based on M1 and M2.

M10. Identify *Value Interfaces* and *Value Ports* based on M6.

M11. Identify *Value Exchanges* and *Value Objects* based on M8.

The conclusion of M11 yields an e3value model corresponding to the *i** model that was obtained after M8. After completing this phase, the modeler should proceed to the Evaluation Phase.

Evaluation phase: This phase consists of six sequential steps and results in the analysis of the *i** model and its corresponding e3value model that are developed in the modeling phase:

E1. Evaluate *goal* satisfaction by propagating labels. Trace the impact of lower-level *tasks* and *softgoals* on higher-level *softgoals*, as well as, lower-level *tasks* on higher-level *goals*. As depicted in Section 5.5.2, *softgoals* and *goals* can either be: fully satisfied (denoted by a checkmark), partially satisfied (denoted by a dot underneath a checkmark), fully denied (denoted by a cross), or partially denied (denoted by a dot underneath a cross). In case the status of a *softgoal* or *goal* cannot be resolved then it can be marked as unknown (denoted by a dot above a question mark).

E2. Assess whether one or more topmost *goal*/*softgoal* of each *actor*, *agent*, and *role* are satisfied? Use the technique outlined by Horkoff & Yu (2009, 2011, 2013), that is summarized in Section 5.5.1, to evaluate the satisfaction or denial of top-level *softgoals* and *goals* for each *actor*, *agent*, and *role*. If topmost *goal*/*softgoal* of any *actor*, *agent*, or *role* is unfulfilled then it means that a win-win strategy does not exist in this coopetitive relationship. In this case, the modeler should proceed to the Exploration Phase. If the

[28] The rationale for making this distinction and identifying strategic *resources* is explained in Appendix 1.

top-level *softgoals* and *goals* of each *actor*, *agent*, and *role* are satisfied then the modeler should continue to E3.

E3. Calculate the Value Added by each *Activity*. A technique for calculating the Value Added by an *Activity* is described in Section 7.4.1.

E4. Determine whether the Value Added by any *Activity* can be increased?

E5. Calculate the Added Value of each *Actor*. A technique for computing the Added Value of an *Actor* is described in Section 7.4.2.

E6. Assess whether the Added Value of any *Actor* can be increased?

It can be concluded that a win-win strategy exists in this relationship if the result of E2 is positive while the results of E4 as well as E6 are negative. However, if E2 is negative or either of E4 and E6 are positive then it means that a win-win strategy does not exist in this relationship. In this case, the modeler should proceed to the Exploration Phase.

Exploration phase: In the Exploration phase, a modeler can investigate any of six lines of action iteratively in the pursuit of a win-win strategy. If a win-win strategy cannot be discriminated initially then this method can be repeated to generate a strategy that results in win-win. A modeler can:

X1. Generate a change in relationships (i.e., *dependencies*) among some *actors*, *agents*, or *roles*.

X2. Generate additional alternatives (i.e., *tasks*) for satisfying *goals* and *softgoals* of some *actor*, *agent*, or *role*.

X3. Generate a change in *softgoals* of some *actor*, *agent*, or *role*.

X4. Generate a change in *goals* of some *actor*, *agent*, or *role*.

X5. Generate a change in *beliefs* of some *actor*, *agent*, or *role*. This will only happen if that *actor*, *agent*, or *role* thinks that the state of affairs in the world has changed or that its original *beliefs* were incorrect.

X6. Add/Remove some *actor*, *agent*, or *role*.

Each step in this phase effects a change in the *i** model that was developed in the Modeling phase and analyzed in the Evaluation phase. Any changes to the *i** model may also result in changes to the e3value model. Therefore, completing any step in this phase leads the modeler to a corresponding step in the Modeling phase. This starts a new iteration of this method that leads to the performance of steps in the Modeling phase as well as the steps in the Evaluation phase and, if needed, additional steps of the Exploration phase.

7.4 Analysis Techniques

The bargaining power and negotiating leverage of an actor in a coopetition relationship is determined by two factors: (7.4.1) Value Added of an *Activity* in a Value Chain; and (7.4.2) Added Value of an *Actor* to a Multi-party Economic Relationship. Calculating these factors requires the modeler to understand willingness-to-pay (WP) and opportunity cost (OC). WP refers to the maximum resources (e.g., money) that an actor (e.g., customer) will voluntarily relinquish in exchange for another resource (e.g., product). OC refers to the minimum resources (e.g., money) that an actor (e.g., vendor) will voluntarily accept to relinquish that resource (e.g., product). The logics of WP and OC hold because a rational and self-interested actor cannot be expected to give up a more valuable resource in exchange for a less valuable resource but that it will gladly give up a less valuable resource in exchange for a more valuable resource (Brandenburger & Stuart, 1996). In this section we describe techniques for analyzing the: (7.4.1) Value Added of an Activity in a Value Chain; and (7.4.2) Added Value of an Actor to a Multi-party Economic Relationship.

7.4.1 Considering the Value Added of an Activity in a Value Chain

Value added is an intuitive concept that is defined by Lieberman, Garcia-Castro, & Balasubramanian (2016) “as revenue minus the cost of purchased inputs”. A market in which a consumer (A_1) buys a finished product (O_2) from a vendor (A_2) and that vendor (A_2) procures raw materials (O_1) from a supplier (A_3) are shown in Figure 7-12 and Figure 7-13. A_2 performs an activity (C_1), by applying its competences and combining its resources, to transform O_1 (that it has procured from A_3) into O_2. Since O_2 is useful for A_1, A_1 buys O_2 from A_2 by compensating it with X. While the following exposition discusses the relationship between A_1 and A_2 – such a relationship holds likewise between A_2 and A_3. This is because, just as A_2 is a vendor that sells O_2 to A_1 which is its customer – similarly A_3 is a vendor that sells O_1 to A_2 which is its customer.

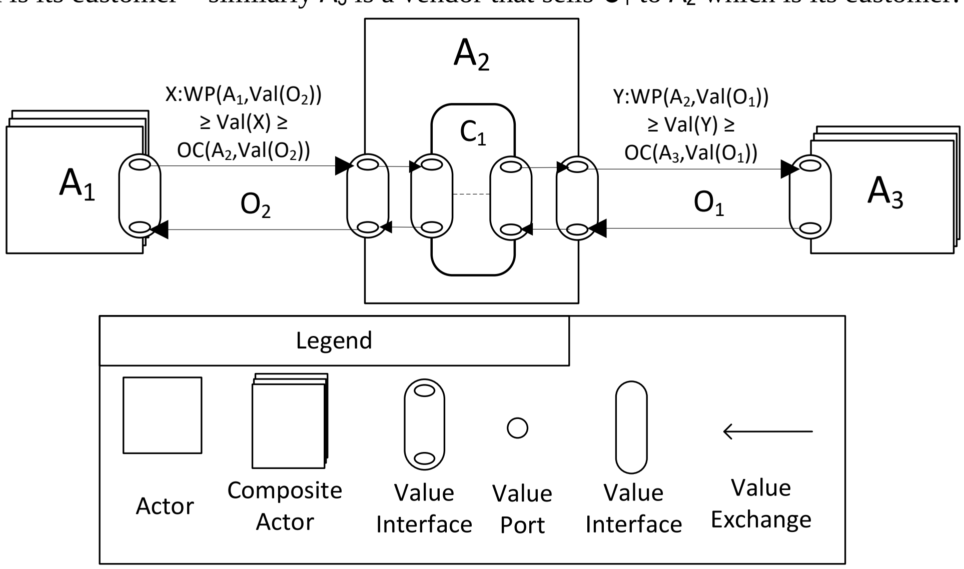

Figure 7-12 e3value diagram of A_2’s value constellation.

In this market, two economic factors impose an upper and lower bound on $Val(X)$ and $Val(Y)$ respectively. $Val(X)$ is the *value* of the *value object* X. The upper bound is dictated by the customers A_1 and A_2 while the lower bound is determined by the vendors A_2 and A_3 such that $Val(X)$ and $Val(Y)$ is determined through a process of bargaining and negotiation between A_1 and A_2 as well as A_2 and A_3. The upper and lower bounds in the formula above an arrow representing value exchanges are denoted in Figure 7-12. These are X and Y between A_1 and A_2 as well as A_2 and A_3 respectively. In this example the value added by A_2 is $Val(X) – Val(Y)$.

The optional expression after the colon above a *value exchange* is a constraint on the *value* of that *value object*. In Figure 7-12 it is used to indicate upper bound from $WP()$ and lower bound from $OC()$.

We focus on the relationship between A_1 and A_2 to discuss these upper and lower bounds on $Val(X)$ but this technique is also applicable in the relationship between A_2 and A_3.The maximum amount of resources that A_1 is willing to pay A_2 is less than or equal to the maximum benefit, utility, or value that A_1 can obtain from O_2. This upper bound refers to the concept of '*willingness to pay*'. This WP is noted as $WP(A_1,Val(O_2))$ in Figure 7-12. A_1 is unwilling to pay an amount higher than $WP(A_1,Val(O_2))$ because doing so would mean that A_1 would give away more resources for O_2 than what A_1 considers it to be worth.

Conversely, however, A_1 is willing to pay A_2 an amount less than $WP(A_1,Val(O_2))$ for O_2 because that would mean that A_1 is underpaying A_2 by giving away fewer resources for O_2 than what A_1 considers it to be worth. A rational and self-interest seeking economic actor is willing to underpay for a resource because doing so creates a perceived surplus. However, that actor is unwilling to overpay for a resource because doing so creates a perceived deficit for that actor.

The minimum amount of resources that A_2 is willing to accept from A_1 is greater than or equal to the maximum amount of resources that A_2 can obtain from O_2 through an alternate use (e.g., selling it to someone else). This lower bound refers to the concept of '*opportunity cost*' that was discussed in Section 7.4. This OC is noted in Figure 7-12 as $OC(A_2,Val(O_2))$. A_2 is unwilling to accept an amount less than $OC(A_2,Val(O_2))$ because doing so would mean that A_2 would receive lower value by selling O_2 to A_1 than it can by applying O_2 to some other use.

Conversely, however, A_2 is willing to accept an amount from A_2 that is greater than $OC(A_2,Val(O_2))$ for O_2 because that would mean that A_2 is getting more value for O_2 from A_1 than it would from the next best alternative use of O_2. The structural configuration of such bargaining and negotiating between A_1 and A_2 as well as A_2 and A_3 is shown in Figure 7-13.

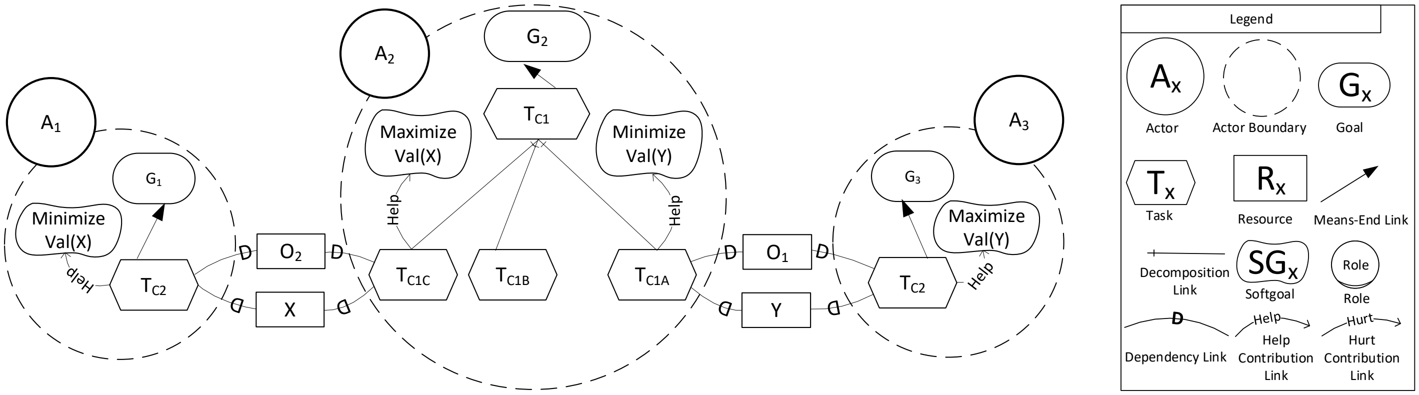

Figure 7-13 i* Strategic Rationale (SR) diagram to understand willingness-to-pay and opportunity cost.

7.4.2 Considering the Added Value of an Actor to a Multi-party Economic Relationship

Added value is different from value added because while the latter represents economic margin (i.e., difference between revenues and purchased inputs), the former denotes the worth of a party in a multi-party economic relationship.

In the context of a specific *actor* or *player*, added value refers to the "value created by all the players in the vertical chain minus the value created by all the players in the vertical chain except the one in question" (Brandenburger & Stuart, 1996). A market in which a consumer (A_1) buys two products O_1 and O_2 from two vendors A_2 and A_3 respectively is shown in Figures 7-14, 7-15, and 7-16. A_1 can use O_1 and O_2 separately (i.e., without each other) or it can use them jointly (i.e., with each other). A situation in which A_1 consumes O_1 and O_2 separately is shown in Figure 7-15. A situation in which A_1 consumes O_1 and O_2 jointly is shown in Figure 7-16. These two alternative situations are shown in the *i** model in Figure 7-14.

The presence of complementarity between O_1 and O_2 is shown in Figure 7-14. A_1 is able to satisfy more objectives by using O_1 and O_2 together than by using either O_1 or O_2 separately in Figure 7-14. This represents an incentive for A_1 to use O_1 and O_2 jointly rather than separately. *Actors* A_2 and A_3 are complementors because their *value objects* are more valuable for the actor A_1 jointly rather than separately.

In a situation of complementarity, as depicted in Figure 7-16, it is not feasible to use the WP of A_1 for O_1 or O_2 as the upper bound on the value that their respective firms (i.e., A_2 and A_3) can appropriate from this joint value constellation. Rather, the presence of a surplus from synergy necessitates the calculation of the added values of A_2 and A_3 to determine the maximum amount of value that each firm can appropriate from this joint *value constellation*.

Recall that the optional expression after the colon above a *value exchange* is a constraint on the value of the named *value object*. In Figure 7-15 and Figure 7-16 it is used to indicate upper bound from WP() and lower bound from OC().

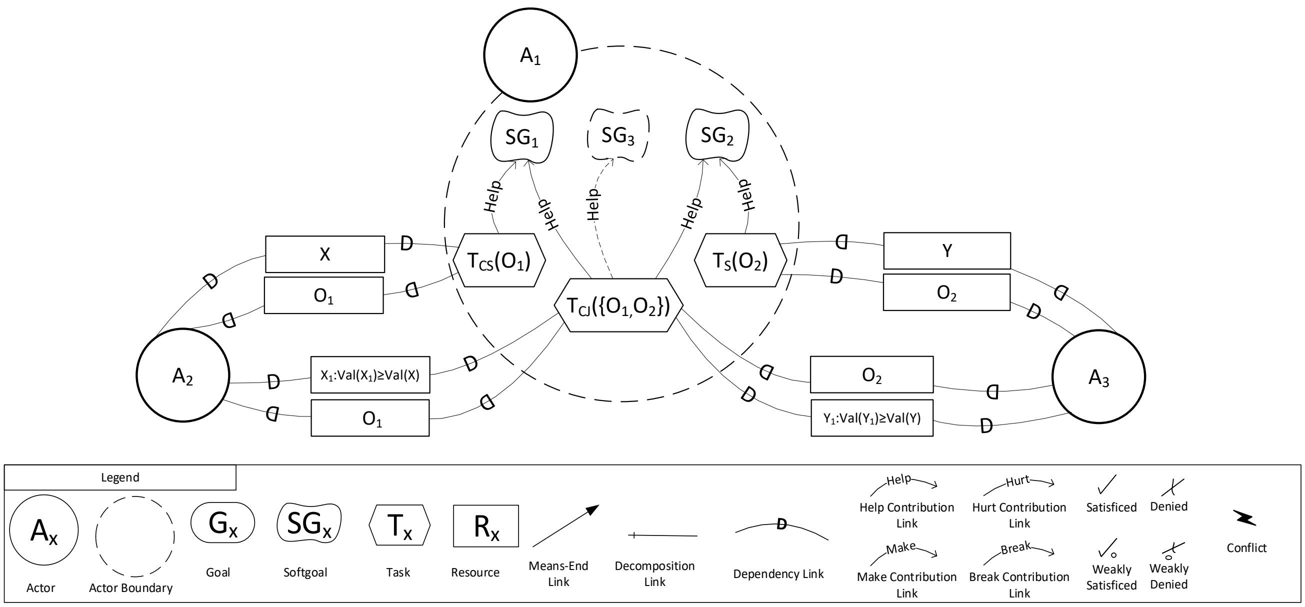

Figure 7-14 *i** model of A_1 with complementarity between A_2 and A_3.

Complementarity exists in the case of joint usage of O_1 and O_2 because by using these products together the consumer (A_1) can satisfy more of its objectives than it can by using either O_1 or O_2 separately. Therefore, this consumer (A_1) is willing to pay a greater amount for the relatively higher utility or benefit that it can obtain this combined offering than that from using either of these products without the other.

This presence of complementarity is indicated via the greater outbound *value exchange* from the consumer for O_1, O_2 in Figure 7-16 compared to the sum of the outbound *value exchanges* from that consumer for O_1 and O_2 in Figure 7-14.

The difference between these *value exchanges* can be regarded as the surplus from synergy because it refers to an amount that is only present when O_1 and O_2 are together but is absent when O_1 and O_2 are separate.

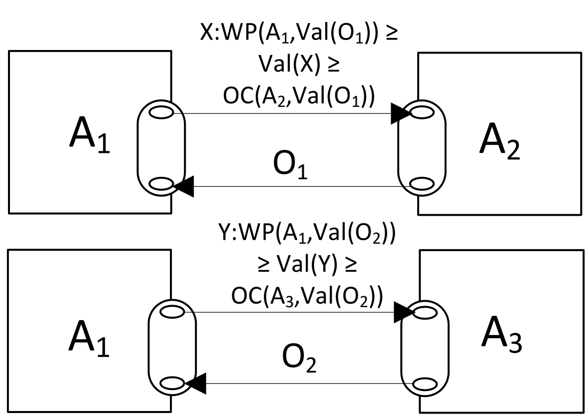

Figure 7-15 e3value diagram of A_1's value constellation with separate usage of O_1 and O_2.

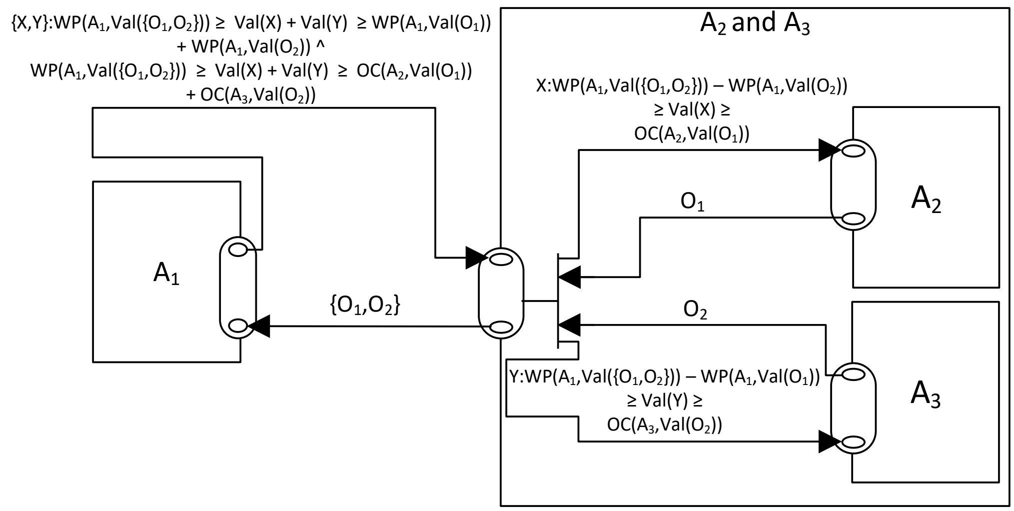

Figure 7-16 e3value diagram of A_1's value constellation with complementarity between A_2 and A_3.

The amounts of value, Val(X) and Val(Y), that can be appropriated by actors, A_2 and A_3, is specified as a range because Val(X) and Val(Y) are dependent on each other. Since the total value that can be appropriated by all the actors is fixed, WP(A_1,Val($\{O_1,O_2\}$)), then the more/less amount of value that is appropriated by an actor (i.e., A_2 or A_3) reduces or increases the amount of value that is remaining for appropriation by another actor, (i.e., A_3 or A_2). As discussed in Section 7.4, if an actor (i.e., A_2 or A_3) appropriates a greater amount of value than their added value then another actor (i.e., A_3 or A_2) will only be able to appropriate an amount of value less than their opportunity cost. The presence as well as the magnitude of complementarity can be expressed and explained by using *i** and e3value together in this way.

7.5 Illustration of Modeling and Analysis of Coopetition with Value

In this illustration, we demonstrate the application of the modeling approach that is depicted in Figure 7-11 to generate a win-win strategy. This process comprises three phases: Modeling, Evaluation, and Exploration. In the Modeling phase, an *i** model is instantiated and populated. In the Evaluation phase, the impacts of various choices on objectives are calculated to detect the presence of any extant win-win strategies. In the Exploration phase, new alternatives are found by generating relational configurations that yield positive-sum outcomes. This process can be repeated to generate multiple win-win strategies.

7.5.1 Complementarity between Microsoft Windows and Intel Pentium

A widely-studied case of complementarity and coopetition pertains to 'Wintel' (i.e., Microsoft Windows operating system (OS) on Intel x86 chipsets) (Gomes-Casseres, 2005). Throughout the 1990s, Microsoft and Intel simultaneously competed and cooperated with each other (Yoffie & Kwak, 2006). They cooperated to achieve their common goal of establishing Wintel as the de facto standard in personal computing (Brandenburger & Nalebuff, 1996).

This joint objective comprised of enlarging the market for Windows on x86 by competing with vendors of substitute products, such as Apple and Motorola (Golnam et al., 2014). However, Microsoft and Intel also had their private goals of maximizing their individual shares of the collective value created by the Wintel alliance (Casadesus-Masanell & Yoffie, 2007). This required these firms “to manage a partially convergent interest and goal structure” (Castaldo, & Dagnino, 2009).

7.5.2 Analyzing strategic complementarity in the Wintel alliance

Brandenburger & Nalebuff (1996) suggest that complementarity between Windows and Pentium motivated the coopetitive relationship between Microsoft and Intel. The basic reason for the presence of this complementarity was that a customer (i.e., PC user), with a specific set of requirements, could do more by using these products together rather than separately. For example, a PC user could get better performance in Windows with Pentium because Intel had optimized that chipset for Windows and Microsoft had implemented the MMX multimedia instruction set from Intel into Windows (Yoffie & Kwak, 2006). If this user chose a different OS (e.g., Linux) on Pentium or Windows on a different chipset (e.g., K6) then that user would have foregone performance improvements that stemmed from the co-optimization of Windows and Pentium. However, while Wintel offered performance advantages to a PC user (compared to substitutes of Windows and Pentium) it also locked that user into a relationship with proprietary vendors.

Microsoft and Intel charged premium prices and this translated into higher costs for that user. Conversely, if this user chose a different OS or chipset then they would have saved money but would not have benefited from the performance advantages of Wintel. This was just one of many tradeoffs that vendors (such as Microsoft, Intel, Apple, and AMD) had to analyze to develop persuasive value propositions for their target customers.

As this illustration indicates, reasoning about complementarity requires the ability to evaluate the objectives of an actor (e.g., PC user), the options that that are available to meet those objectives, and the impact of those options on those objectives. Each alternative can impact the satisfaction or denial of an actor’s goals differently since there are trade-offs between those options. The satisfaction of an objective leads to realization of benefits for an actor while its denial impairs such benefit realization. Therefore, to understand the presence and extent of complementarity between entities the individual and collective effects, of those entities, on value creation must be compared. This can be done using text, as was done in this sub-section, as well as by using models, as is done in the following sub-section.

7.5.3 As-Is Scenario: Discriminating Win-Win strategies with *i**

Modeling Phase: *i** models depicting the impact of different combinations of OSs and chipsets in the As-Is scenario are shown in Figures 7-17 and 7-18. These models show that the *goal* of a Home User is to Buy PC and each combination impacts the satisfaction of various objectives of a Home User of PC (Personal Computer) differently.

Prior to cooperation between Microsoft and Intel, a Home User can buy Windows on any chipset (e.g., K6 from AMD) (Figure 7-17) or any operating system on Pentium (e.g., Linux from Red Hat) (Figure 7-18). In this As-Is scenario, Windows and Pentium are not co-optimized thus Windows is comparable to any OS with respect to Pentium and Pentium is comparable to any chipset with respect to Window.

The requirements of a Home User are represented as *softgoals* in Figure 7-17 and Figure 7-18. This is because their satisfaction is judged subjectively from the perspective of that Home User. A Home User needs to Buy PC so it can use that PC (Figures 7-17 and 7-18) to satisfy its objectives.

The top level *softgoals* of Home User are Peace of mind, Choose market leader, and Lower cost. Various lower-level *softgoals* make *help* or *hurt* contributions to different upper-level *softgoals*. This requires the Home User to perform trade-off analysis so that it can understand the ramifications of each option.

The *softgoal* Peace of mind is helped by Optimized performance, Single support channel, Large user community, and Use free-libre software. The *softgoal* Choose market leader is helped by Many applications, and Large user community. The *softgoal* Lower cost is helped by Single support channel, Avoid vendor lock-in, and Use free/libre software.

Windows on any chipset (Figure 7-17) as well as Any OS on Pentium (Figure 7-18) are examples of alternate means that satisfy the same *goal* of Buy PC hence these are represented as *tasks* within the Home User. Requirements that are satisfied or denied if the Home User chooses Windows on any chipset (e.g., K6) are shown in Figure 7-17 and requirements that are satisfied or denied if the Home User chooses any OS on Pentium (e.g., Linux) are shown in Figure 7-18.

The *task* Windows on any chipset makes *help* contributions to Many applications, and Large user community. It makes *hurt* contributions to Optimized performance, Single support channel, Avoid vendor lock-in, and Use free/libre software. The *task* Any OS on Pentium makes *help* contributions to Avoid vendor lock-in, and Use free/libre software. It makes *hurt* contributions to Optimized performance, Single support channel, Many applications, and Large user community.

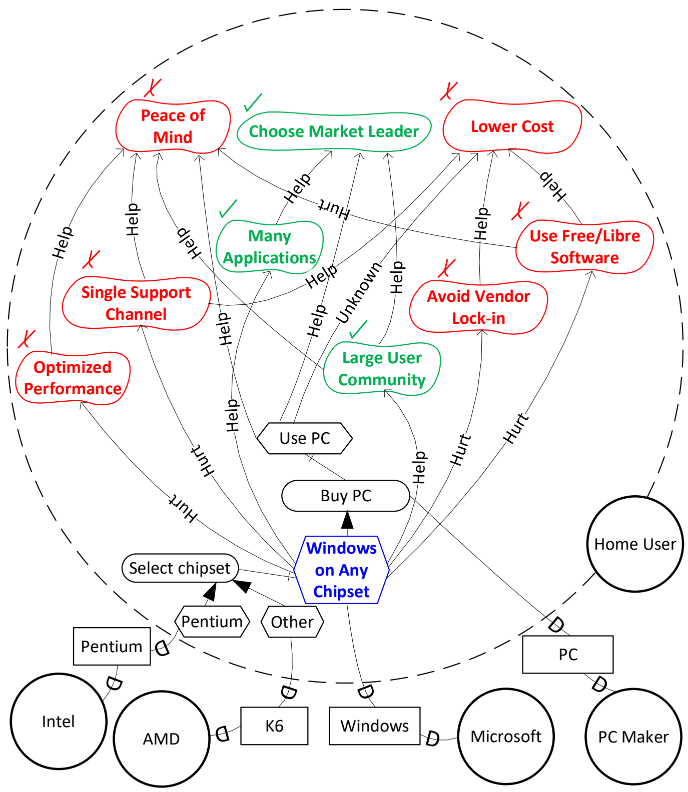

Figure 7-17 *i** model showing impact of Windows on any chipset on the objectives of a Home User

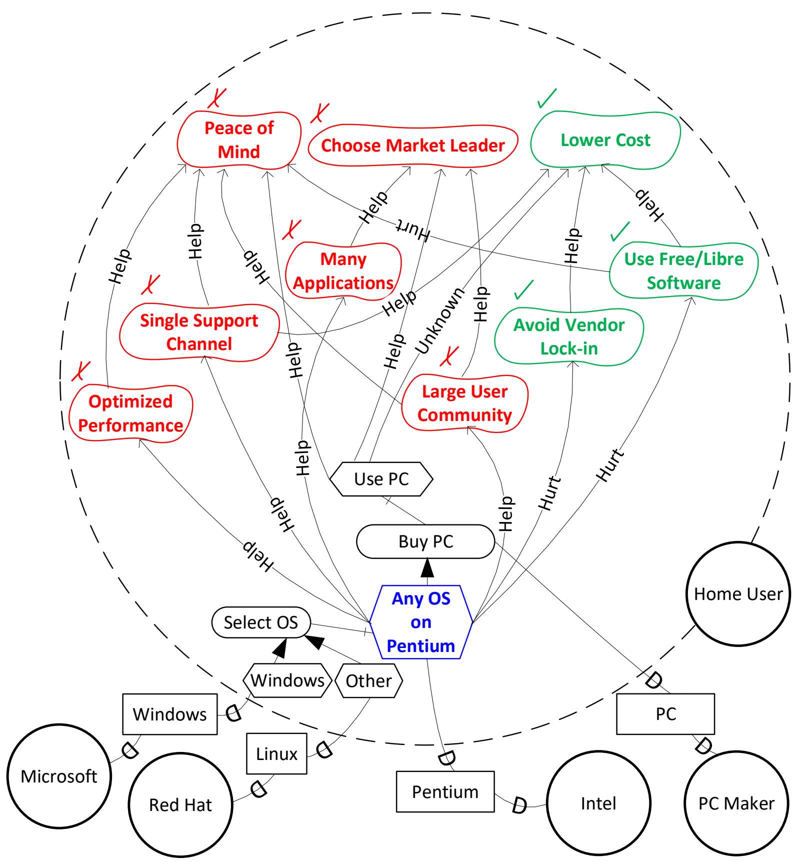

Figure 7-18 *i** model showing impact of any operating system on Pentium on the objectives of a Home User

In the diagrams in this illustration, we have omitted *dependencies* from the Home User to the vendors (e.g., for money) to simplify the visual presentation and interpretation of these diagrams.

We use e3value to show the independent *value constellations* of Intel and Microsoft in Figure 7-19. In this e3value model, each of these vendors provide their products to a Home User separately. We have depicted Microsoft and Intel in Figure 7-19 because we are interested in understanding the relationship among these vendors. However, as discussed above, Windows is comparable to any OS with respect to Pentium and Pentium is comparable to any chipset with respect to Windows because Windows and Pentium are not co-optimized. Therefore, a Home User can substitute Windows with any OS and Pentium with any chipset.

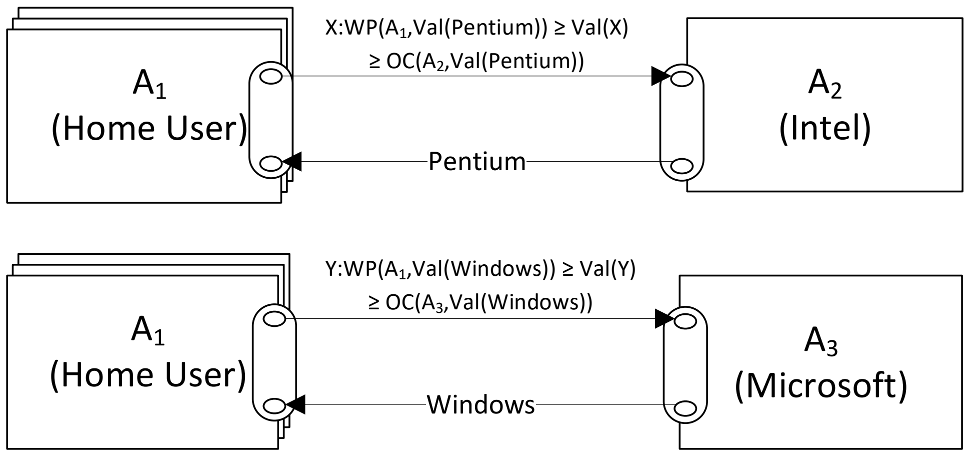

Figure 7-19 e3value diagram of separate value constellations of Microsoft and Intel.

Intel delivers a Pentium chip to a Home User who pays Intel an amount that is less than or equal to that Home User's WP for Pentium and is greater than or equal to Intel's OC for selling Pentium. This is shown in the upper sub-diagram in Figure 7-19. Microsoft delivers Windows OS to a Home User who pays Microsoft an amount that is less than or equal to that Home User's WP for Windows and is greater than or equal to Microsoft's OC for selling Windows. This is shown in the lower sub-diagram in Figure 7-19.

Evaluation phase: In the Evaluation phase, *softgoal* satisfaction in the *i** model and *value exchanges* in the e3value model are analyzed to assess the presence of win-win strategies. Analysis of *softgoal* satisfaction in the *i** model of Windows on any chipset in Figure 7-17 shows that one top-level *softgoal* is satisfied (i.e., Choose market leader) and two top-level *softgoals* are denied (i.e., Peace of mind, and Lower cost). Analysis of *softgoal* satisfaction in the *i** model of Any OS on Pentium in Figure 7-18 shows that one top-level *softgoal* is satisfied (i.e., Lower cost) and two top-level *softgoals* are denied (i.e., Peace of mind, and Choose market leader).

This analysis shows that, in the As-Is scenario, more *softgoals* of a Home User are denied (i.e., two) than satisfied (i.e., one). We can apply this finding to set the upper bound of WP for Home User in the e3value model in Figure 7-19 for the purposes of analysis. Recall that our framework treats quantities (e.g., WP, OC, etc.) solely in a nominal as well as subjective manner and only for the purpose of comparing scenarios. We assume that each top-level *softgoal* that is satisfied is worth 1 unit of WP for the Home User. Therefore, in the As-Is scenario, if the upper bound that can be earned by an OS provider (e.g., Microsoft or Red Hat) is *x* then the upper bound that can be earned by any chipset vendor (e.g., Intel or AMD) is *1-x*.

Analysis of *softgoal* satisfaction in *i** models of the Home User indicates that there exist opportunities for OS providers and chipset vendors to raise the upper bound of WP for Home User for their respective products. If OS providers and chipset vendors can enable the satisfaction of additional *softgoals* of Home User, in comparison to the As-Is scenario, then that Home User's WP for their products will be increased.

Analysis of *softgoal* satisfaction in e3value model of the As-Is scenario reveals that a win-win strategy does not exist for Microsoft and Intel because, from the perspective of the Home User, their products (i.e., Windows and Pentium respectively) are replaceable with other OSs (e.g., Linux by Red Hat) and chipsets (e.g., K6 by AMD). While the total upper bound of Home User's WP for Microsoft Windows and Intel Pentium is 1 each, the presence of ready substitutes for these products indicates that the Home User can bargain and negotiate a total WP for these products that is less than 1. These findings trigger the search for a win-win strategy by Microsoft and Intel.

Exploration phase: In the Exploration phase, a modeler can pursue any of six lines of action incrementally and iteratively. As depicted in Section 7.3, they can add/remove some *actor*, *agent*, or *role*; generate a change in *beliefs* of some *actor*, *agent*, or *role*; generate a change in *goals* of some *actor*, *agent*, or *role;* generate a change in *softgoals* of some *actor, agent,* or *role*; generate additional alternatives for achieving *goals* of some *actor*, *agent*, or *role*; or generate a change in relationships among some *actors*, *agents*, or *roles*. The selection of an option in the Exploration phase may trigger additional steps in the Modeling phase and Evaluation as well as Exploration phases.

An *i** model depicting the impact of Windows on Pentium on the *softgoals* of Home User in the To-Be scenario is shown in Figure 7-20. This To-Be scenario refers to a situation in which Microsoft and Intel collaborate to co-optimize and bundle Windows and Pentium to jointly offer a value proposition to Home User that is superior to individual value propositions offered by Microsoft and Intel separately in the As-Is Scenario. In this To-Be scenario, a Home User buys Windows on Microsoft from Wintel, which is an alliance between Microsoft and Intel.

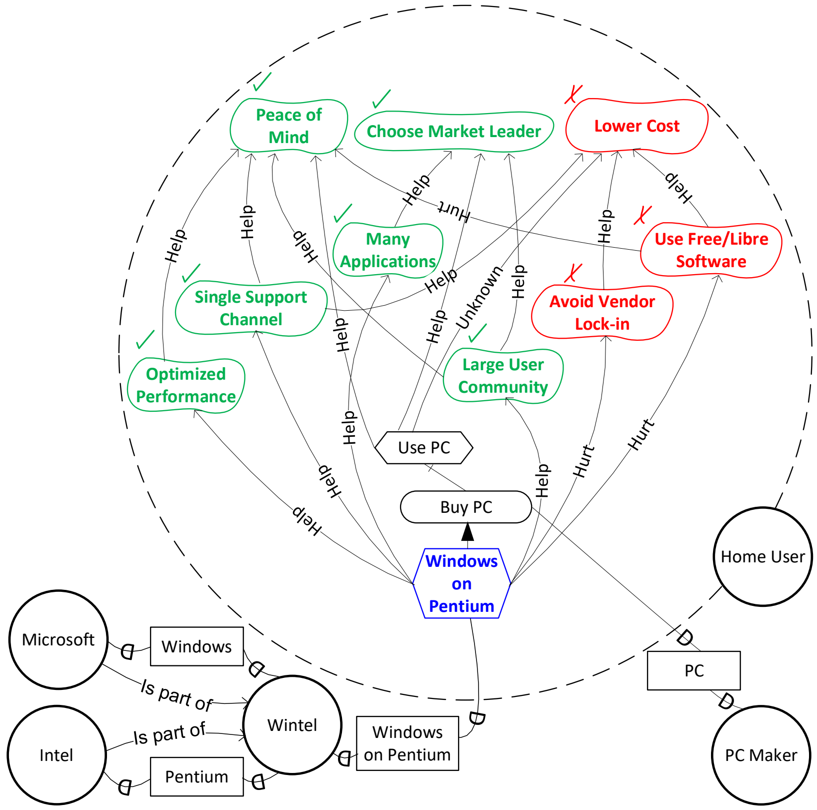

Figure 7-20 i* model showing adequacy of Wintel

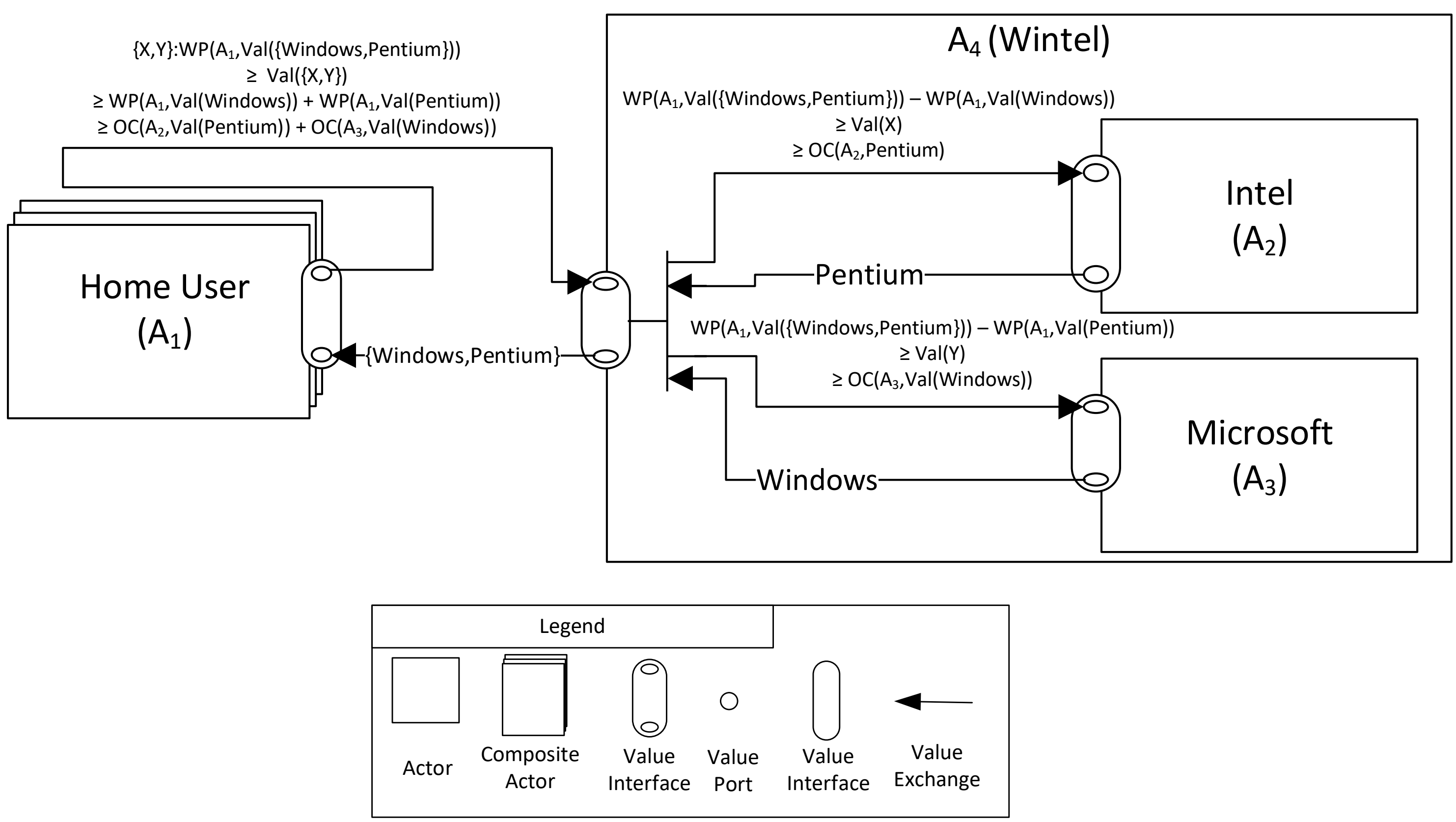

Figure 7-21 e3value diagram of Wintel's value constellation

Wintel is a distinct actor and Microsoft as well as Intel are connected with it using the *is-part-of* link. A new *task* in Home User, Windows on Pentium, is created to represent the new alternative that is available to the Home User to purchase Windows on Pentium directly from Wintel.

Evaluation phase: A comparison of *softgoal* satisfaction for Home User in the As-Is scenario that is depicted in Figure 7-17 as well as Figure 7-18 and the To-Be scenario that is depicted in Figure 7-20 indicates that Windows on Pentium satisfies more requirements of a Home User in comparison to Any OS on Pentium or Windows on Any Chipset. It shows that Windows on Pentium satisfies the *softgoals* Peace of mind and Choose market leader for the Home User.

The joint *value constellation* of Wintel, wherein the Home User gets the Microsoft OS and the Intel chipset together (i.e., Windows on Pentium) is shown in Figure 7-21. In this case the WP of a Home User for Windows and Pentium together (i.e., To-Be scenario) is greater than the sums of their WP for Windows and Pentium separately (i.e., As-Is scenario).

Windows and Pentium are complements so a Home User is willing to pay more for an offer that combines their value propositions than one that keeps them apart. Both Windows and Pentium are more beneficial to a Home User and offer greater utility to that Home User when they are together than when they are separate. As discussed above, this can be understood by comparing the As-Is scenario (i.e., Figure 7-17 and Figure 7-18) with the To-Be scenario (i.e., Figure 7-20).

This difference between a Home User's WP for Windows as well as Pentium jointly and the sum of a Home User's WP for Windows as well as Pentium separately can be regarded as surplus from synergy. This is additional value that is present within a joint *value constellation* of Microsoft and Intel but is absent from the individual value constellations of these vendors.

Calculating the amount of value that is acquired by Microsoft and Intel in their separate *value constellations* is relatively straightforward in Figure 7-19. This is because the upper bound of value that Microsoft and Intel can appropriate individually is constrained by a Home User's WP for their respective products alone (i.e., Windows, Pentium).

We stated above that if 1 unit of WP equates to the satisfaction of each top-level *softgoal* then, in the As-Is scenario, the total upper bound on WP for any OS provider and any chipset vendor is 1. However, because rivals can satisfy the same *softgoals* of a Home User as any OS provider and any chipset vendor then the actual total upper bound WP of a Home User for any OS and for any chipset is likely to be lower than 1.

This is due to the bargaining power and negotiating leverage of the Home User. Therefore, the sum of the upper bounds of WP of a Home User for Windows (or any other OS) and Pentium (or any other chipset), in the As-Is scenario, is likely to be less than 1.

By contrast, in the To-Be scenario, Microsoft and Intel collaborate to create Wintel for serving the Home User with a combined value proposition that no rival can match. Therefore, in the To-Be scenario, the sum of the upper bounds of WP of a Home User for Windows on Pentium is 2.

The absence of substitutors in the To-Be scenario means that the bargaining power and negotiating leverage of the Home User are reduced in comparison to the As-Is scenario. Therefore, the Home User is unlikely to be able to lower the upper bound of the WP for Windows on Pentium from Wintel below 2. This difference between the total upper bound of the WP of the Home User in the As-Is scenario and the To-Be scenario can be regarded as surplus from synergy.

Both Microsoft and Intel can stake their claims on this surplus from synergy that is generated by their partnership in Wintel. While neither Microsoft nor Intel will voluntarily accept an amount that is lower in value than their OC for Windows and Pentium respectively – this presence of surplus, in the To-Be scenario, creates the possibility for them to appropriate an amount that is greater in value than a Home User's separate WP for Windows and Pentium in the As-Is scenario.

Added value is relevant for determining the upper bound on the amount of value that Microsoft and Intel can appropriate from for themselves from the Wintel constellation. The reason that this is the case is because if an *actor* appropriates an amount of value greater than this limit then the amount of value remaining for the other *actors* to appropriate becomes lower than their OCs. In such a case those other *actors* would be worse off by participating in such an economic relationship and they would be better off by abstaining from it (Brandenburger & Stuart, 1996). This logic describes the paradox of joint value creation and individual value appropriation within coopetition wherein firms are "cooperating to create a bigger business 'pie,' while competing to divide it up" (Brandenburger & Nalebuff, 1996). Hence, being able to analyze complementarity is a crucial requirement for managing coopetitive relationships.

Added value is calculated by subtracting economic value of the relationship without the focal *actor* from economic value of the relationship with all *actors* (Brandenburger & Stuart, 1996). The formulae for calculating added value is denoted in Figure 7-21 above the arrows representing *value transactions* from the *composite actor*, Wintel, to its constituent *actors*, Microsoft and Intel. These formulae above the inbound *value transaction* for Microsoft/Intel indicate the upper bound on value that Microsoft/Intel can appropriate for itself from Wintel. Thus, added value is a Home User's WP for Windows and Pentium (i.e., value of the economic relationship with all *actors* involved) less that Home User's WP for Pentium/Windows (i.e., value of the economic relationship without the focal *actor*). These formulae also specify the lower bound on the amount of value that Microsoft/Intel will voluntarily accept as their OCs for Windows/Pentium respectively.

7.5.4 Summary of Illustrative Example

In this illustration, we depicted complementarity in the Wintel case using a combination of *i** and e3value. We demonstrated the joint application of these modeling languages to express and evaluate *value added* of an activity in a value chain as well as the *added value* of an *actor* in a value constellation. The first step involved the development of *actor* and *goal* models using *i** to explain the strategic rationales and strategic dependencies between software businesses and focal stakeholders. The second step involved comparing these models to identify the relative impact of each alternative on the satisfaction of requirements of *actors*. The third step involved the development of e3value models of separate and joint value constellations of software businesses to measure the magnitude of complementarity between them.

7.6 Summary

In this chapter, we developed and used the second advanced facet, consisting of *i** and e3value modeling, for finding and generating win-win strategies. As this modeling-supported reasoning shows, *i** is useful for understanding the sources of complementarity while e3value is useful for determining the extent of complementarity. *i** and e3value explain different aspects of strategic complementarity between actors and together they can represent more facets of synergistic value creation than either of them can depict alone.

Gordijn, Yu, & van der Raadt, (2006) note that, "*i** goal models complement the e3value models by revealing the strategic reasoning (*i**) behind the value exchanges (e3value)". Due to such compatibility, *i** and e3value have been used jointly to depict strategic relationships between actors in the scholarly literature (e.g., Gordijn, Yu, & van der Raadt, 2006, and Ouyang & Zhao, 2014). This is also consistent with the recommendation from Bleistein et al. (2004) that, "depending on the needs, several languages can also be used together in a complementary way". The next chapter presents the third advanced facet in our modeling framework. It focuses on modeling of sequential moves which is relevant for understanding reciprocity in a multi-party economic relationship.

8. Advanced Facet 3: Sequential Moves - Addressing Reciprocity Requirements

In the third advanced facet of our modeling framework, we analyze reciprocity among *actors* using *i** and Game Tree in combination. Recall that this facet for modeling sequential moves is necessary for analyzing reciprocity, which is a key aspect of coopetition. Reciprocity serves as a signal that the actions of an actor will very likely be met by similar actions by actors that are impacted by those actions. Reciprocity entails "rewarding kindness with kindness and punishing unkindness with unkindness" (Ashraf et al., 2006) and strategic actors should "expect this behavior from others" (Sobel, 2005).

A combined metamodel of *i** and Game Tree that is useful for modeling reciprocity is presented in Figure 8-6. This combined metamodel includes the *i** metamodel[29] in Figure 6-3 and adds entities and relationships from Game Tree. A standard Game Tree metamodel does not exist and thus we introduce a metamodel depicting the ontology of Game Tree in Figure 8-6. This metamodel is based on concepts explained by Dixit & Nalebuff (2008). We combine *i** and Game Tree to meet these requirements from Section 3.2: R1 (Task), R2 (Sequence), and R3 (Outcome).

In this chapter, we explain each component of the third advanced facet of our conceptual modeling framework for analyzing and designing strategic coopetition: (8.1) a metamodel that combines extended *i** with Game Tree to cover relevant concepts and semantics, (8.2) visual notation for utilizing this combined metamodel, (8.3) process description detailing construction steps and guidelines for developing and evaluating models based on this combined metamodel, (8.4) analysis techniques including approaches for evaluating models based on this combined metamodel, (8.5) illustrative representation of a real-world scenario to demonstrate expressiveness and analytical power of models based on this combined metamodel.

As in the preceding chapters, we start by motivating and illustrating this facet with a simplified example - cake sharing between two siblings. We continue the Cake Sharing example that was first presented in Chapter 5 to demonstrate the joint application of extended *i** with Game Tree for generating a win-win strategy between two *actors*. This is a simplified example because it does not contain all the features in this facet. In Game Theory terms, the example from Chapter 5 can be referred to as a *game*. A *game* involves any strategic situation in which two or more *players* are involved and where the *moves* of one *player* impact other *players*. In the example in Section 5, CC and SS are *i** *actors* and we can treat each *i** *actor* as a Game Tree *player* because a *player* is an active participant in a *game*.

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[29] We include the extended *i** metamodel from chapter 6 (section 6.1).

For ease of reading, Figure 5-1 and Figure 5-2 (from Chapter 5) are reproduced here as Figure 8-1 and Figure 8-2 respectively. *i** models that portray two possible As-Is scenarios between CC and SS are presented in Figure 8-1 and Figure 8-2. To recall, in Scenario 1 (Figure 8-1), SS chooses the large slice for itself and offers the small slice to CC while in Scenario 2 (Figure 8-2) SS chooses the small slice for itself and offers the large slice to CC. As explained in Section 5, using only *i** models, neither Scenario 1 nor Scenario 2 represents a win-win strategy because in Scenario 1 SS wins and CC loses while in Scenario 2 CC wins and SS loses.

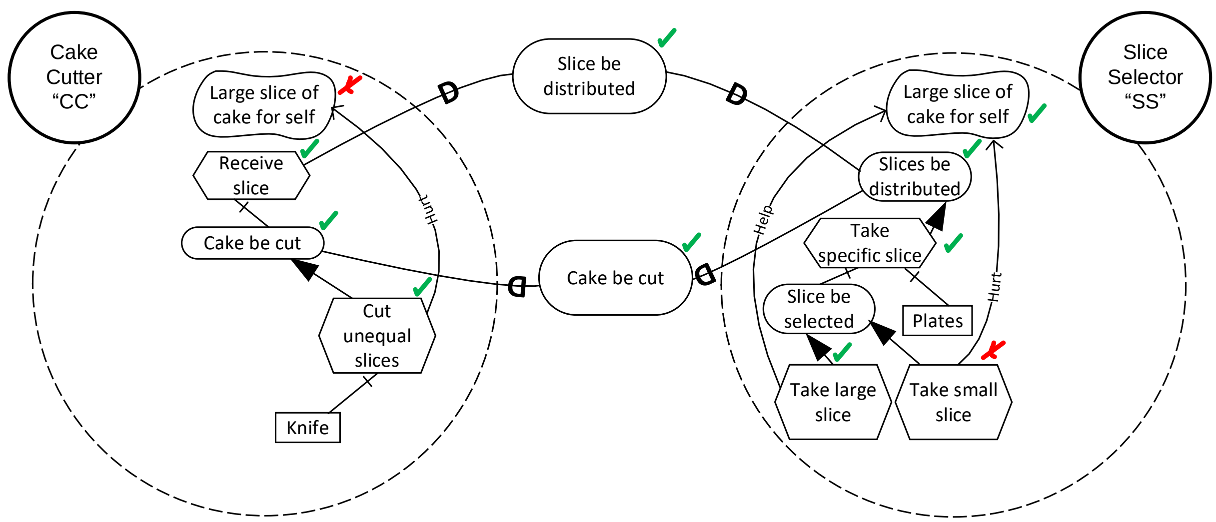

Figure 8-1 *i** model depicting As-Is relationship among "CC" and "SS" (Scenario 1).

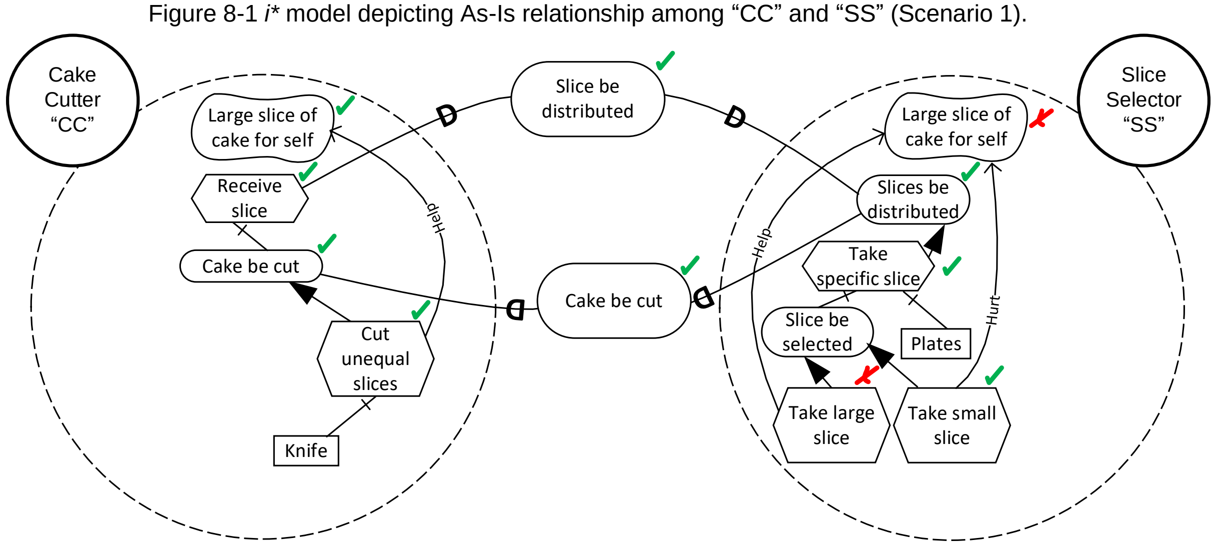

Figure 8-2 *i** model depicting As-Is relationship among "CC" and "SS" (Scenario 2).

In this advanced facet, we complement *i** modeling with Game Tree modeling to show the gain or loss associated with Scenario 1 and Scenario 2 for each *actor* or *player*. Adopting the concepts and terminology of Game Theory, a Game Tree representing sequential *moves* by CC and SS as well as the *payoffs* associated with each *decision path* is depicted in Figure 8-3. A *decision* entails the selection of a specific *move* from possible *moves* that are available in a particular state. CC has only one option which is represented by the *task* Cut unequal slices in Figure 8-1 and Figure 8-2. This is depicted as the only *option* that is possible and CC, as the first-mover, *moves* to Cut unequal slices in Figure 8-3. A *move* involves the selection of an *option* in a *decision* and carrying it out. SS has two *options* which are represented by the *tasks* Take large slice and Take small slice in Figure 8-1 and Figure 8-2. This is depicted as a *decision* involving two possible *options* (Take large slice (Scenario 1) and Take small slice (Scenario 2)) in Figure 8-3. Each *decision* path (i.e., course of action) depicts a unique sequence of *moves* undertaken by the players in a *game*.

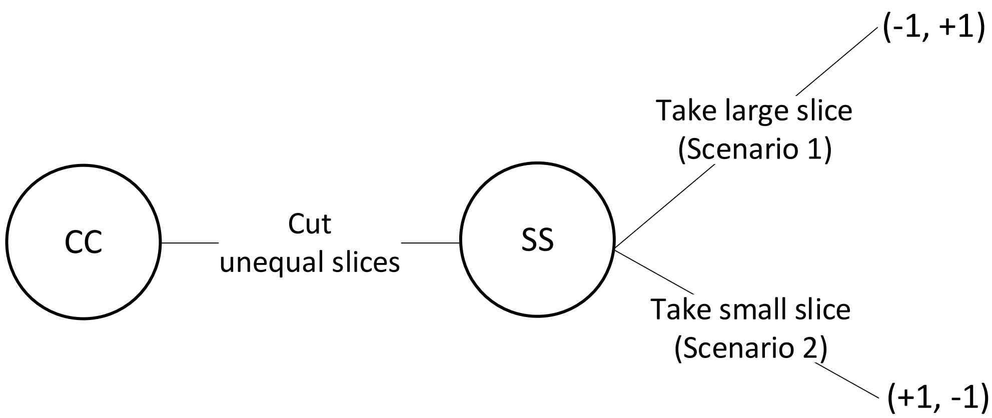

Figure 8-3 Game Tree depicting As-Is decision paths with resulting payoffs for “CC” and “SS”

This *game* has two *decision paths* as CC has one *option* and SS has two *options*. Associated with each *decision path*, which represents a unique sequence of *moves* by *players* from root to leaf node, is a *payoff* for each *player* in that *decision path*. A *payoff* is the reward or penalty associated with a specific course of action for a *player*. The sequence of interactions between CC and SS is shown in Figure 8-3. CC moves first since it is necessary for the cake to be cut before cake slices can be distributed by SS. CC has only one *option* available to it in the As-Is configuration so CC moves to Cut unequal slices. SS makes the next *move* by deciding whether to Take large slice or Take small slice of the cake. SS can exercise the *option* Take large slice (i.e., opportunistic) or the *option* Take small slice (i.e., altruistic).

In Section 4.8, we noted that reasoning about actor intentionality as well as analysis of sequential moves are essential requirements for understanding complementarity. Recall from Section 3.3.2 that none of the conceptual modeling languages meet these requirements individually but they can be combined to meet these requirements collectively. We use *i** and Game Tree jointly because *i** supports the analysis of *actor* intentionality but does not support analysis of sequential moves while Game Tree supports analysis of sequential moves but does not support the analysis of *actor* intentionality.

To complement game-theoretic modeling, we can refer to *i* goal* satisfaction analysis in *i** (Figure 8-1 and Figure 8-2) to calculate the *payoffs* for each player in Game Tree (Figure 8-3). Let us suppose that if SS decides to keep the larger slice of cake for itself then it earns a *payoff* of +1 while CC earns a *payoff* of -1. This is because, in this situation, SS is able to satisfy its *softgoal* while CC is unable to fulfil its *softgoal*. Conversely, if SS decides to keep the smaller slice of cake for itself then it earns a *payoff* of -1 while CC earns a *payoff* of +1. This is because, in this situation, SS is unable to satisfy its *softgoal* while CC is able to fulfil its *softgoal*.

An analysis of Game Tree in Figure 8-3 indicates that the As-Is relationship between CC and SS only comprises win-lose outcomes. This is because in one outcome CC (+1) is better off but SS (-1) is worse off while in the other outcome SS (+1) is better off but CC (-1) is worse off. This aspect of the As-Is relationship between CC and SS motivates the need for generating a strategy leading to a win-win outcome. CC evaluates *payoffs* in Figure 8-3 to recognize that it is disadvantaged in the As-Is configuration because it has only one *option* (Cut unequal slices) while SS has two options (Take large slice, Take small slice) of which one is advantageous (Take large slice) while the other is disadvantageous (Take small slice) for SS. Therefore, SS is expected to choose the *option* Take large slice to earn a *payoff* of +1 instead of the *option* Take small slice to earn a *payoff* of -1. If SS will always Take large slice of that cake for itself then CC will always earn a *payoff* of -1.

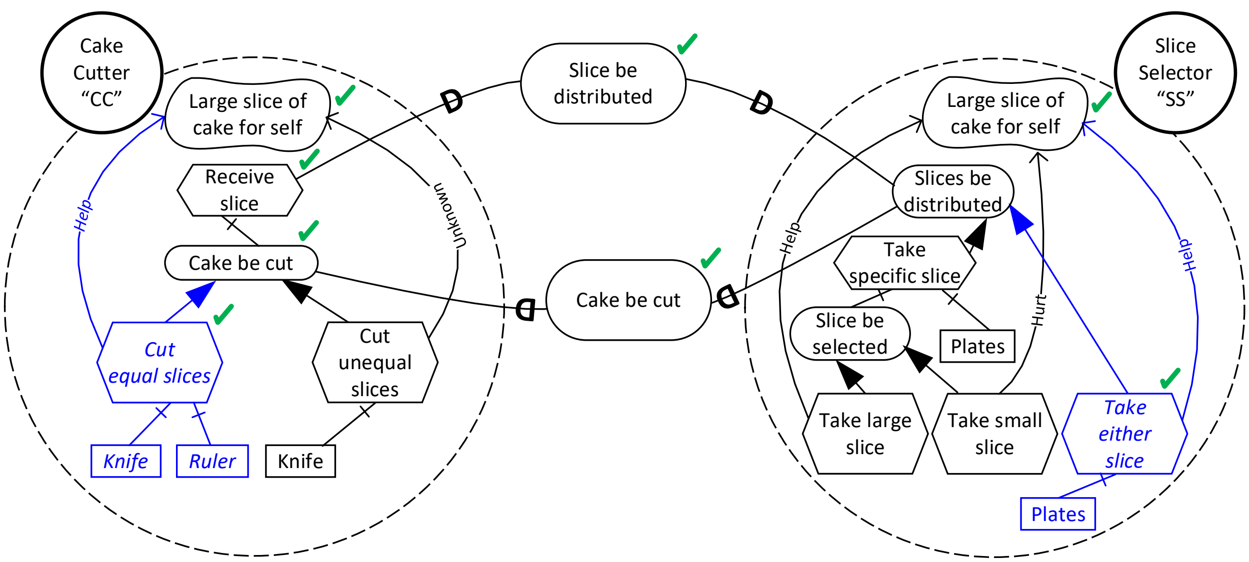

Figure 8-4 *i** model depicting a To-Be relationship among "CC" and "SS"

For ease of reading, Figure 5-3 is reproduced here as Figure 8-4 with new elements added. Model elements with black color represent existing model elements from Figure 8-1 and Figure 8-2 while model elements with blue color represent new model elements in Figure 8-4. To create a win-win strategy CC explores a new alternative that can help it to achieve its sole *softgoal* (Large slice of cake for self). However, this alternative must also help SS to satisfy its only *softgoal* (Large slice of cake for self). This new strategy (To-Be) can only exist if CC cuts the cake into equal slices because with unequal slices only one of the *actors* (CC or SS) will get the large slice of that cake. If CC cuts the cake into equal slices then both slices will be equal. This new alternative for CC will also change the alternatives available to SS. This is because by cutting the cake into equal slices CC will require SS to generate a new alternative so it can Take either slice.

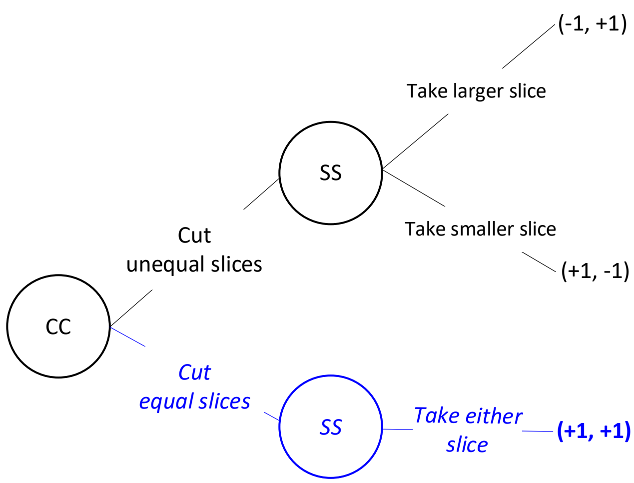

Figure 8-5 Game Tree depicting To-Be decision paths with resulting payoffs for “CC” and “SS”.

A Game Tree that includes new *options* for CC (Cut equal slices) and SS (Take either slice) as well as their resulting *payoffs* is depicted in Figure 8-5. This results in a new *decision path* in which CC, as first-mover, chooses Cut equal slices and then SS, as the second-mover, chooses the only available option Take either slice. We can refer to *i* goal* satisfaction analysis in Figure 8-4 to calculate the payoffs for each player in this *game* (Figure 8-5). An analysis of Game Tree in Figure 8-5 indicates that the To-Be relationship between CC and SS comprises a *decision path* leading to a win-win outcomes. If CC *moves* to Cut equal slices then both CC and SS earn a payoff of +1 because in the To-Be configuration, both CC and SS satisfy their *softgoals* in the *i** model (Figure 8-4). By generating this new *decision path*, via the *i** model of Figure 8-4, this Game Tree (Figure 8-5) shows that CC eliminates the possibility for SS to act either opportunistically or altruistically. This new alternative represents a win-win strategy for CC and SS.

This simplified example illustrates how *i** modeling and Game Tree complement each other. The Game Tree maps out the space of alternate decision paths leading to different payoffs, while the *i** model details the contributing factors towards the payoffs.

8.1 Modeling Ontology

In the third advanced facet our modeling framework, we use two modeling languages, *i** and Game Tree, in combination to analyze reciprocity between *actors*. A combined metamodel of *i** (Yu, 2011) and Game Tree (based on Dixit & Nalebuff, 2008), for modeling reciprocity, is presented in Figure 8-6. We connect the ontologies of Game Tree and *i** by linking: (i) Game Tree *players* to *i* actors*, (ii) Game Tree *options* to *i* tasks*, and (iii) Game Tree *payoffs* to *i* goals*, *softgoals*, and *beliefs*. Game Tree *players* are mapped to *i* actors* with a 1:1 cardinality and Game Tree *options* are mapped to *i* tasks* with a 1:1 cardinality. 1:1 cardinality ensures that mapping between instances of entities in corresponding *i** and Game Tree models is straightforward and unambiguous. However, this one-to-one mapping does not require each element in an *i** model to be represented in its corresponding Game Tree model and vice versa. The only elements that appear in corresponding *i** and Game Tree models are those which are necessary for analyzing reciprocity.

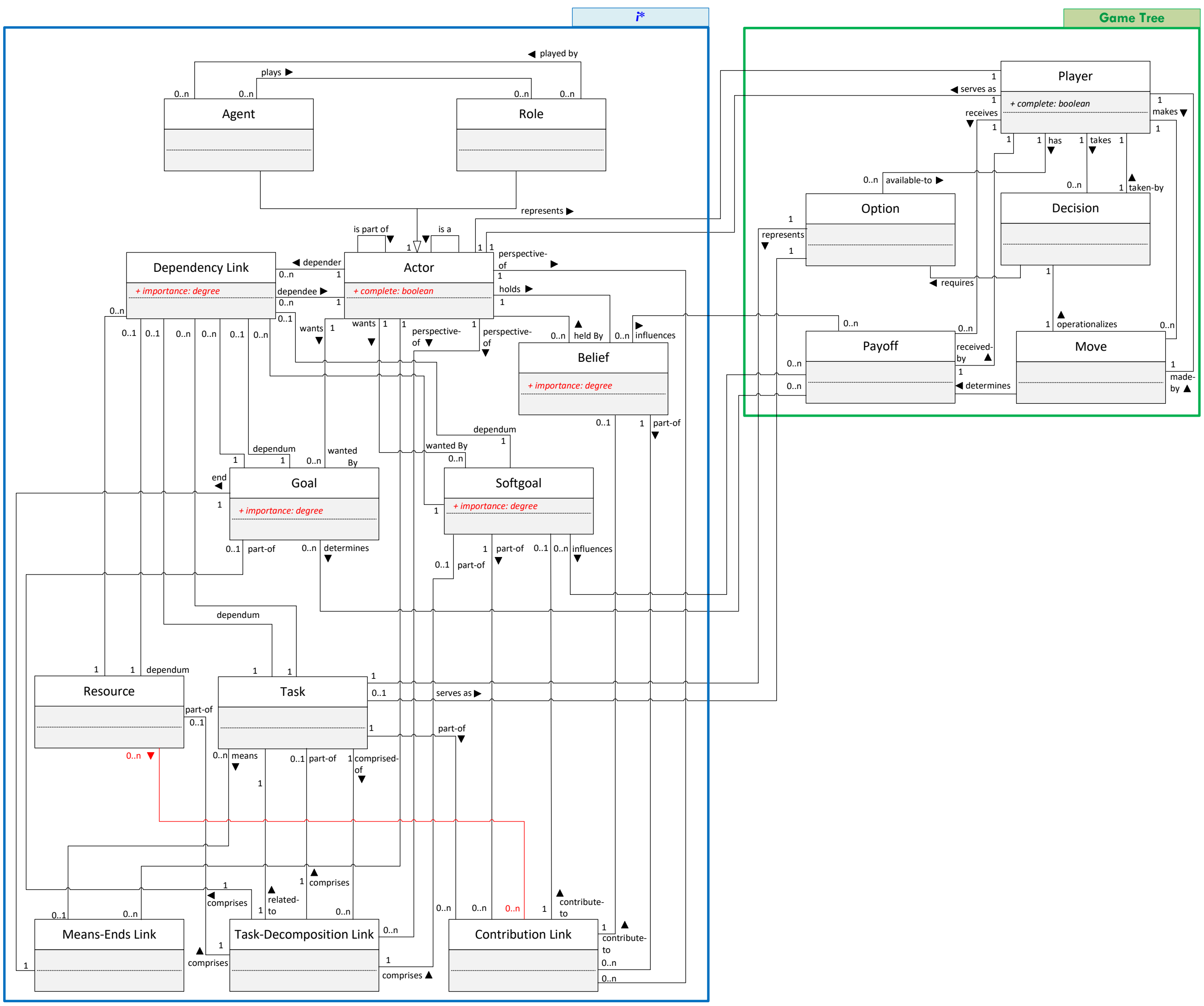

Figure 8-6 Metamodel combining *i** and Game Tree (based on Yu (2011) and Dixit & Nalebuff (2008))

Game Tree *payoffs* are mapped to *i* goal*s, *softgoals*, and *beliefs* with an n:n cardinality. Game Tree *payoffs* are computed by analyzing *goal* and *softgoal* satisfaction in *i** as well as by assessing *beliefs* in *i**. This allows the full impact of relevant *i** elements to be reflected in Game Tree *payoffs*. Section 8.4.1 presents a technique for calculating *payoffs* for every *decision path* and Section 8.4.2 presents a technique for evaluating *payoffs* for each *decision path* in the Game Tree. We acknowledge that other researchers may connect the ontologies of *i** and Game Tree in other ways.

8.2 Visual Notation

Ziegler (2004) notes that "a Game Tree is a graphical representation of the players' possible choices (also called their action sets) at each point in time, the sequence in which these choices are made, and the payoffs resulting from any combination of choices." It supports the depiction of *decisions*, their sequence, as well as the *payoffs* associated with each decision path from root to leaf nodes. Game Tree includes visual notation and Figure 8-7 presents notations and symbols corresponding with Game Tree elements that are described in Section 8.1 (based on Dixit & Nalebuff, 2008). Details about these notation and syntax rules of Game Tree can be found in Dixit & Nalebuff (2008). *i** and Game Tree models are visually depicted in separate diagrams. *i* actors* and Game Tree *players* with the same names are treated as corresponding entities. Similarly, *i* tasks* and Game Tree *options* with identical names are treated as corresponding entities.

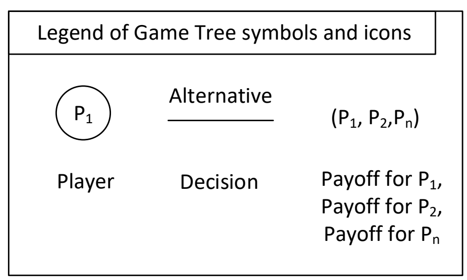

Figure 8-7 Symbols and icons in Game Tree (based on Dixit & Nalebuff (2008))

We also extend the *i** notation slightly to depict multiple *options* as well as *moves* and countermoves in the same *i** model. Each *option* is designated a number which is enclosed within angle brackets (e.g., <1>). Countermoves corresponding to this *option* are denoted as <1.x> where x denotes a possible response to <1>. Therefore, <1.1> and <1.2> represent two possible responses to <1>. Countermoves in response to <1.1> and <1.2> are depicted as <1.1.x> or <1.2.x>. This allows a sequence of *moves* and countermoves of any length to be represented in the *i** model. An *n*-tuple of *payoffs* is depicted at the terminal node of each *decision* path where *n* refers to the players that make *moves* or *countermoves* in that *decision* path. The sequence of payoffs listed in this *n*-tuple follow the sequence of *players* that makes *moves* and *countermoves*. No other visual links are used to show correspondence between *i** and Game Tree.

8.3 Method

We extend the method, for identifying and developing win-win strategies that is introduced in Section 5.4 by adding support for modeling of reciprocity. It comprises three phases: Modeling, Evaluation, and Exploration (Figure 8-3). In the Modeling phase, an *i** model as well as its corresponding Game Tree model are instantiated and populated. In the Evaluation phase, the presence of any extant win-win strategies are detected, with reference to *i** *goal* and *softgoal* satisfaction as well as *payoff* assessment in Game Tree, by calculating the impacts of various choices on objectives. In the Exploration phase, new alternatives are found by generating relational configurations that yield positive-sum outcomes. This process can be repeated to generate as many win-win strategies as necessary.

Modeling phase: In this phase, the modeler develops an *i** model as well as its corresponding Game Tree that covers the concepts needed to perform analysis of positive-sum outcomes and win-win strategies in coopetitive relationships. In this phase, intentional aspects of *actors* are modeled using *i** in terms of *beliefs*, *goals*, *tasks*, *resources*, *softgoals*, and strategic relationships among *actors* are modeled as *dependencies* among them. Additionally, sequence-related aspects of their relationship are modeled using Game Tree in terms of *players*, *decisions*, *options*, *moves*, *value interfaces*, and *payoffs*. This phase consists of eleven steps and yields an *i** model as well as its corresponding Game Tree:

M1. Identify focal *actors* that are: concrete as *agents*, and, abstract as *roles*.

M2. Identify additional *actors*, *agents*, and *roles*. *Agents* and *roles* should be modeled when it is important to separate and separately analyze behaviors (i.e., *roles*) from the entities that carry out those behaviors (i.e., *agents*). If this differentiation does not improve the analysis then undifferentiated *actors* can be used.

M3. Identify *beliefs* for each *actors*, *agents*, and *roles* (with ‘Importance’).

M4. Identify *goals* for each *actors*, *agents*, and *roles* (with ‘Importance’).

M5. Identify *softgoals* for each *actors*, *agents*, and *roles* (with ‘Importance’).

M6. Identify alternative *tasks* for achieving each *goal*. Depict the subsidiary parts of a *task*. Differentiate between strategic *resources* and generic *resources* to model only those *resources* that are strategic[30]. Depict the *resources*, typically information assets, that underlie *beliefs*. Portray impact of *tasks* on *softgoals*.

M7. Identify *contribution links* from *softgoals* to *softgoals*, *beliefs* to *beliefs*, *tasks* to *softgoals*, and *resources* to *beliefs*.

[30] The rationale for making this distinction and identifying strategic *resources* is explained in Appendix 1.

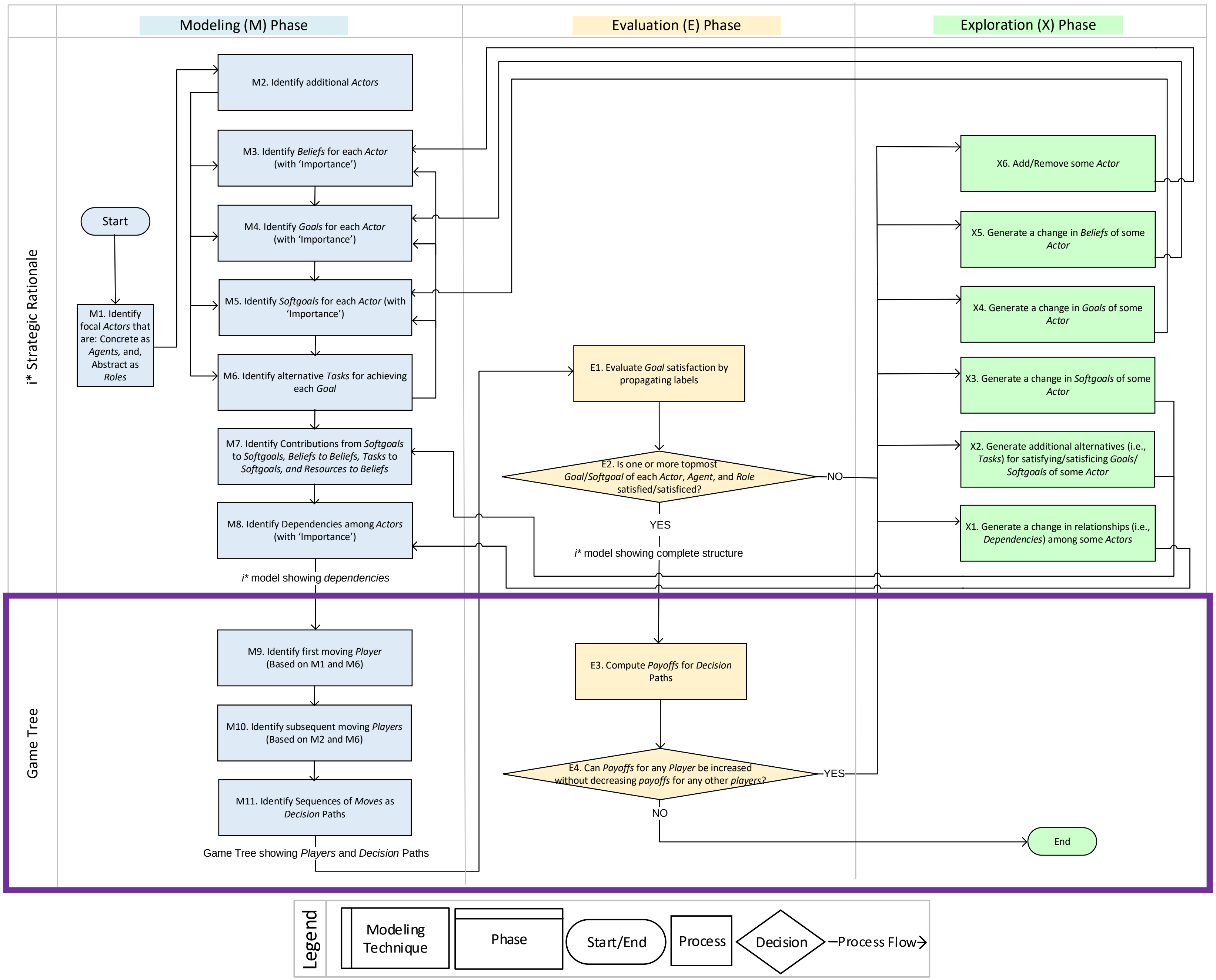

Figure 8-8 Process steps for using *i** modeling with Game Tree to get to win-win (new steps that are added to Section 5.4 are enclosed in purple box)

M8. Identify dependencies among *actors*, *agents*, and *roles* (with ‘Importance’).

The conclusion of M8 yields an *i** model showing *dependencies* and this *i** model is used to develop a corresponding Game Tree.

M9. Identify first-moving *player* based on M1 and M6.

M10. Identify subsequent moving *players* based on M2 and M6.

M11. Identify sequences of *moves* as *decision* paths.

The conclusion of M11 yields a Game Tree corresponding to the *i** model that was obtained after M8. After completing this phase, the modeler should proceed to the Evaluation Phase.

Evaluation phase: This phase consists of four sequential steps and results in the analysis of the *i** model and its corresponding Game Tree that are developed in the modeling phase:

E1. Evaluate *goal* satisfaction by propagating labels. Trace the impact of lower-level *tasks* and *softgoals* on higher-level *softgoals*, as well as, lower-level *tasks* on higher-level *goals*. As depicted in Section 5.5.2, *softgoals* and *goals* can either be: fully satisfied (denoted by a checkmark), partially satisfied (denoted by a dot underneath a checkmark), fully denied (denoted by a cross), or partially denied (denoted by a dot underneath a cross). In case the status of a *softgoal* or *goal* cannot be resolved then it can be marked as unknown (denoted by a dot above a question mark).

E2. Assess whether one or more topmost *goal*/*softgoal* of each *actor*, *agent*, and *role* are satisfied? Use the technique outlined by Horkoff & Yu (2009, 2011, 2013), that is summarized in Section 5.5.1, to evaluate the satisfaction or denial of top-level *softgoals* and *goals* for each *actor*, *agent*, and *role*. If topmost *goal*/*softgoal* of any *actor*, *agent*, or *role* is unfulfilled then it means that a win-win strategy does not exist in this coopetitive relationship. In this case, the modeler should proceed to the Exploration Phase. If the top-level *softgoals* and *goals* of each *actor, agent,* and *role* are satisfied then the modeler should continue to E3.

E3. Compute the *payoffs* for each *decision* path. A technique for calculating the *payoffs* for a *decision* path is described in Section 8.4.1.

E4. Assess whether *payoffs* for any *player* be increased without decreasing *payoffs* for any other *players*? A technique for evaluating the *payoffs* for a *decision* path is described in Section 8.4.2.

It can be concluded that a win-win strategy exists in this coopetitive relationship if the results of E2 of is positive and E4 is negative. However, if E2 is negative or E4 is negative then it means that a win-win strategy does not exist in this relationship. In this case, the modeler should proceed to the Exploration Phase.

Exploration phase: In the Exploration phase, a modeler can investigate any of six lines of action incrementally and iteratively in the pursuit of a win-win strategy. If a win-win strategy cannot be found initially then this method can be repeated to generate a strategy that results in win-win. A modeler can:

X1. Generate a change in relationships (i.e., *dependencies*) among some *actors*, *agents*, or *roles*.

X2. Generate additional alternatives (i.e., *tasks*) for satisfying *goals* and *softgoals* of some *actor*, *agent*, or *role*.

X3. Generate a change in *softgoals* of some *actor*, *agent*, or *role*.

X4. Generate a change in *goals* of some *actor*, *agent*, or *role*.

X5. Generate a change in *beliefs* of some *actor*, *agent*, or *role*. This will only happen if that *actor*, *agent*, or *role* thinks that the state of affairs in the world has changed or that its original *beliefs* were incorrect.

X6. Add/Remove some *actor*, *agent*, or *role*.

Each step in this phase effects a change in the *i** model that was developed in the Modeling phase and analyzed in the Evaluation phase. Any changes to the *i** model may result in changes to the Game Tree. Therefore, completing any step in this phase leads the modeler to a corresponding step in the Modeling phase. This starts a new iteration of this method leading to the performance of steps in the Modeling phase as well as the steps in the Evaluation phase and, if needed, additional steps of the Exploration phase.

8.4 Analysis Techniques

Combined analysis of an Game Tree and its corresponding *i** model involves two sequential steps: (8.4.1) calculation of *payoffs* for every *decision* path in Game Tree based on relevant intentional elements in the *i** model, and (8.4.2) identification of *decision* paths in Game Tree that result in positive-sum outcome. We acknowledge that there can be other techniques, as well as variants of this technique, that can be used to calculate *payoffs* for each *actor* in every *decision* path.

8.4.1 Calculating *Payoffs* for every *Decision* Path

In Game Tree, a *payoff* is calculated for each *player* that makes a *move* or countermove in a *decision* path. We present a formula for calculating *payoff* for each *player* that makes a *move* or countermove in a *decision* path. This formula can automate calculation as each *payoff* is evaluated with reference to two components that can be obtained programmatically from an *i** model. The *payoff* for any *player* is based on the assessment of these intentional elements of the corresponding *actor* within the accompanying *i** model:

(i) satisfaction or denial of *goals* and *softgoals* for that *actor*

(ii) confirmation or contradiction of *beliefs* that are held by that *actor*

$$\sum_{i=1}^{count(sac())} \left(imp(sac(i))\right) - \sum_{j=1}^{count(dec())} \left(imp(dec(j))\right)$$

#	Compact notation	Extended notation	Meaning
1	i	i	Iterator for all satisfied *softgoals* and *goals* as well as confirmed *beliefs* in a particular *actor*
2	count(sac())	count(satisfied_confirmed())	Count of all satisfied *softgoals* and *goals* as well as confirmed *beliefs* for that *actor*
3	imp(sac(i))	importance(satisfied_confirmed(i))	Importance degree of a specific *softgoal*, *goal*, or *belief* (from 2)
4	j	j	Iterator for all denied *softgoals* and *goals* as well as contradicted *beliefs* in a particular *actor*
5	count(dec())	count(denied_contradicted())	Count of all denied *softgoals* and *goals* as well as contradicted *beliefs* for that *actor*
6	imp(dec(j))	importance(denied_contradicted(j))	Importance degree of a specific *softgoal*, *goal*, or *belief* (from 5)

Table 8-1 Components of formula for calculating *payoff* for a *player* associated with a specific *decision* path

An example showing the calculation of *payoffs* for two *players* using the application of this formula is presented in Figure 8-9. $Actor_1$ is the first mover and can select $Task_{1a}$ or $Task_{1b}$ as its first move. $Task_{1a}$ has a help contribution to $Softgoal_{1a}$ and a hurt contribution to $Softgoal_{1b}$ while $Task_{1b}$ has a help contribution to $Softgoal_{1b}$ and a hurt contribution to $Softgoal_{1a}$. For $Actor_1$, $Softgoal_{1a}$ has an *importance* degree of 2 while $Softgoal_{1b}$ has an *importance* degree of 1. $Actor_2$ is the second mover and can select: (1) $Task_{2a}$ or $Task_{2b}$ as its countermove if $Actor_1$ selects $Task_{1a}$ as its first move; or (2) $Task_{2c}$ or $Task_{2d}$ as its countermove if $Actor_1$ selects $Task_{1b}$ as its first move. For $Actor_2$, $Softgoal_{2a}$ and $Softgoal_{2c}$ have *importance* degree of 2 while $Softgoal_{2b}$ and $Softgoal_{2d}$ have *importance* degree of 1. A Game Tree that corresponds with this *i** model is presented in Figure 8-10.

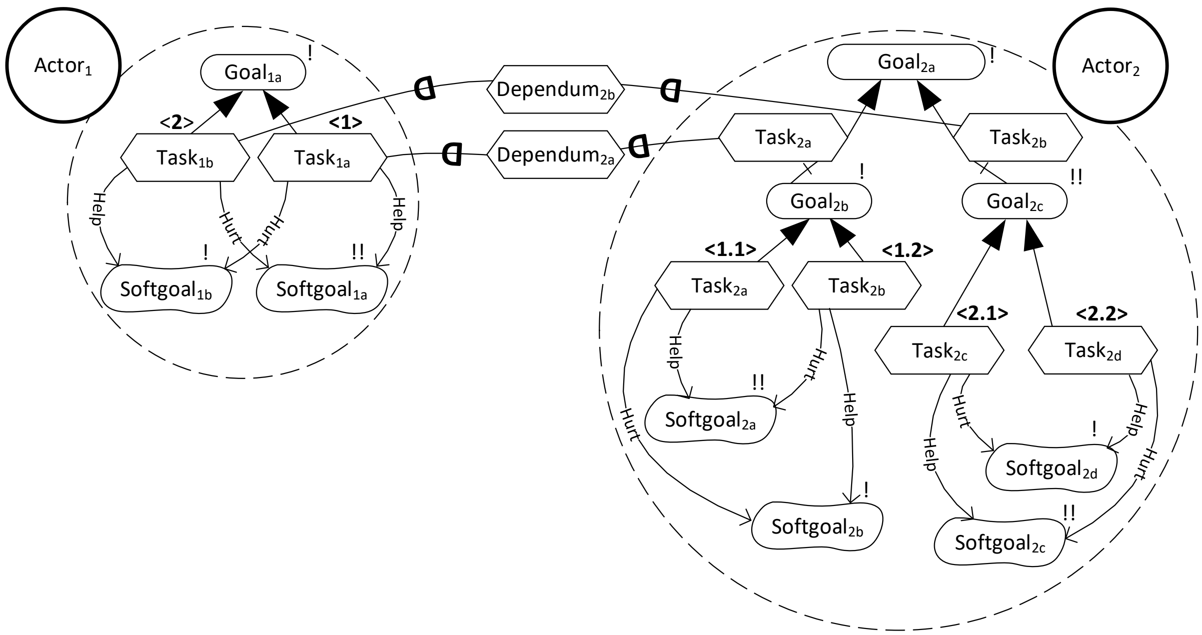

Figure 8-9 *i** model showing an *actor* with two possible moves and another *actor* with two possible countermoves

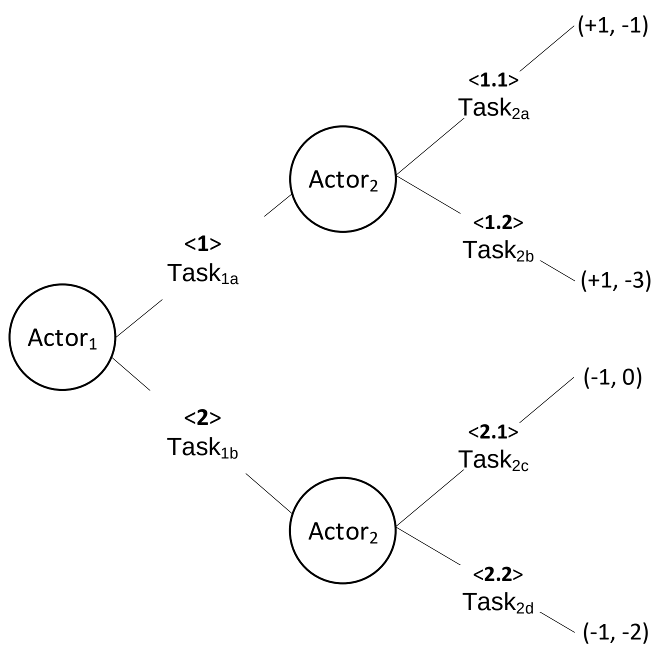

Figure 8-10 Game Tree showing first-moving player with two possible moves and second-moving player also with two possible countermoves

If Actor_1 selects Task_{1a} then Softgoal_{1a} with an importance of 2 is satisfied but Softgoal_{1b} with importance of 1 is denied. Conversely, if Actor_1 selects Task_{1b} then Softgoal_{1b} with an importance of 1 is satisfied but Softgoal_{1a} with importance of 2 is denied. By applying our formula for calculating payoffs we find that the payoff for Actor1 is positive 1 (i.e., 2-1) when it selects Task_{1a} as its first move and negative 1 (i.e., 1-2) when it selects $Task_{1b}$ as its first move. We ignore $Goal_{1a}$, with an *importance* of 1, from this calculation because $Task_{1a}$ and $Task_{1b}$ are alternate means to that same end.

Similarly, if $Actor_2$ selects $Task_{2a}$ then $Softgoal_{2a}$ with an importance of 2 is satisfied but $Softgoal_{2b}$ with importance of 1 is denied. However, if $Actor_2$ selects $Task_{2b}$ then $Softgoal_{2b}$ with an importance of 1 is satisfied but $Softgoal_{2a}$ with importance of 2 is denied. Likewise, if $Actor_2$ selects $Task_{2c}$ then $Softgoal_{2c}$ with an importance of 2 is satisfied but $Softgoal_{2d}$ with importance of 1 is denied. Conversely, if $Actor_2$ selects $Task_{2d}$ then $Softgoal_{2d}$ with an importance of 1 is satisfied but $Softgoal_{2c}$ with importance of 1 is denied.

We subtract 2 from payoffs that are calculated for $Task_{2a}$ and $Task_{2b}$ as well as 1 from the payoffs calculated for $Task_{2c}$ and $Task_{2d}$. This is because $Goal_{2b}$, with an importance of 1, is not satisfied when $Task_{2c}$ or $Task_{2d}$ are selected while $Goal_{2c}$, with an importance of 2, is not satisfied when $Task_{2a}$ or $Task_{2b}$ are selected. We ignore $Goal_{2a}$, with an *importance* of 1, from this calculation because $Task_{2a}$ as well as $Task_{2b}$ are alternate means to that same end and $Goal_{2a}$ is a sub-goal of $Task_{2a}$ while $Goal_{2b}$ is a sub-goal of $Task_{2b}$.

8.4.2 Evaluating *Payoffs* for each Decision Path in the Game Tree

Payoff for every actor that makes a move or countermove are depicted as an n-tuple adjacent to the terminal node corresponding with each *decision* path. This feature of Game Trees allows a modeler to "find the optimal strategy as a sequence of best possible moves of a given player taking into account possible moves of the other player up to a given depth" (Borovska & Lazarova, 2007).

The order of *payoffs* that are listed in each *payoff* tuple corresponds to the sequence of *players* in order of their *moves* and countermoves. The payoff for each player can be determined from a *payoff* tuple based on the position of that payoff in the tuple. *Payoffs* for a *player*, resulting from various *decision* paths can be compared, to identify the best (i.e., reward maximizing or penalty minimizing) course of action for that *player*.

Four *payoff* tuples are depicted in Figure 8-10 because there are two steps and two choices per step (i.e., 2+2). A comparison of these *payoff* tuples reveals that the maximum *payoff* available to: (1) $Actor_1$ corresponds with $Task_{1a}$ (i.e., is positive 1); and (2) $Actor_2$ corresponds with $Task_{2c}$ (i.e., is 0). However, $Task_{2c}$ is on a *decision* path that corresponds to a preceding *move* by $Actor_1$ (i.e., $Task_{1b}$) that corresponds to a payoff of negative 1. Since $Actor_1$ prefers $Task_{1a}$ then the countermoves available to $Actor_2$ are $Task_{2a}$and $Task_{2b}$ with *payoffs* of -1 and -3 respectively. Based on these *payoffs*, $Actor_2$ is likely to select $Task_{2a}$ because this results in a relatively higher payoff for $Actor_2$ than $Task_{2b}$.

8.5 Illustration of Modeling and Analysis of Coopetition with Sequence of Moves

8.5.1 Apple App Store and Adobe Flash Gallery Software Ecosystems

A widely studied case of strategic coopetition pertains to the relationship between the software ecosystems (SECOs) of Apple and Adobe (see Ghazawneh & Henfridsson, 2010, 2011, Eaton et al. 2015, Prince 2013, Elaluf-Calderwood et al. 2011). Apple and Adobe operated as partners because Adobe's Flash-based web-applications added value to Apple's web browser (Safari) on its desktop OS (macOS). Similarly, Adobe generated acceptance and adoption of its Flash technology from Apple's customer base that accessed Flash-based web-applications on their Apple computers. However, Apple and Adobe also behaved as rivals since they operated competing SECOs for mobile apps (i.e., Apple iOS app store and Adobe Flash Gallery).

Modeling Phase: Apple's 'walled garden' strategy and Adobe's participation is depicted in Figure 8-11. In the Modeling phase, we use *i** to show the internal intentional structures of Adobe and Apple. This model is based on details from (Ghazawneh & Henfridsson, 2010, 2011, Eaton et al. 2015, Prince 2013, Elaluf-Calderwood et al. 2011) and is adapted from Pant & Yu (2018a).

A condensed model of Apple's strategy is shown on the left side of Figure 8-11. Apple's *goal* was to drive the adoption of its proprietary OS (i.e., iOS) in the mobile device market (iOS be adopted in smart mobile device market). The success of iOS was tied to higher sales of iPhone, iPod, and iPad devices because Apple's iOS and its mobile devices were only compatible with each other (not shown*[31]).

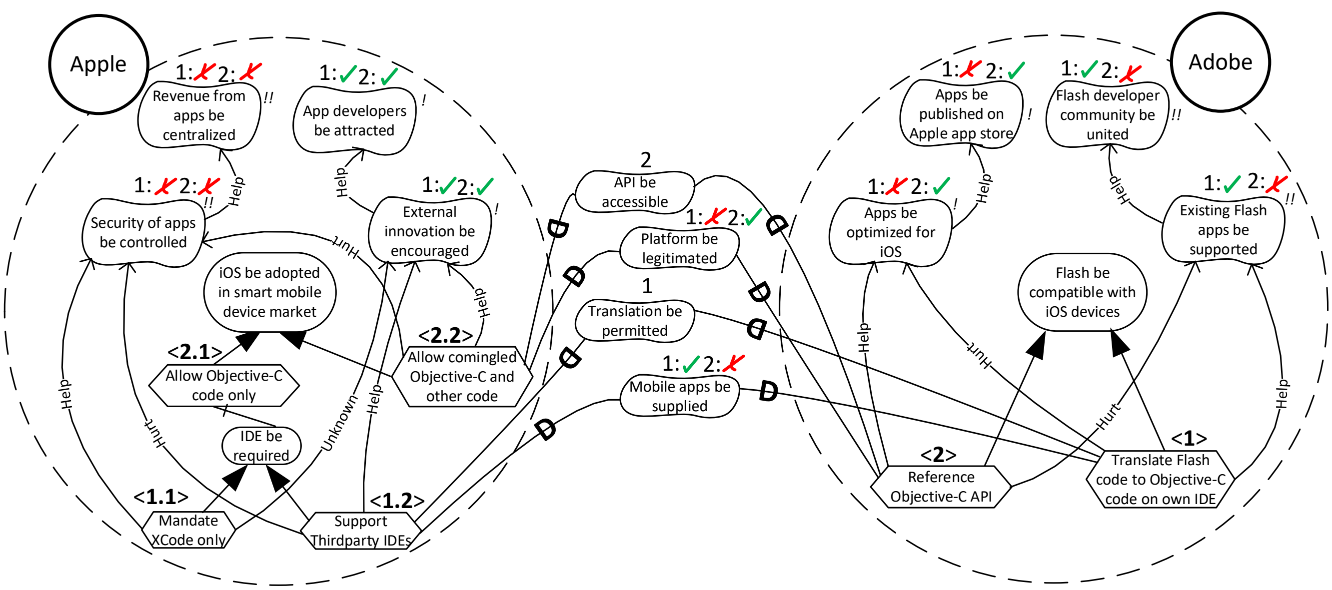

Figure 8-11 *i** model depicting As-Is actor relationships (Adapted from Pant & Yu (2018a)).

[31] In this instance, and in the remainder of this chapter, certain aspects of the relationship between *actors* are not shown to declutter visual presentation of the models. These details are provided in-text only to explain the context of the models.

Apple's SECO was a core component of its iOS proliferation strategy. A mobile OS requires a complementary catalog of third-party apps to boost its acceptance and adoption by users (*softgoal* External innovation be encouraged). Third-party apps bring new capabilities to a mobile OS and make that mobile OS more useful for its users. Hence, a relatively large catalog of apps ostensibly affords greater choice to the users of a SECO compared to a relatively small catalog.

Moreover, positive cross-side network effects synergistically correlate the user base and developer community on a SECO (Boudreau, 2012) such that growth in the numbers of apps (and their developers) on a SECO attracts more users to that SECO while growth in the number of users on a SECO incentivizes more developers to develop apps for that SECO (*softgoal* App developers be attracted).

Apple coupled its mobile hardware and software tightly so that it could exert maximal control on the security of apps that were used on iPhone, iPod, and iPad devices (*softgoal* Security of apps be controlled). App developers could generate revenues by charging users for downloading their apps in addition to building in-app purchases and value-added offers into their mobile apps (not shown*).

Apple protected its commissions from these income streams by forcing users to purchase apps from its iOS app store (i.e., prevent revenue flight) as well as requiring developers to use its IDE and programming language (i.e., prevent revenue obfuscation). This 'walled-garden' strategy helped Apple to safeguard its commissions (*softgoal* Revenue from apps be centralized).

Apple had two strategic options (*tasks* Allow Objective-C code only and Allow comingled Objective-C and other code). Objective-C is Apple's proprietary programming language that is supported by iOS. Each of these options impacted Apple's *softgoals* differently.

The option to Allow comingled Objective-C and other code (e.g., Adobe Flash code) afforded app developers the opportunity to hide forbidden or malicious functionality outside the purview of Apple security reviews (Hurts *softgoal* Security of apps be controlled).

The option to Allow Objective-C code only had two sub-options. Objective-C code could be developed using Apple XCode (*task* Mandate XCode only) or generated using a third-party IDE (*task* Support Third-party IDEs). XCode is Apple's native integrated development environment (IDE) for iOS.

Third-party IDEs afforded app developers the opportunity to bypass security policies implemented by Apple in its XCode IDE (Hurts *softgoal* security of apps be controlled).

The Mandate XCode only option could have positive or negative impact (Unknown) on the *softgoal* External innovation be encouraged. The outcome of this option depended upon the perceived difficulty of using Apple's XCode IDE by an app developer that was unfamiliar with Objective-C.

If usage of XCode was perceived as being simple then it would Help that *softgoal* but if it was perceived as being complex then it would Hurt that *softgoal* (not shown*).

Now consider Adobe's strategic options. Adobe intended for its Flash technology to be supported on Apple iOS devices (*goal* Flash be compatible with iOS devices). A plethora of Flash-based web-apps could be accessed on the Internet and Adobe's objective was to make these apps available on popular mobile devices such as iPhones, iPods, and iPads. To achieve this objective Adobe had two alternatives which were: Reference Objective-C API (*task*) and Translate Flash code to Objective-C code on own IDE (*task*). Each of these strategies had different pros and cons for Adobe.

The first alternative involved translating Flash code into Objective-C code directly within Adobe's IDE for developing Flash applications (Adobe Flash Builder). Under this option, developers of Adobe Flash apps did not need to use any Apple tools or technologies.

This translation option is depicted as scenario <1> in Figure 8-11. This option allowed reuse of Flash code (Helps *softgoal* Existing Flash apps be supported). It also allowed cohesion to be maintained in the Flash developer community (Helps *softgoal* Flash developer community be united).

The second alternative involved referencing Objective-C API from Flash code directly within Adobe's IDE for developing Flash applications (Adobe Flash Builder). This commingling option is depicted as scenario <2> in Figure 8-11. This option allowed developers to optimize apps for iOS (Helps *softgoal* Apps be optimized for iOS) and for those apps to be publishable on Apple iOS app store (Helps *softgoal* Apps be published on Apple app store).

Adobe depended on Apple for the operationalization of both options under its consideration (i.e., Translate Flash code to Objective-C code on own IDE and Reference Objective-C API). This reliance is shown via outbound dependency links from Adobe to Apple (Translation be permitted and API be accessible respectively for the two options).

Evaluation Phase: The payoffs for Adobe and Apple in each of these scenarios are depicted in Figure 8-12. In the Evaluation phase, we use a Game Tree to compare various alternatives. Adobe was the first-mover since it had the choice of selecting either the translation (<1>) or the commingling (<2>) option.

Apple was the second mover since it controlled the iOS platform and could permit or prohibit actions by third-parties that depended on it for some decision or action. Therefore, Apple could respond to Adobe either by supporting its first-move or blocking it.

If Adobe selected the translation option (<1>) and Apple supported it then Adobe obtained a payoff of +2 while Apple obtained a payoff of -2. This is because the high priority *softgoals* of Adobe were achieved but the high priority *softgoals* of Apple were denied (comparing *softgoals* priorities and achievements associated with <1> in Figure 8-11). However, if Adobe selected the translation option (<1>) and Apple blocked it then Adobe obtained a payoff of -2 while Apple obtained a payoff of +1. This is because Apple was able to avoid the countermanding of its high priority *softgoals* but the high priority *softgoals* of Adobe were not fulfilled (<1> in Figure 8-11).

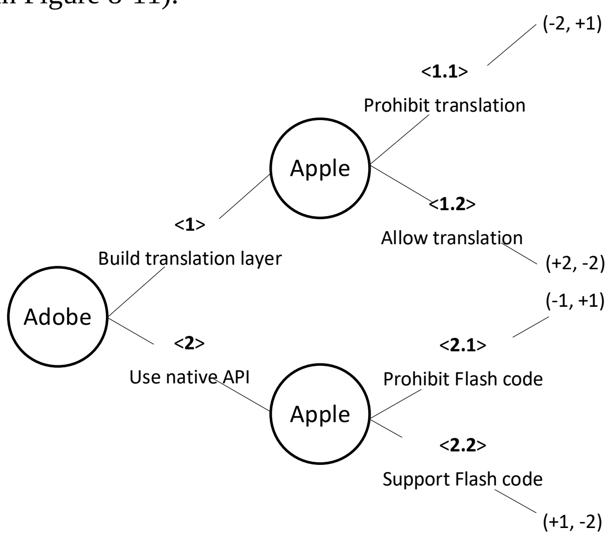

Figure 8-12 Game Tree depicting As-Is decisions and payoffs (Adapted from Pant & Yu (2018a))

Alternatively, if Adobe selected the commingling option (<2>) and Apple supported it then Adobe obtained a payoff of +1 while Apple obtained a payoff of -2. This is because some *softgoals* of Adobe, albeit of lower priority, were satisfied but the high priority *softgoals* of Apple were denied (<2> in Figure 8-11). However, if Adobe selected the commingling option (<2>) and Apple blocked it then Adobe obtained a *payoff* of -1 while Apple obtained a *payoff* of +2. This is because high priority *softgoals* of Adobe were unfulfilled but Apple was able to avoid the denial of its high priority *softgoals* (<2> in Figure 8-11).

This analysis of Figure 8-12, following the Evaluation phase of Figure 8-11, shows that the relationship between Adobe and Apple did not comprise of any win-win strategies. Rather their relationship characterized only win-lose strategies wherein if one party wins then the other party loses.

We now illustrate the methodology depicted in Figure 8-8 by applying the Exploration phase to generate a win-win strategy for Adobe and Apple. In the Exploration phase, we use *i** and Game Tree to contemplate and create new strategic options.

Exploration Phase: An extended *i** model showing the goals of Adobe and Apple is presented in Figure 8-13. Existing model elements are denoted by black color while new model elements are denoted by blue color.

It is possible that decision-makers at Adobe predicted that Apple was unlikely to greenlight either of Adobe's As-Is strategies (of translation or commingling) because each of these strategies would result in the denial of Apple's *softgoals*. Moreover, Adobe decision-makers likely recognized the asymmetry in the bargaining power between Apple and Adobe because Apple governed and controlled the iOS platform at its own sole discretion. Therefore, Adobe needed to generate new strategies that could help it to satisfy its own goals while enabling Apple to meet its objectives as well.

The Exploration phase in Section 8.3 offers six possible activities for generating new win-win strategies. In terms of *goals*, Adobe wanted to bring support for Flash to popular mobile devices. It could have changed its *goal* to making Flash apps compatible with Android devices (not shown*).

With respect to *dependencies*, Adobe could have tried to change its relationship with Apple purely at the interface level. It could have paid fees to Apple to induce Apple to support its chosen option (not shown*). In terms of *softgoals*, Adobe could influence Apple to modify its *softgoals*. Adobe could mount a public relations campaign to encourage Apple to support Flash (not shown*).

With respect to *actors*, Apple or Adobe were in a dyadic relationship. Adobe could have incentivized Apple to add support for Flash into iOS by bringing a new actor (e.g., its community of Flash app developers) into this relationship. Access to a large developer community that was willing to embrace iOS app development could be persuasive and compelling for Apple (not shown*).

In terms of *tasks*, Adobe SMEs might have reasoned that Adobe needed to generate new alternatives in its search for a win-win strategy. Adobe decision-makers likely recognized that Flash support on iOS could help Apple to satisfy its *softgoals* of Encouraging external innovation and Attracting App developers. However, Adobe might also have understood that Apple would not support Flash on iOS if it meant that its more important *softgoals* (i.e., Security of apps be controlled and Revenue from apps be centralized) were denied. Therefore, Adobe would have needed to create a new alternative that would be helpful for Apple to achieve its higher priority *softgoals*.

Starting with existing options to create new options is useful because the impact of existing options on extant intentional elements of actors is likely to be well understood in the Evaluation phase. As shown in Figure 8-11, translation option (<1>) was preferable to Adobe over commingling option (<2>) since the former satisfied its higher priority *softgoals* while the latter satisfied its lower priority *softgoals* (comparing <1> and <2> in Figure 8-11). However, Adobe's operationalization of the translation option (<1>) via its own IDE (Adobe Flash Builder) made it unacceptable for Apple. This is because it countermanded Apple's higher priority *softgoal* of Security of apps be controlled and its related higher priority *softgoal* of Revenue from apps be centralized.

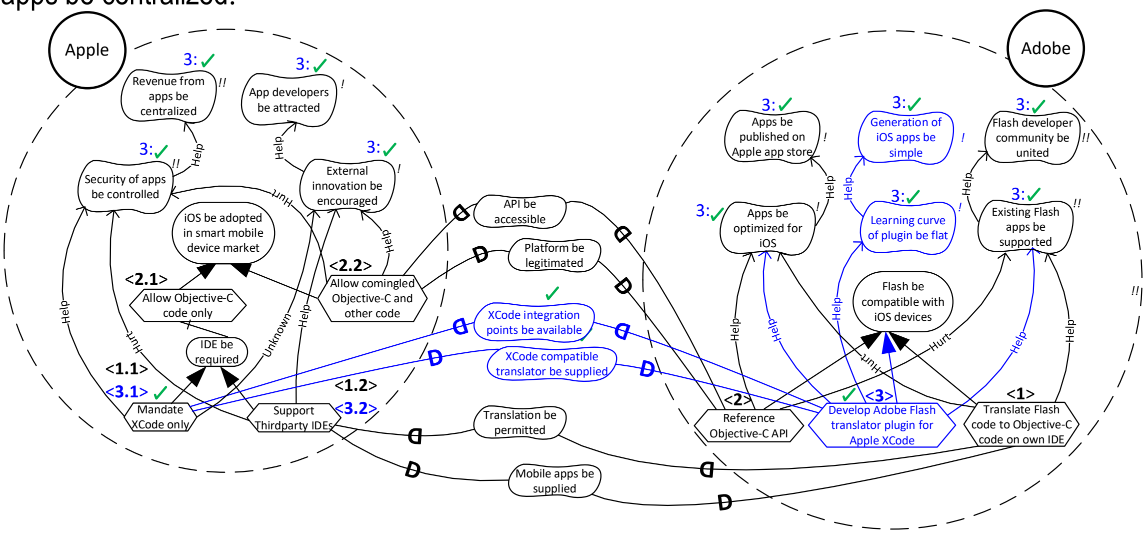

Figure 8-13 *i** model depicting To-Be actor relationships (Adapted from Pant & Yu (2018a))

However, a different implementation of the translation option might have helped Adobe and Apple to achieve their higher priority *softgoals*. For example, Adobe could have developed Adobe Flash translator plugin for Apple XCode. Such a plugin could be embedded within XCode and could automatically inherit and apply the security policies implemented by Apple in its IDE.

In such an implementation, app developers would have been able to convert Flash code into Objective-C code using XCode rather than Flash Builder. Developers of Flash apps would have had a minimal learning curve (Learning curve of plugin be flat) which would have been limited to learning the usage of the Adobe supplied translator plugin inside XCode (Generation of iOS apps be simple).

Apple would have been satisfied knowing that the output of this translator plugin would be Objective-C code generated inside XCode. Likewise, Adobe would have been contented knowing that its Flash apps would be supported on Apple iOS devices. Eaton et al. (2015) have noted that various blogs and online news articles about Apple's service system discussed that a Flash Plug-in option by Adobe was not realized.

Evaluation Phase: An extended Game Tree showing the *payoffs* for Adobe and Apple is presented in Figure 8-14. Two *decision paths* at the top of this Game Tree are the same as those in Figure 8-12. The *decision path* on the bottom of this Game Tree reflects the new alternative that is present in Figure 8-13.

This *decision path* is shown in blue color to differentiate it from the others. If Adobe were to select the plugin option and Apple supported it then both Adobe and Apple would have obtained *payoffs* of +3 each. This is because both *players* could have satisfied each of their *softgoals*.

Additionally, this new *task* would have unlocked additional *softgoals* for Adobe. However, if Adobe were to select the plugin option and Apple blocked it then both Adobe and Apple would have obtained *payoffs* of -2. This is because neither of the *players* would have been able to fulfil any of their *softgoals* and would have missed out on a promising business opportunity. Therefore, this plugin *option* represents a win-win strategy for Adobe and Apple wherein both *players* would be better off if they operationalize it as partners.

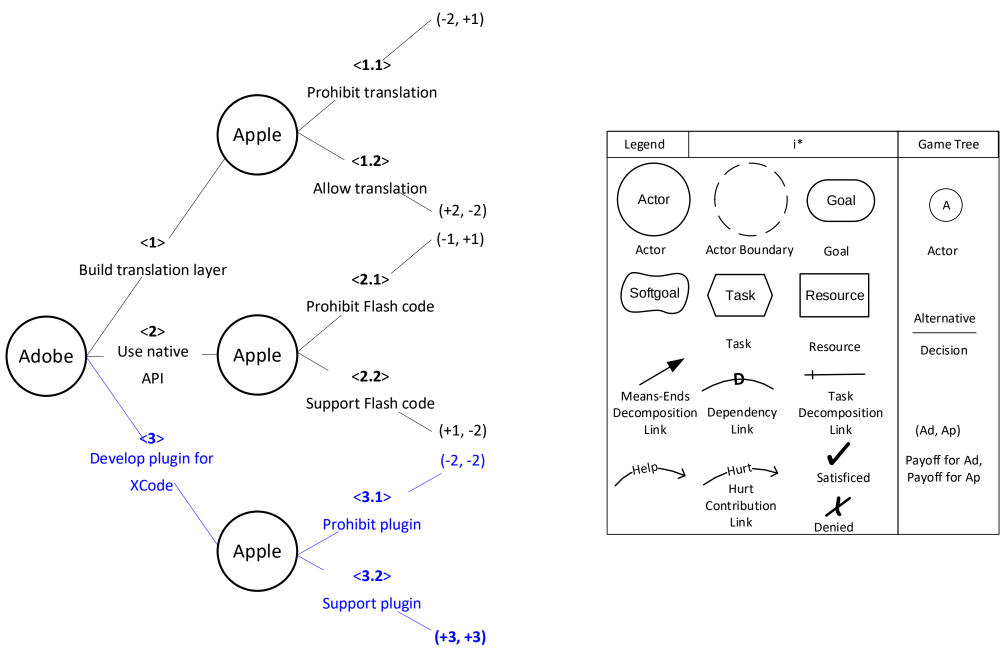

Figure 8-14 Game Tree depicting To-Be decisions and payoffs (Adapted from Pant & Yu (2018a))

8.5.2 Summary of Illustrative Example

In this illustration, we applied the methodology that is described in Section 8.3 to a case involving Adobe and Apple in the smartphone apps marketplace. This strategy was arrived at in one iteration. In the general case, one may need to go through various paths in the exploratory phase multiple times to arrive at a win-win strategy. For instance, in this example, Adobe was able to generate a new alternative (Develop Adobe Flash translator plugin for Apple XCode) that was compatible with an element of Apple's internal intentional structure (Mandate XCode only). However, generation of win-win strategies in other cases may require changes to be made to the internal intentional structures of multiple actors. Such cases will necessitate multiple iterations over different paths of this process.

Similarly, additional iterations of this process would yield other win-win strategies. For instance, in this example, Adobe could have performed additional exploration to generate other alternatives that resulted in win-win. It could have developed a translator that converted Flash code to HTML5 code since iOS supported HTML5 (not shown*). Alternatively, it could have developed a translator that converted Flash code to JavaScript since iOS supported JavaScript (not shown*). It is conceivable that each of these options might have led to better *payoffs* for Adobe and Apple.

8.6 Summary

In this chapter, we developed and used the third advanced facet, consisting of *i** and Game Tree modeling, for finding and generating win-win strategies. As this modeling-supported reasoning shows, *i** is useful for understanding the causes of reciprocality while Game Tree is useful for determining the benefits and costs of reciprocation. *i** and Game Tree explain different aspects of reciprocity between actors and together they can represent more facets of interlinked behaviors than either of them can depict alone. Specifically, *i** is used to show the internal intentional structure of actors that are considering a tit-for-tat move/countermove while Game Tree is used to show the sequence of moves/countermoves that are implicated in reciprocal behaviour as well as resulting payoffs.

The illustration in this chapter was based on a historical case where the intentionality and moves of actors were known. In a real-world setting, this approach can be used to understand the causes of various courses of action (i.e., decision paths) as well as their effects on different actors. It should be noted that, in the real-world, a modeler is likely to have incomplete and imperfect information about the intentionality and moves of actors. This risk can be mitigated through gathering of accurate information and validating of its correctness prior to inclusion in the models. In the next chapter we present results of testing our framework to model and analyze a published case study of Amazon and Microsoft under coopetition in the cloud-based database-as-a-service (DBaaS) market.

9. Case Study - Coopeting Mega-Vendors in the Global Software Industry

9.1 Introduction

The global software industry is characterized by constant disruption and is continually reshaped by breakthrough innovations from software organizations. Technological advances, such as cloud computing, afford valuable opportunities for organizations to redesign their business models and redefine their strategies. Organizations in the software industry operate within ecosystems to benefit from network effects. This results in coopetitive relationships among them because those organizations have to manage objectives that are partly convergent and partly divergent. For example, organizations in the software industry cooperate by participating in open source communities, standards bodies, industry advocacy groups and trade associations; while, at the same time, competing over customers, talent, funding, and patents. The presence of concomitant cooperation and competition in the software industry makes it an appropriate domain for testing our conceptual modeling framework for modeling and analyzing strategic coopetition. This chapter presents results of evaluating the application of our framework to this case study.

9.2 Case Study

The material for the case study presented in this chapter is synthesized from peer-reviewed research papers[32] and depicts the coopetitive relationship between Amazon and Microsoft in the database market. Microsoft offers its SQL Server database software through on-premise and own or partner-run cloud platforms. Amazon offers its database services, including Aurora, DynamoDB, and Redshift exclusively via its own cloud platform. At the start of their relationship, Microsoft and Amazon were engaged in purely competitive dealings in which they targeted the same new customers while also trying to poach existing customers from each other. Over time, their rivalrous relationship gave way to a hybrid relationship in which each of them offered blended solutions in brownfield accounts (i.e., where one was an incumbent) while continuing to compete in greenfield accounts (i.e., net-new customers for both). The resulting conceptual models explain the win-win rationale for the strategic relationship between these software mega-vendors.

9.3 Objectives

We were interested in developing a framework that had practical relevance for professionals because our objective for this framework was, and remains, industry acceptance and adoption. The objective of evaluating our conceptual modeling framework was to assess its quality for representing and reasoning about strategic coopetition in the industry. We were also interested in understanding whether there were areas for improvement in our framework. This is the essence of the design science approach in which artefacts are designed, tested, and improved continually in an iterative and incremental manner. These

[32] These papers are DaSilva et al. (2013), Isckia (2009), Ritala et al. (2014), and Spillner, Toffetti, & López (2017).

objectives necessitated our testing this framework with multiple users (including ourselves). We acknowledge that our goal was to test the quality of the framework in terms of its usability and usefulness for different users. This is because our framework is new and we were interested in understanding whether its elements (e.g., metamodel, notation, methodology, etc.) could be improved. The technique that we adopted for evaluating usability and usefulness of our framework did not include comparing of models and analyses produced by different users in terms of similarity and resemblance.

9.3.1 Testing with subjects

The purpose of our framework was to offer decision-support to users and we were interested in understanding whether our framework was fit for its purpose. Testing with subjects allowed us to understand the strengths and weaknesses of our framework as perceived by users that had tested the application of our framework. Test subjects' perspectives about the strengths of our framework highlighted aspects that were fit for purpose while weaknesses indicated opportunities for improvement. Additionally, we were also interested in eliciting specific recommendations for improving our framework from test subjects when they identified weaknesses. Testing with subjects allowed us to enlarge the sources of ideas for improvement thereby infusing additional insights into our design.

9.3.2 Self-test

Self-test refers to testing by the authors of the framework as applied to the case study. Performing a self-test allowed us to evaluate the combined application of *i**, e3value, and Game Tree components of our framework. Our intention in conducting a self-test was to critically assess the efficacy of our framework for representing and reasoning about coopetitive relationships. We were interested in discerning those aspects of a coopetitive relationship that could be modeled and analyzed satisfactorily using our framework. We were also interested in identifying those aspects of coopetitive relationships that could not be expressed or evaluated properly using our framework. In previous chapters, we had applied each facet of our framework on an individual basis and self-testing provided us an opportunity to test our framework as a whole. Self-testing afforded an opportunity for us to critically reflect on our framework.

9.4 Participants

We recognize that industry practitioners possess different degrees of familiarity with various modeling languages. Our aim was for our framework to be tested by participants with different levels of proficiency with the languages in our framework. Our target was also for the adequacy of our framework to be assessed by participants with different industry backgrounds. This is because we were interested in eliciting ideas, for improving our framework, from multiple viewpoints based on the different background of each tester.

9.4.1 Testing with subjects

We tested our framework by studying its application to this case by a Master's student from Utrecht University (Subject 1) and a Bachelor's student from the University of Toronto (Subject 2). These subjects were acquainted with our research and approached us separately in February 2019. They expressed their willingness to participate in our research and we established a separate research project for each subject.

Each subject had classroom experience with UML and BPMN modeling after having completed multiple courses. Subject 2 did not have prior experience with *i**, e3value, or Game Tree modeling. Subject 1 had previous experience with *i**, e3value, or Game Tree modeling however they had only used these languages separately but not in connection with each other.

Each subject received course credit from their respective academic programs for participating in our research. Subject 2 completed a credit-based upper-level independent study course under our supervision while Subject 1 based their graduate thesis on our research project.

This technique for testing with subjects is comparable to Evermann (2003). Evermann (2003) developed extensions to a conceptual modeling language (i.e., Unified Modelling Language) in his PhD research at the University of British Columbia and tested those extensions with subjects in a similar way.

9.4.2 Self-testing

We tested our framework by applying it to the same case about coopetition in the database market between Microsoft and Amazon. The doctoral candidate (referred to in the rest of this chapter as Researcher 1) developed *i**, e3value, and Game Tree models as well as corresponding analyses.

These models and analyses were reviewed by their research supervisor (referred to in the rest of this chapter as Researcher 2). Researcher 1 revised models and updated resulting analyses iteratively and incrementally based on the feedback of Researcher 2.

Researcher 1 had considerable experience with *i**, e3value, and Game Tree modeling. This was evidenced by publications, in peer-reviewed journals as well as juried conferences and workshops, on which Researcher 1 was the lead author. Researcher 2 also had substantial experience with *i**, e3value, and Game Tree modeling because Researcher 2 was the inventor of *i** and had published several influential papers about conceptual modeling (including about these languages) in prestigious venues.

This technique for self-testing is comparable to Lessard (2014). Lessard (2014) developed a conceptual modeling language (i.e., Value Cocreation Modelling) in her PhD research at the University of Toronto and evaluated it through self-testing in a similar way.

9.5 Materials

Our conceptual modeling framework is comprised of multiple facets and each facet is comprised of many components. This modular design of our framework supports holistic application as well as granular improvement. Our aim was for each component to be tested so that the strengths and weaknesses of our framework could be assessed at a fine-grained level. We were interested in making focused improvements to targeted components of our framework when testing identified them as specific areas for improvement.

At the start of testing we created three identical sets of materials. One set was provided to Subject 1, another set was provided to Subject 2, and the third set was utilized by us. Each tester used identical material to ensure that testing with subjects and self-testing had the same focus and scope. This enabled comparison and combination of findings from each test result. As noted above, we did not contrast models and analyses that were produced in each test in terms of similarity and resemblance. Rather, we assessed critical reflections of each tester about the application of our framework. These consisted of three groups of items:

- Modeling artefacts including metamodel, and methodology for each facet of our framework. We created separate online folders for each tester on Google Drive and uploaded PDF documents containing the metamodels for *i** (Figures 6-1 and 6-4), *i** and e3value (Figures 7-1 and 7-3), as well as *i** and Game Tree (Figures 8-1 and 8-3). We also uploaded three of our published research papers[33] that demonstrated the application of different facets of our framework to case studies. These papers contained illustrations depicting the use of *i**, *i** with e3value, and *i** with Game Tree.
- Guidelines for applying each facet of our framework[34]. We compiled guidelines for developing models based on *i**[35], *i** with e3value[36], and *i** with Game Tree[37]. For ease of application, each guideline was categorized along three dimensions: type, kind, and phase. 'Type' refers to the function of a guideline in terms of its purpose (e.g., is it relevant for evaluation, layout, naming, etc.). 'Kind' refers to the polarity of a guideline wherein a positive guideline prescribes an action while a negative guideline proscribes an action. 'Phase' refers to scope of applicability of a guideline in terms of one or more steps in a methodology in our framework (e.g., M1, E1, X1, etc.).
- List of research papers from peer-reviewed sources that describe this Microsoft and Amazon case. In February 2019, we conducted an exploratory literature review on Google Scholar about this case. We searched for the terms "coopetition" AND "Microsoft" AND "Amazon" AND "database". We applied the "AND" operator to this search to obtain results that represented an intersection set of relevant

[33] These papers are Pant & Yu (2017a, 2018b, 2019).
[34] These guidelines are included in Appendix 3.
[35] These guidelines were adapted from source: *i** wiki at http://istar.rwth-aachen.de/tiki-index.php?page=*i**+Guide.
[36] These guidelines were synthesized from sources: van der Raadt (2005) and Pant & Yu (2017a).
[37] These guidelines were synthesized from sources: Pant & Yu (2018a) and Pant & Yu (2018c).

research papers about this case. We sorted these search results by relevance and read the first ten research papers with at least fifty citations. Based on these readings we selected three papers[38] that, in our judgement, best described the strategic details of this case. Additionally, we added two more papers[39] to this reading list based on input from both subject – each of whom nominated one paper.

9.6 Modeling, Analysis, and Critical Reflection

We conducted testing with subjects and performed self-testing over a one year period that commenced in February 2019 and concluded in February 2020. Our intention was for both subjects to have the same amount of time available for developing models and analyses. Additionally, our motivation was for the self-test to include the development of models and analyses at the same time as both subjects. This approach was conducive for comparing critical reflections, about our framework, from multiple perspectives.

9.6.1 Testing with subjects

Over this period of twelve months, we worked closely with each subject to provide instructions, offer guidance, and review their work. We convened weekly discussions with each subject over Skype and communicated with them via email, text, as well as mobile messaging. To ensure the comparability of their work, we ensured that both subjects received similar suggestions, recommendations, and feedback from us. To avoid the risk of bias from groupthink, these subjects were not introduced to each other and they conducted their research projects independently. Each research project spanned three main phases:

- Case content: This phase spanned one month in duration and was conducted during February 2019. At the first step, each subject was instructed to read the research papers describing this case study. These subjects were also asked to identify one additional resource each that they felt supplemented their understanding of this case. A reading list of all papers, that was relevant for both subjects, was compiled by us and shared with each subject. This was done to ensure that both subjects had access to identical sources of knowledge about this case. During this phase each subject was invited to verbally discuss their interpretation of these papers with us on an individual basis. Any advice or insights that we shared with either subject was also communicated to the other subject to ensure that we provided identical information about this case to both subjects. At the conclusion of this phase, each subject indicated their readiness to commence the modeling and analysis phase.
- Modeling and Analysis: This phase was comprised of two sub-phases that were performed over an eight-month duration. Each subject used diagramming tools including Microsoft Visio, Lucid Chart, and draw.io/diagrams.net to build models. This phase began in March 2019 and ended in October 2019.

[38] These papers are DaSilva et al. (2013), Isckia (2009), and Ritala et al. (2014).
[39] These papers are Narendula (2012), and Spillner, Toffetti, & López (2017).

- In the first sub-phase of this phase, each subject began by sketching rough diagrams of *i**, e3value, and Game Tree models. This sub-phase presented the subjects with an opportunity to learn these modeling techniques in the context of our framework. Each subject iterated through various versions of sketches during each week and uploaded select versions to Google Drive on a weekly basis for our review. We inspected their sketches each week and shared our verbal feedback over Skype discussions. The focus of this sub-phase was not on the content of their sketches per se but rather on the semantic and syntactic correctness of their *i**, e3value, and Game Tree models. During this sub-phase, our focus was on ensuring that each subject developed proper models using these techniques. This initial sub-phase lasted for two months and, by the end of this sub-phase, each subject was ready to apply the metamodels, methodologies, and guidelines associated with each aspects of our framework. Samples of early sketches of *i**, e3value, and Game Tree diagrams by the two subjects are included in Appendix 4.
- In the second sub-phase of this phase, each subject developed semantically and syntactically correct depictions of this case. The focus of each subject in this sub-phase was to build models with progressively greater analytical fitness and explanatory power in an incremental manner. This process unfolded iteratively such that the quality of *i**, e3value, and Game Tree models improved with each round. Each subject worked on a fortnightly cycle to elaborate and refine their models. We convened weekly Skype calls separately with each subject to discuss their progress and challenges in each round. On each Skype call we discussed changes to model contents from the preceding round as well as the reasoning behind those changes. To ensure that *i**, e3value, and Game Tree models were co-developed, we required each subject to explain the contents of each type of model individually as well as collectively. For traceability of model content, each subject was also required to associate model components to source publications in the reading list from which they were derived. Samples of *i**, e3value, and Game Tree models depicting this case are included in Appendix 4.

- Critical Reflection: This phase spanned three months in duration and was conducted between November 2019 and January 2020. In this phase, subjects submitted their observations and findings about the appropriateness of our framework for modeling this case. For the subjects, guidelines served as proxies for the purposes of assessing our framework as they provided pathways for operationalizing our framework. During the Modeling and Analysis phase, each subject was instructed to record their experiences of applying our guidelines to model this case. They were required to chronicle successes or failures depending on whether they were able to articulate and assess some aspect of this case properly or not. They were also required to suggest changes to the guidelines because those could reflect potential improvement opportunities for our framework. Each subject shared a report containing their critical reflections with us separately and verbally described its contents over multiple Skype discussions. The scope of their critical reflection was intentionally limited to the adequacy of our framework only for modeling and analyzing coopetition but not the general capabilities and limitations of *i**, e3value, and Game Tree in other contexts.

9.6.2 Self-testing

We conducted the self-test over the same twelve-month period as the subject-test. Researcher 1 met with Researcher 2 in person on a weekly basis to discuss models diagrams as well as analysis results. Researcher 1 and Researcher 2 only discussed self-testing during these meetings and did not discuss progress of Subject 1 and Subject 2 from subject-testing. Subject-testing was discussed in separate meetings that were convened at different occasions than meetings about self-testing. Separation of meetings to review subject-testing from meetings to review self-testing, allowed status of each kind of test to be assessed in isolation. This ensured that subject-testing and self-testing received comparable attention and equivalent focus. Models and analyses associated with self-testing are presented in Appendix 5. Three phases of self-testing included:

- Case content: This phase was conducted in February 2019 and spanned one month in duration. We started by reading each research paper associated with this case study. Researcher 1 prepared a list of key ideas in these papers by focusing on actors, actions, outcomes, and objectives. Actors were identified based on nouns (e.g., Microsoft), actions were identified based on verbs (e.g., advertise), outcomes were identified based on pairings of nouns and adjectives (e.g., product launch was successful), and objectives were identified based on pairings of verbs and nouns (e.g., become market leader). Researcher 1 also prepared a list of case analysis questions based on strategic decisions in this case that were described in the source literature. Since this was a historical case, details of decisions was used to infer the kinds of case analysis questions that must have been answered by decision-makers. Researcher 1 and Researcher 2 discussed key ideas in these papers to ensure that relevant actors, actions, outcomes, and objectives were identified. Researcher 1 and Researcher 2 also reviewed the case analysis questions that were inferred from the source literature. We identified same or similar details of the case that were described in all or many papers as well as details that were covered only in one or some papers. Presence of the same or similar detail in all or many papers was regarded as more credible than detail in one or some papers. We also found some details that were consistent across multiple papers and others that were inconsistent across different papers. In cases of such disagreement regarding a detail in different papers, we chose the detail from the paper with higher number of citations. We acknowledge that a higher citation count does not guarantee credibility. Therefore, we also applied our subjective understanding of the case to select one detail over another detail when those details disagreed. At the conclusion of this phase, Researcher 1 had a comprehensive understanding of this case and was ready to commence modeling and analysis.

- Modeling and Analysis: This phase was conducted over an eight-month period between March 2019 and October 2019. Unlike in subject-testing, this phase was not split into any sub-phases in self-testing. Researcher 1 prepared a list of entities and relationships to represent key ideas of this case based on the list of that was prepared during the previous phase. This list of entities and relationships encompassed a thorough understanding of this case by Researcher 1. These entities and relationships instantiated metamodels of *i** (Section 6.1), e3value (Section 7.1), and Game Tree (Section 8.1). Actors, from the case study readings, were instantiated as *actors* in *i** as well as e3value and as *players* in Game Tree. Actions were instantiated as *tasks* in *i**, *value activities* in e3value, and *move* in Game Tree. Outcomes were instantiated as *goal* or *softgoal* satisfaction in *i**, *value exchanges* in e3value, and *payoffs* in Game Tree. Objectives were instantiated as *goals* or *softgoals* in *i** depending on whether the objectives were clear-cut (i.e., *goals*) or subjective (i.e., *softgoals*). Recall that e3value and Game Tree do not comprise the notion of objective. Researcher 1 used Microsoft Visio to construct diagrams of the case using stencils for *i**, and e3value. A stencil for Game Tree modeling was not available so shapes in the basic template such as circles and lines were used to create diagrams of Game Tree. This process of modeling and analysis was performed incrementally and interactively over many iterations. In the first iteration, simple *i** models were developed to show the *actors* as well as the *dependencies* between them in As-Is and To-Be configurations. These initial *i** models excluded the internal intentional structures of the *actors*. In the second iteration, these *i** models were updated to include the internal intentional structures of the *actors* by adding their *goals*, *tasks*, and *resources*. *Dependencies* were also attached to these model elements during this iteration. In the third iteration, *softgoals* were introduced within the *actors* and *contribution links* from *tasks* as well as *softgoals* were added to connect *softgoals*. In the fourth iteration, scenarios were generated to answer case analysis questions that were elicited from historical decisions in this case that were described in the source literature. These scenarios were labelled and then satisfaction labels of model elements were propagated across *i** models. Subsequent iterations over *i** models involved elaborating and refining those *i** model until they could be used to satisfactorily answer case analysis questions. Adequacy of *i** models for analyzing this case was determined by assessing whether these *i** models led to the same conclusions as those that were described in the source literature. These finalized *i** models are included in Appendix 5 as Figures A5-1 and A5-4 for the As-Is and To-Be configurations respectively. These finalized *i** models were then used to create e3value models and Game Trees. Here, we first depicted the As-Is and To-Be configurations using e3value and then Game Tree models. In the first iteration of e3value modeling, we included the *actors, value ports,* and *value interfaces* by referring to corresponding model elements in the *i** models. In the second iteration, we included *value exchanges* to connect *value interfaces* of *actors* so that they could transfer *value objects*. In the third iteration, we added *value objects* and parameterized these *value objects* based on case analysis questions to be answered using e3value models. In the fourth iteration, we assessed the adequacy of the finalized e3value models for answering case analysis questions by checking whether changes to the parameters of the *value objects* yielded changes to the conclusions. These finalized *i** models are included in Appendix 5 as Figures A5-2 (As-Is configuration), and A5-6 as well as A5-7 (To-Be configuration). After finalizing the e3value models we developed Game Trees corresponding with the As-Is and To-Be configurations of this case. In the first iteration of Game Tree modeling, we included the *players*, *decisions*, and *moves* by referring to corresponding model elements in the *i** models. In the second iteration, we included *payoffs* for each *decision* path in the Game Tree based on case analysis questions to be answered using Game Trees. In the fourth iteration, we checked the sufficiency of the finalized Game Trees for answering case analysis questions by assessing whether changes to the *payoffs* yielded changes to the conclusions. These finalized Game Trees are included in Appendix 5 as Figures A5-3 and A5-5 for the As-Is and To-Be configurations respectively.

- Critical Reflection: This phase was conducted over three months beginning in November 2019 and concluding in January 2020. In this phase we checked the quality of our framework in terms of its usability and usefulness for modeling and analyzing strategic coopetition. Our findings from this critical reflection phase are described in Section 9.7.2. Assessing usability entailed adopting a critical lens to evaluate the guidelines for applying the metamodel, methodology, and analysis techniques in our framework based on our experience with this case study. Recall that these guidelines are included in Appendix 3. Inspecting usefulness encompassed comparing the contents of our *i**, e3value, and Game Tree models as well as the results from analyzing those models with the details of this case from text in the source literature. To assess usability, we revisited the guidelines that we had used to develop the *i**, e3value, and Game Tree models for this case study. In the first pass, we evaluated each guideline individually and categorized each guideline in terms of its frequency of application to model and analyze this case as well as its clarity of instruction. In the second pass, we evaluated all guidelines collectively to identify redundancies and omissions. To inspect usefulness, we focused on the models and their analyses separately. In the first pass, we performed a three-way match between the contents of our models, the original list of key ideas of this case that were identified during our initial reading of the source literature, and a new list of key ideas of this case that were identified during our subsequent reading of the same source literature. In the second pass, we contrasted the decisions expressed in the finalized *i**, e3value, and Game Tree models with decisions in this case study that were described in text within the source literature.

9.7 Results and Discussion

9.7.1 Testing with subjects

We evaluated critical reflections submitted by each subject to understand potential areas for improvement in our framework. We examined each subject's comments associated with the guidelines for each facet of our framework. They provided comments only for guidelines requiring change and each comment indicated the kind of suggested change as well as the rationale for that change. Summary of the feedback from each subject regarding these guidelines is presented in Tables 9-1 and 9-2. The numbers indicate the counts of guidelines in each kind (i.e., positive, negative) and type (concept, evaluation, layout, methodology, etc.).

Kind ➔	Positive			Negative			Grand Total
Recommendation ➔ | Type 🡻	Keep	Change	Total	Keep	Change	Total	
Concept	37	0	37	34	0	34	71
Concept & Evaluation	2	0	2	1	0	1	3
Evaluation	19	0	19	6	0	6	25
Layout	13	0	13	9	1	10	23
Methodology	24	0	24	9	0	9	33
Methodology & Layout	1	0	1	0	0	0	1
Naming	13	0	13	5	0	5	18
Notation	13	1	14	7	0	7	21
Grand Total	122	1	123	71	1	72	195

Table 9-1 Summary of feedback from Subject 1 to guidelines for our modeling framework

Kind ➔	Positive			Negative			Grand Total
Recommendation ➔ | Type 🡻	Keep	Change	Total	Keep	Change	Total	
Concept	26	11	37	23	11	34	71
Concept & Evaluation	1	1	2	0	1	1	3
Evaluation	11	8	19	2	4	6	25
Layout	6	7	13	2	8	10	23
Methodology	16	8	24	8	1	9	33
Methodology & Layout	1	0	1	0	0	0	1
Naming	9	4	13	4	1	5	18
Notation	13	1	14	7	0	7	21
Grand Total	83	40	123	46	26	72	195

Table 9-2 Summary of feedback from Subject 2 to guidelines for our modeling framework

We followed the technique for "subsuming particulars into the general" described in Miles, Huberman & Saldana (2019) to group each change recommendation into one of five clusters. These clusters represent rationales for recommendations by subjects necessitating changes to guidelines: Impractical, Incomplete, Repetitive, Unclear, and Unnecessary. Meaning of each cluster is described in Table 9-3. These clusters were developed subjectively by us and we acknowledge that other researchers may construct other clusters for grouping these data. The assignment of each change recommendation to a cluster was also based on our subjective judgement and it is possible that other researchers may perform assignments differently.

Cluster	Meaning
Impractical	This guideline cannot be implemented efficiently
Incomplete	This guideline requires additional details
Repetitive	This guideline is identical to some other guideline
Unclear	This guideline is ambiguous or confusing
Unnecessary	This guideline does not appear to serve a purpose

Table 9-3 Meanings of each cluster describing perceived weakness of a guideline

Summaries of recommendations from both users for changing guidelines in terms of their type and kind are presented in Tables 9-4 and 9-5.

Type 🡻 | Cluster 🡺	Impractical	Incomplete	Repetitive	Unclear	Unnecessary	Total
Concept	4	4	3	6	5	22
Concept & Evaluation	1	1	0	0	0	2
Evaluation	1	4	1	5	1	12
Layout	3	2	3	2	6	16
Methodology	2	1	3	1	2	9
Methodology & Layout	0	0	0	0	0	0
Naming	0	1	0	1	3	5
Notation	2	0	0	0	0	2
Total	13	13	10	15	17	68

Table 9-4 Summary of recommendations from both subjects clustered by type of guideline

Type 🡻 | Cluster 🡺	Impractical	Incomplete	Repetitive	Unclear	Unnecessary	Total
Positive	7	9	7	10	8	41
Negative	5	5	4	7	6	27
Total	12	14	11	17	14	68

Table 9-5 Summary of recommendations from both subjects clustered by kind of guideline

Content analysis techniques are useful for distilling the essence of inputs from participants (Huberman & Miles, 2002). Cumulatively, both subjects recommended changes to 68 out of 195 guidelines (Tables 9-1 and 9-2). Our review of the content of change recommendations uncovered two main pathways for improving our framework:

- Semantic simplification: 22 out of 68 change recommendations pertained to Concept guidelines and another 2 were related to Concept and Evaluation guidelines (Table 9-4). These guidelines impelled (positive) or impeded (negative) particular model-building actions. Six of these recommendations appeared to point out guidelines that were ambiguous and 5 seemed to refer to guidelines that required additional details. These 11 guidelines should be revised and elaborated as necessary. Additionally, 5 guidelines appeared to be unpragmatic, another 5 did not seem to serve a purpose, and 3 looked like it was identical to some other guideline. These 13 guidelines can be removed to yield a finetuned set of Concept as well as Concept and Evaluation guidelines. Adoption of these 24 recommendations may result in a framework with less complex semantics that are easier to apply.

- Visual streamlining: 16 out of total 68 change recommendations pertained to Layout guidelines (Table 9-4). These guidelines also encouraged (positive) or discouraged (negative) specific model-building activities. Slightly less than half (6) of these recommendations seemed to point out guidelines that did not serve a purpose. Additionally, 3 guidelines appeared to be unrealistic and another 3 seemed to be redundant. Therefore, 12 out of 16 change recommendations related to Layout indicated opportunities for rationalizing 16 guidelines down to just 2. The removal of these 12 guidelines may lead to a framework with less complicated visualization that is easier to adopt.

In addition to recommending changes to the guidelines, each subject also proposed new guidelines. Subject 2 proposed a new Concept guideline that was of Negative kind. Subject 1 proposed eleven new guidelines of which 9 were of Positive and 2 were of Negative kind. 7 of these 11 new guidelines pertained to Layout while 4 pertained to Concept. Each of these new guidelines filled some gaps in the original guidelines as perceived by these subjects. The incorporation of these modeler-suggested guidelines may yield a more modeler-friendly framework.

At the end of the critical reflection phase, each subject was asked to summarize the process they followed to apply our framework to the case of Microsoft and Amazon. Both subjects indicated that, in conjunction with reviewing the modeling guidelines, they also referred to the metamodels and methodologies associated with these facets. This deepened their understanding of the underlying concepts of *i**, e3value and Game Tree as well as the links between *i**, e3value, and Game Tree for the purposes of coopetition modeling.

Subject 1 indicated that they had accumulated substantial experience with developing e3value and Game Tree models through previous graduate coursework. During the first phase of our research project, they gained experience with *i** modeling. Therefore, after completing the first phase, they found the majority of the guidelines for using and combining *i**, Game Tree, and e3value to be sufficient. Subject 2 also indicated that, after completing the first phase of our research project, they did not have difficulty in understanding the mappings between concepts from *i** with e3value and Game Tree. At the end of phase 1, they regarded their understanding of these modeling languages to be adequate for the purposes of applying our framework. They did not encounter major difficulties in combining *i** with e3value and Game Tree to model the Microsoft and Amazon case because they had gained sufficient knowledge of building *i**, e3value and Game Tree models in the first phase of our research project.

9.7.2 Self-testing

We evaluated the usability and its usefulness our framework. As noted above, to assess usability, we adopted a critical lens to evaluate the guidelines for applying the metamodel, methodology, and analysis techniques in our framework to model and analyze this case study.

Upon evaluating each guideline individually, we found that guidelines varied in terms of the frequency of their application wherein some guidelines were applied multiple times while others were not applied at all. A closer inspection of this difference revealed that this was the result of the idiosyncrasies and peculiarities of the content in this case study. For example, *i* actor* specialization is depicted using *Is-A* link and *actor* composition is depicted using *Is-part-of* link in the *i** model of the To-Be configuration for this case study that is presented in Figure A5-4. Therefore, guidelines for incorporating *Is-A* and *Is-part-of* links are relevant for modeling this case but guidelines for incorporating *Plays* link are not relevant because this *link* is not utilized for modeling this case. However, we acknowledge that it is possible that certain guidelines are likely to be more applicable in all cases due to the semantics and syntax of the constituent modeling languages in our framework (i.e., *i**, e3value, and Game Tree). For example, guidelines pertaining to inclusion of *actors* are likely to be relevant for all *i** models while guidelines pertaining to representation of *beliefs* are only likely to be relevant for some *i** models. In retrospect, separating more frequently applicable guidelines from less frequently applicable guidelines would have allowed us to focus on these distinct groups of guidelines differently. This is because relatively greater opportunities exist for deviating from more frequently applicable guidelines than from less frequently applicable guidelines and each deviation from a guideline can result in errors and mistakes in the models and analyses.

We also found that guidelines differed from each other in terms of clarity of instruction wherein the application of some guidelines was objectively direct while others required subjective interpretation by the modeler. For example, the guidelines ‘Ensure that both sides of a *Dependency* Link point in the same direction’ as well as ‘Do not reuse *Dependums* in more than one *Dependency* Relation’ can be applied straightforwardly. However, the guideline ‘Split a large and complex model into consistent pieces to facilitate easier presentation and rendering’ can be applied in many ways based on a modeler’s definition of a ‘large and complex model’ as well as their understanding of the meaning of ‘easier presentation and rendering’. Similarly, the guideline ‘Use *Contribution Links* from any element only to a *Softgoal* element’ assumes that the modeler is familiar with the metamodel of *i** to know that ‘any element’ refers only to *softgoals* and *tasks*. In hindsight, separating guidelines whose meaning was objectively direct from those that required subjective interpretation would have signaled the degree of flexibility of each guideline to us. This would have been beneficial as we would have applied guidelines in each group differently by tightly complying with objectively direct guidelines and loosely adhering to subjectively interpretable guidelines.

To assess usability, as noted above, we also examined all guidelines collectively. Upon inspecting them collectively, we uncovered redundancies among various guidelines as well as omissions from guidelines.

We found examples of guidelines that attempted to convey the same meaning using different words. Such occurrences enlarged the set of guidelines potentially exacerbating acceptance and adoption by modelers. For example, the guidelines 'Keep elements horizontal and straight' and 'Do not tilt or twist elements' convey the same meaning even though one is prescriptive while the other is prohibitive. Similarly, the guideline 'Be consistent with the direction of the *Task Decomposition Link* between a *Task* and sub *Task* or *Resource*' and 'Be consistent with the direction of the *Task Decomposition Link* between a *Task* and a *Softgoal*' overlap and can be consolidated into a single guideline such as 'Be consistent with the direction of the *Task Decomposition Link* between a *Task* and sub *Task* or *Resource* or *Softgoal*'. Another example of overlapping guidelines are 'Model the As-Is state of the knowledge domain and system without the presence of the new system To-Be introduced' and 'Do not include the new system To-Be introduced in the model of the As-Is state of the knowledge domain and system'. These guidelines specify what must be included and what must be excluded from As-Is and To-Be models. These can be combined into one guideline such as 'Depict the current state of the knowledge domain and system only in the As-Is model and the future state of the knowledge domain and system only in the To-Be model'. In retrospect, combining many guidelines that convey the same meaning into a single guideline would have reduced the number of guidelines and rationalized their application. Guidelines that attempt to the convey the same meaning in different words increase opportunities for misinterpretation leading to mistakes and errors.

We also found instances where no guidelines existed to convey the meaning of certain aspects of our framework. For example, some guidelines that cover the concept of *added-value* (i.e., of an *actor* in a multi-party economic relationship) are 'Detect if the *Added Value* of any *Actor* can be increased by assessing e3value and *i** SR models', '*Added Value* of an *Actor* refers to the increase in the overall worth of the value network attributable to the presence of that *Actor*', and '*Added Value* of an *Actor* does not refer to the incremental increase in the worth of a *Value Object* attributable to any *Activity*'. However, none of the guidelines for *added-value* explain its calculation by estimating *willingness-to-pay* (*WP*) and approximation of *opportunity-cost* (*OC*). Similarly, some guidelines that relate to the calculation of *payoffs* in a Game Tree are 'Calculate *Payoffs* in Game Tree by evaluating satisfaction and denial of associated *softgoals* in *i** SR model' and 'While calculating associated *Payoffs* in Game Tree consider the relative *priorities* of *softgoals* in *i** SR model'. However, none of the guidelines for *payoff* explain techniques for translating relative *priorities* of *softgoals* into *payoffs*. In hindsight, the presence of guidelines to explain these notions would have simplified the application of our framework, to model and analyze this case, by presenting relevant instructions in a single base of knowledge.

To appraise usefulness, as noted above, we assessed our models and analyses separately. In the first pass, we examined the expressiveness of our framework by inspecting whether key ideas in text from the source literature were properly depicted in our models. To do this we performed a there-way match between the key ideas: (i) described in text in the source literature, (ii) documented in a list that we prepared based on parsing of text from the source literature, and (iii) depicted in our models. Upon conducting this evaluation, we uncovered some gaps that were attributable to our inability to perfectly extract text information from the source literature and express it diagrammatically in our visual models. The reason for this inability is that there are many ways to transform natural language text into visual models and, due to time allotted for this phase of our research, it was infeasible for us to apply all of them. As discussed above, we used a technique that comprised of part-of-speech tagging followed by content transformation to render key ideas from text into visual models. However, this process of transformation is neither standardized nor universally accepted. Researchers have proposed various techniques for developing model contents based on information in natural language text[40a,b]. Hence, it is possible that a different technique, from the one that we utilized, may have yielded a more complete and accurate list of key ideas from the source text content.

In the second pass, we judged whether the decisions portrayed in our models precisely reflected only those aspects of decisions that were explicitly described in text within the source literature. Upon performing this analysis, we recognized that there may have been omissions in some of the decisions that are represented in our models. The reason for this possibility is because our models depict a historical case that is chronicled as text within source literature where, in many cases, the result of a decision was documented but not the full range of options that were considered or the criteria that were used to compare them. In such cases, it was not possible for us to obtain definitive and conclusive information about the range of alternatives implicated in a decision or their attendant trade-offs. Therefore, we synthesized reasonable and customary options and criteria using our domain knowledge and understanding of the subject matter. However, it is possible that we missed some options, and their comparisons, that were considered by decision-makers in this case in the real-world. It is also possible that certain decisions that are expressed in our model do not fully comport with corresponding decisions in the real-world. This is because certain aspects of those decisions in our models may have been generated, as described above, by interpolating and extrapolating from those aspects of that decision that were explicitly detailed in text within the source literature. Not knowing whether each decision, that is depicted in our models, is complete or accurate means that challenges can be raised about conclusions resulting from the analysis of our models.

[40] (a) Examples of research papers in which different approaches are proposed include Liu et al (2014), Ghose et al (2014), and Jureta et al (2008). (b) Osman & Zalhan (2016) present a survey of techniques for developing visual models from text information.

In addition to critically reflecting on the usability and usefulness of our framework, we also identified the following general areas for improving our framework based on modeling and analysis of this case study:

- Visual scalability: We noticed that the size and complexity of *i** models grew quickly as *actors* and intentional elements were introduced. Connecting entities through links became increasingly complicated as *dependency* links between actors and *contribution* links between intentional elements within elements were introduced. Spatial placement of elements to minimize cross-overs of connecting links was difficult as the number of links grew. In some cases, elements needed to be repositioned repeatedly to simplify visual interpretability of a model.
- Temporal reasoning: We were unable to show history in the same model and had to make multiple models to represent As-Is and To-Be scenarios. None of the modeling languages in our framework support the depiction of time because neither *i** nor *e3value* support the concept of time and Game Tree only supports the concept of sequence. Due to this limitation we were unable to understand the impact of intervening duration between various pairs of steps. In coopetitive relationships, modeling of time is relevant because the analysis of path dependency requires an understanding of the sequence as well as intervening duration between steps (e.g., time between opportunistic and benevolent actions).
- Tool support: We developed models using Microsoft Visio with stencils for *i**, e3value, and Game Tree. Visio allowed us to construct visual diagrams, but we were not able to perform automated analysis of these diagrams (e.g., *goal* satisfaction, *payoff* comparison, *value* contrasting, etc.) because Visio does not support that functionality. We also tried Lucid Chart, and draw.io/diagrams.net but they also support diagramming but not analysis. piStar and ADOIT support diagraming and analysis of models but analytic support is partial and limited to a subset of analytic scenarios.

9.8 Summary

This chapter presented results of evaluating our framework to model and analyze a published case about coopetition between Amazon and Microsoft in the cloud-based database-as-a-service market. The main objectives of our evaluation were to: (1) discern the adequacy of our framework to model and analyze strategic coopetition; and (2) identify areas for improvement for our framework by critically reflecting upon its application to this case. This testing was conducted in two parallel streams. In the first stream, two subjects independently and separately developed models and analyses of this case. We analyzed the critical reflections provided by each subject about their perceptions of the adequacy of our framework for representing and reasoning about this case. In the second stream, we applied our framework to this case and developed *i**, e3value, and Game Tree models of As-Is and To-Be scenarios (included in Appendix 5). We shared our critical reflections vis-à-vis the sufficiency of our framework for articulating and assessing this case. In the next chapter we present results of applying our framework to express and evaluate an empirical case involving two coopeting startups in the data science professional development market in Toronto.

10. Empirical Case - Coopeting Startups in Data Science Professional Development Market

10.1 Introduction

The global demand for data science talent has grown significantly because it is regarded as a source of performance improvement in many industries. This growth in demand for data science talent has spawned a booming market for professional development programs. Entrepreneurs have launched new startups that provide such programs in the same market as traditional education institutions including universities and colleges. These startups include training bootcamps and mentorship academies that offer professional development programs either online, on-premise, or through a blended channel. Training bootcamps offer cohort-based training of a pre-set duration in a classroom setting with an accelerated curriculum. Mentorship academies offer personalized coaching to each mentee on an individual basis by pairing a mentee with a mentor, that is an experienced industry professional, for a fixed length of time. This market is extremely lucrative for startups due to high and rising demand for data science professional development programs in Toronto.

The empirical study presented in this chapter is based on year-long research that was conducted in the industry. It portrays the evolution of a competitive relationship between a training bootcamp and a mentorship academy, first into a pre-coopetitive and then into a coopetitive relationship. At the start of our research, the training bootcamp and mentorship academy were competing over learners, instructors, and clients. However, their growth was challenged by mutual rivals (e.g., well-established educational institutions) that had greater resources and were able to offer more comprehensive value propositions. This chapter presents results of applying our framework in this empirical study. The resulting conceptual models explain the win-win rationale for the strategic relationship between these startups.

10.2 Overview

Our empirical study focuses on two professional development startups in the Toronto market. One startup, referred to as Training Bootcamp (TB), offers classroom-based instruction to cohorts of students. Students apply to this program and, upon acceptance, undertake a twelve-week program of study that includes multiple courses that are taught by professional data scientists from the industry. Another startup, referred to as Mentorship Academy (MA), offers personalized one-on-one coaching to mentees by pairing them up with a mentor that is a seasoned data scientist from the industry. The mentor and the mentee develop a customized learning plan that spans twelve weeks and entitles the mentee to an allocation of their mentor's time. TB and MA also offer employment services to their graduates by referring them to job placement opportunities.

10.3 Methodology

We adopted action research (Eden, & Huxham, 1996) methodology to perform this empirical study. Avison, et al., (1999) state, "to make academic research relevant, researchers should try out their theories with practitioners in real situations and real organizations". Action research refers to a portfolio of techniques in which researchers participate actively to bring about changes in the domain that they are concomitantly studying (Eden, & Huxham, 1996). It is used in business research wherein researchers apply critical reflection to link 'doing' with 'studying' (Midgley, 2000). A key element of action research is the notion of 'intervention' which is defined as: "purposeful action by an agent to create change" (Midgley, 2000). Action research has been applied extensively to study coopetition in the industry[41].

10.4 Design

We applied our framework to study the relationship between TB and MA in the context of their stakeholders (i.e., customers, suppliers, and rivals). Our year-long empirical study was commenced in March 2019 and was concluded in March 2020. The founders[42] of these startups were members of our professional networks and were knowledgeable about our experience with advising startups. We were originally invited by founders of these startup separately to provide business advice to their startup on an individualized basis. We recruited these startups into our study upon perceiving these invitations as an opportunity for empirical research. We offered our advisory services to these startups in an arrangement where the startups would participate in our research project in lieu of paying us for advisory services. The founders of these startups agreed to participate in our study because they: (1) were interested in our advice, and (2) did not need to financially compensate us for our advice. They were comfortable with our use of data that were generated and gathered through these advisory engagements, for our research purposes.

The data for our empirical study were gathered through six one-hour interactive and participatory sessions with founders of each startup (i.e., six hours per startup). The format of each meeting consisted of an interview that was followed by a discussion which included conversation as well as activities for model development and evaluation. Interview questionnaires that were used to support data collection are included in Appendix 5. After each meeting, we also constructed models off-site and in our own time (i.e., this time was not counted in time spent with the founders of these startups) in advance of the next meeting. We

[41] Empirical studies where action research was used to analyze coopetition include: Abrahamsen, et al. (2016), Eriksson (2008), Kylanen, & Mariani (2012), Lindgren, & Holgersson (2012), and Van Buuren, Buijs, & Teisman (2010).

[42] The founding teams of TB and MA comprised of three members and two members respectively. In this chapter, we refer to each founder as 'Founder$_{TBx}$' or 'Founder$_{MAx}$' where 'TB' refers to Training Bootcamp, 'MA' refers to Mentorship Academy, and 'x' refers to an identifier of a specific founder in their startup. When we use the phrases 'founders of TB' or 'founders of MA' then we mean each founder of TB or MA respectively. However, when we refer to 'Founder$_{TBx}$' or 'Founder$_{MAx}$' then we are referring only to a specific founder 'x' of TB or MA respectively.

shared our models and analyses with these founders prior to each follow-up meeting. Models were explained and discussed in-person so that revisions could be made in an iterative and incremental manner.

We treated founders of these startups as clients rather than users of our modeling framework and shared our models and analyses with them in diagrammatic and verbal form. We did not expose them explicitly to the technical details of our framework (e.g., ontology, methodology, etc.) in depth. Instead, we focused our deliveries to artefacts (i.e., models) that resulted from the application of our framework to information about their startups. In meetings where any models were discussed, we requested founders of each startup to share their critical reflections about the adequacy and sufficiency of those models for supporting their strategic analysis needs. During the start of our empirical study, we also shared online weblinks to our knowledge catalogs (presented earlier in Chapters 5 and 6) with them so they could browse them independently to acquaint themselves with the content in each catalog. We also showed these catalogs to founders of each startup during in-person meetings to support our collaborative exploration of win-win strategies.

During each in-person meeting, we used our models and analyses to recommend specific activities and suggested particular actions to be performed by each startup. In the context of action research methodology, these function as interventions because an intervention is defined as “the range of planned, programmatic, and systematic activities intended to help an organization increase its effectiveness” (Coghlan, & Shani, 2013). Cumulatively, the differences between corresponding As-Is and To-Be models that are presented in this chapter, serve as a collection of interventions. This is because they represent structural reconfigurations in these startups that are motivated by a desire to improve the effectiveness of each startup.

10.5 Modelling and Analysis

The coopetitive relationship between TB and MA: (1) started as a purely competitive relationship (As-Is) that; (2) progressed into a pre-coopetitive relationship (Intermediate) and then; (3) developed into a coopetitive relationship (To-Be). Each of these transitions and stages are discussed in this section. Evolution of stages in this strategic relationship between TB and MA is depicted in Figure 10-1.

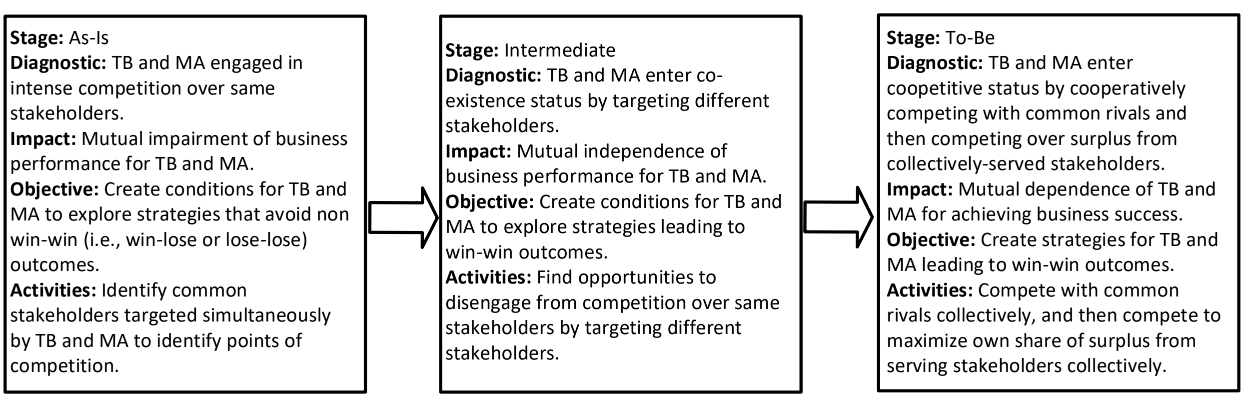

Figure 10-1 Evolution of stages in strategic relationship between TB and MA

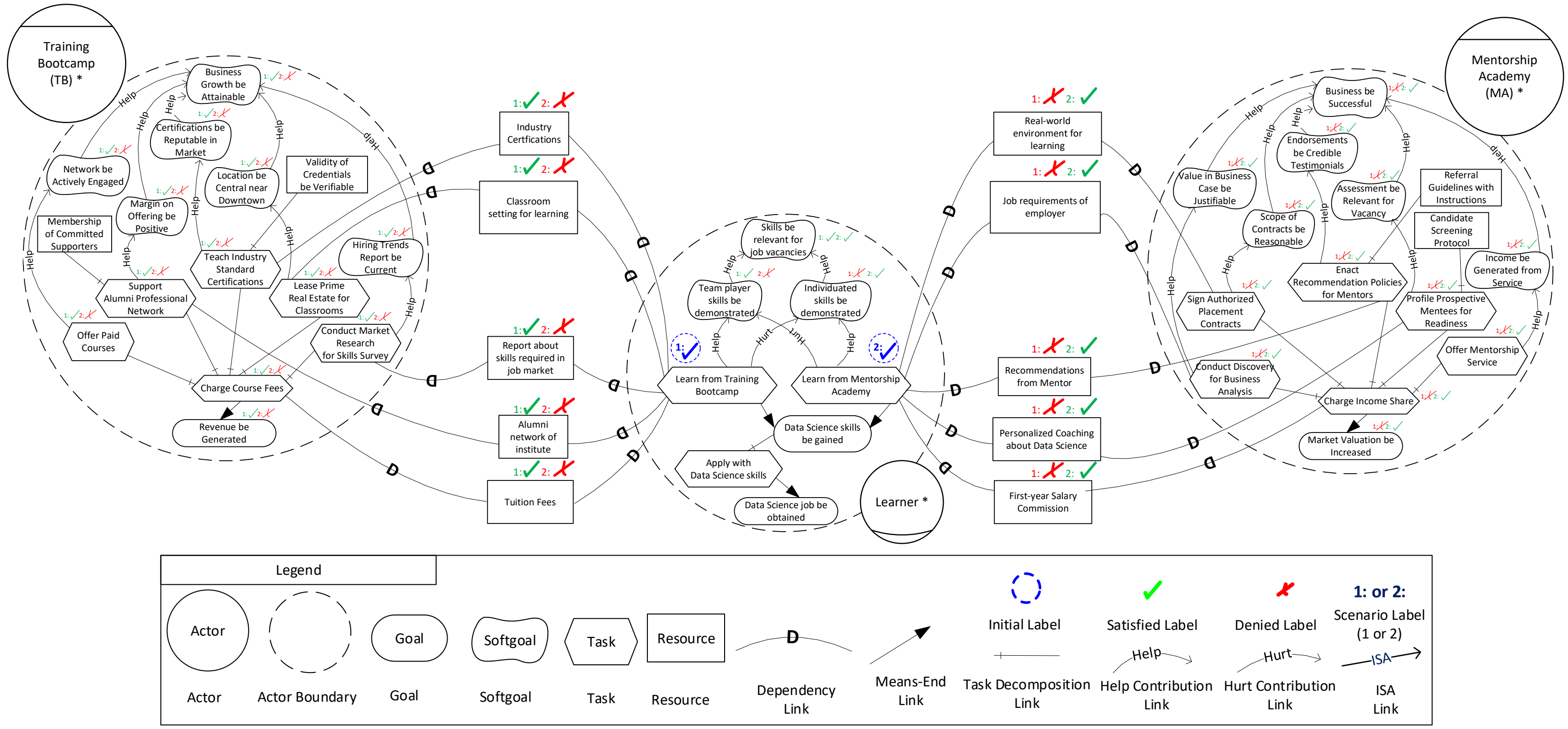

Figure 10-2 *i** model of relationship between TB, MA, and Learner in the past (i.e., As-Is scenario). Use of initial labeling (blue circle) is described in Section 5.2.

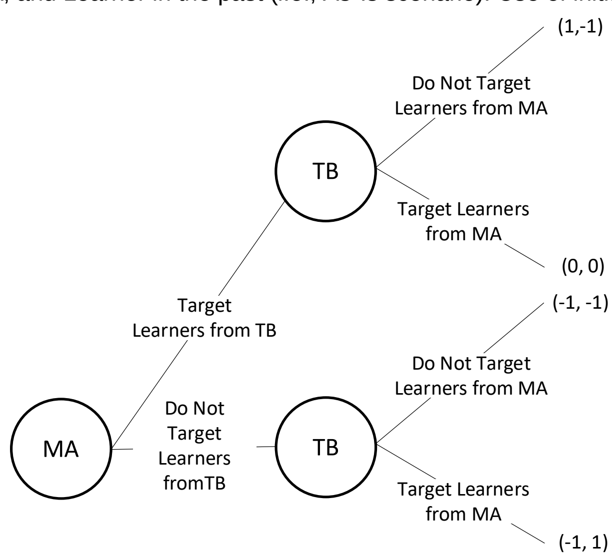

Figure 10-3 Game Tree displaying moves and countermoves available to TB, MA with respect to Learner in the past (i.e., As-Is scenario)

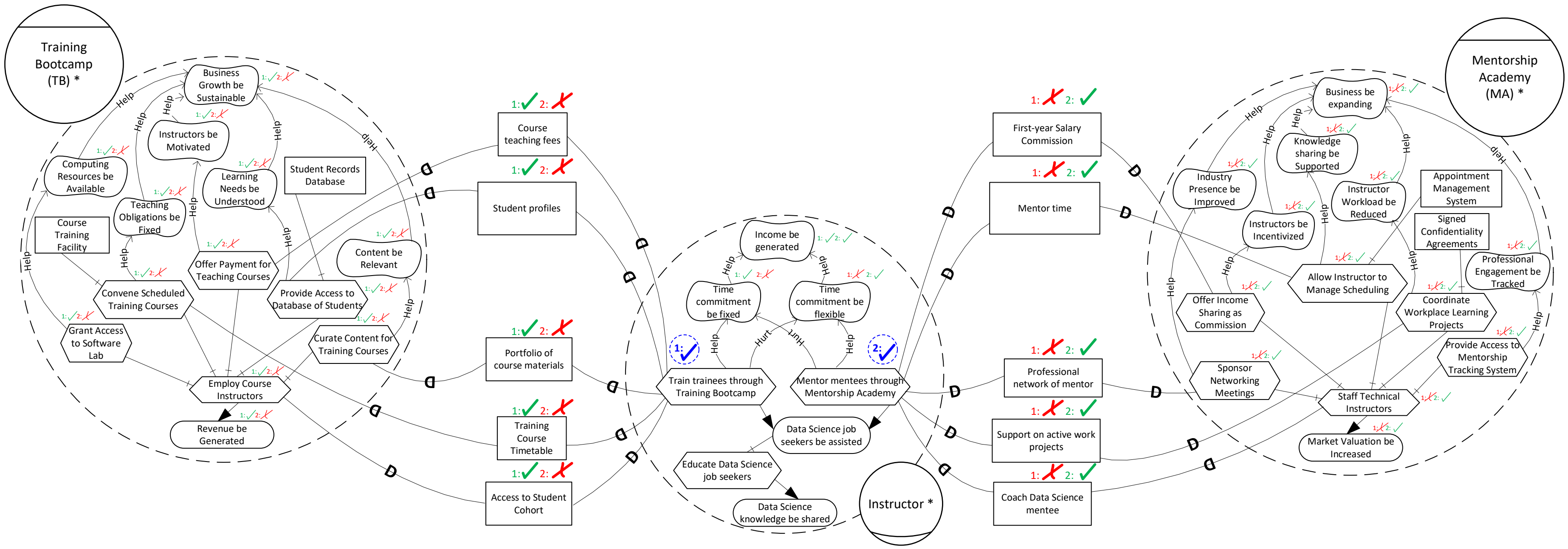

Figure 10-4 *i** model of relationship between TB, MA, and Instructor in the past (i.e., As-Is scenario). Use of initial labeling (blue circle) is described in Section 5.2.

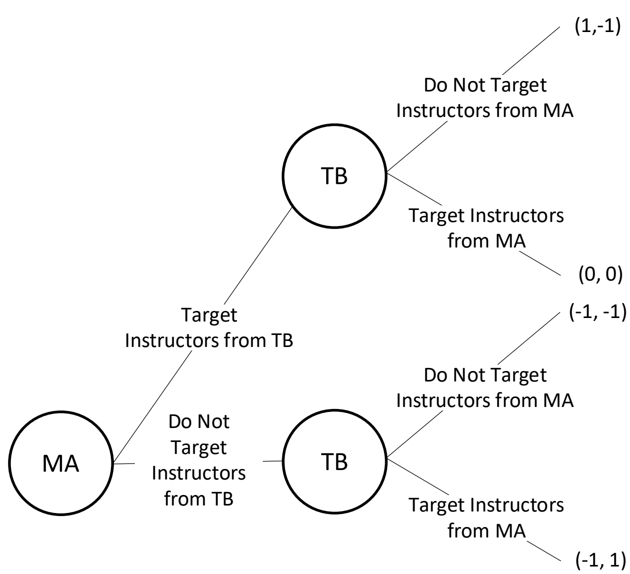

Figure 10-5 Game Tree displaying moves and countermoves available to TB, MA with respect to Learner in the past (i.e., As-Is scenario)

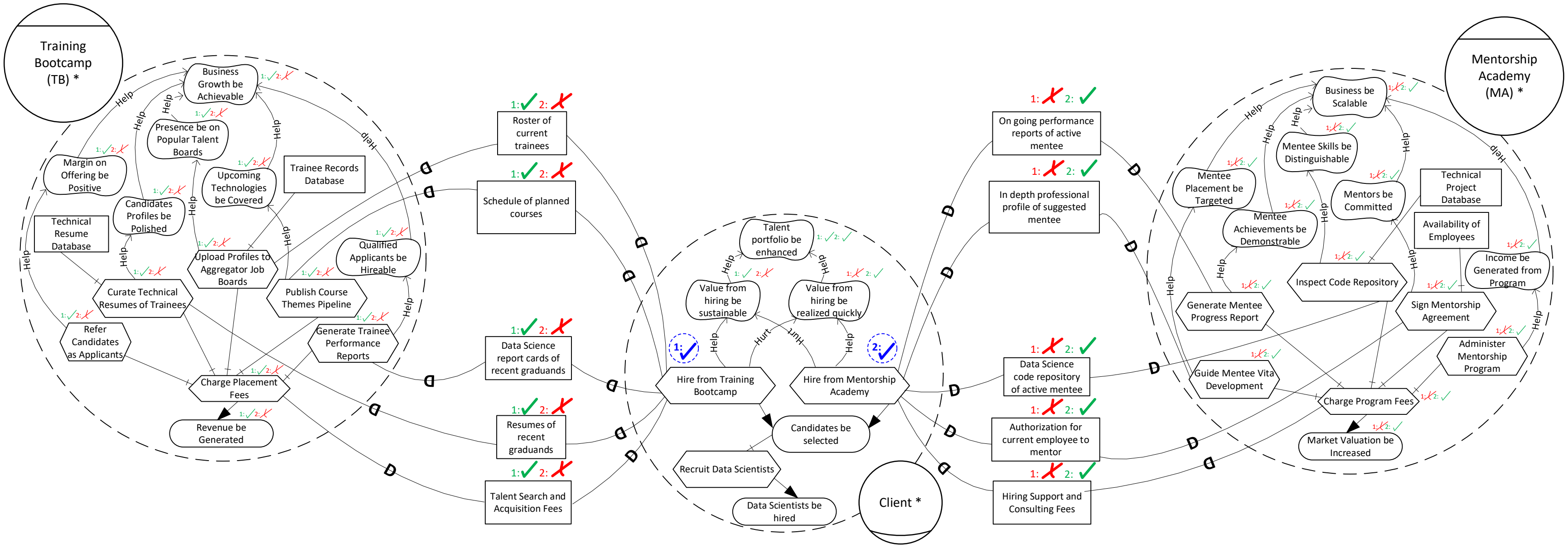

Figure 10-6 *i** model of relationship between TB, MA, and Client in the past (i.e., As-Is scenario). Use of initial labeling (blue circle) is described in Section 5.2.

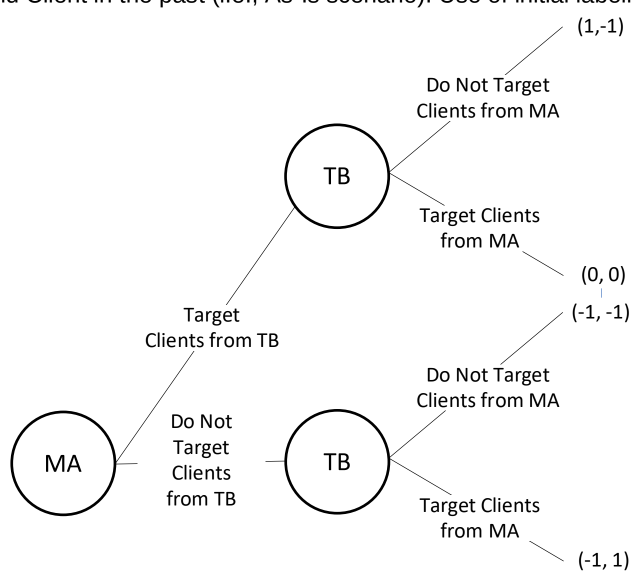

Figure 10-7 Game Tree displaying moves and countermoves available to TB, MA with respect to Client in the past (i.e., As-Is scenario)

10.5.1 As-Is configuration: Competitive relationship

Modeling phase: The key actors are the two startups (TB and MA), Instructor (input market), and Learner as well as Client (output market). An Instructor is a knowledge-holder (e.g., industry professional with expertise in data science) that wishes to satisfy its objectives (e.g., income supplementation) by sharing its knowledge about data science (e.g., by teaching data science courses). A Learner is a knowledge-seeker (e.g., aspiring entrant into the industry) that aims to fulfill its objectives (e.g., securing employment) by obtaining knowledge about data science (e.g., by completing data science coursework). A Client is a knowledge-user (e.g., for-profit business) that intends to benefit (e.g., improve profitability) through the application of Learner's knowledge (e.g., predictive modeling and forecasting).

For visual interpretability, we present *i** models separately for Learner (Figure 10-2), Instructor (Figure 10-4), and Client (Figure 10-6), showing their dependency relationships with TB and MA. These figures depict *actors* that are relevant in the As-Is scenario of our empirical study and represent our interpretation of the input and output markets as perceived by TB and MA prior to our intervention.

In the past (i.e., As-Is scenario), TB and MA did not analyze their input and output markets in a systematic or structured manner. TB and MA regarded their input and output markets to be comprised of three generic, undifferentiated, homogeneous, and monolithic stakeholders: Learner (Figure 10-2), Instructor (Figure 10-4), and Client (Figure 10-6). The internal intentional structures of TB, MA, and Learner are depicted in Figure 10-2, the internal intentional structures of TB, MA, and Instructor are depicted in Figure 10-4, and the internal intentional structures of TB, MA, and Client are depicted in Figure 10-6.

The top-level *goals* of TB and MA are Revenue be generated and Market valuation be increased respectively. These goals are achieved differently in the context of their relationships with each of Learner, Instructor, and Client. With respect to their relationships with Learner, TB's *goal* of Revenue be generated can be fulfilled by the performance of the *task* Charge course fees while MA's *goal* of Market valuation be increased can be fulfilled by the performance of the *task* Charge income share (Figure 10-2).

In terms of their relationships with Instructor, TB's *goal* of Revenue be generated can be fulfilled by the performance of the *task* Employ course instructors while MA's *goal* of Market valuation be increased can be fulfilled by the performance of the *task* Staff technical instructors (Figure 10-4). Regarding their relationships with Client, TB's *goal* of Revenue be generated can be fulfilled by the performance of the *task* Charge placement fees while MA's *goal* of Market valuation be increased can be fulfilled by the performance of the *task* Charge program fees (Figure 10-6).

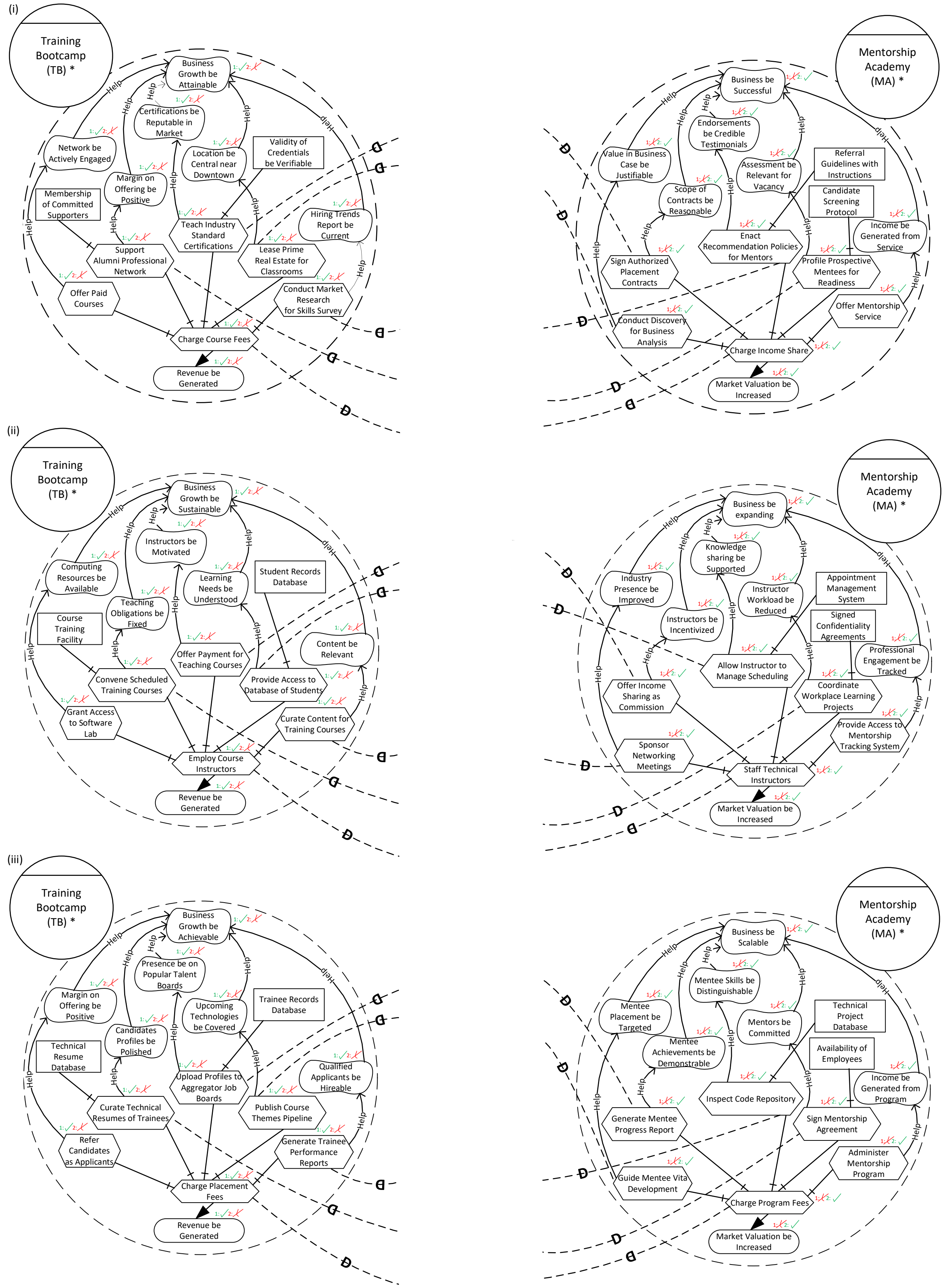

Figure 10-8 Satisfaction of intentional elements of “TB” and “MA” in scenarios 1 and 2 of As-Is configuration reproduced from Figures 10-2, 10-4, and 10-6. Dashed dependency links indicate that certain aspects of the original models are omitted. These model fragments show that when intentional elements of “TB” are satisfied then “MA’s” are denied and vice-versa.

Evaluation phase: In the As-Is configuration, TB and MA, adopted a competitive stance towards each other because they assumed that their service offerings and value propositions were regarded as substitutes by their stakeholders. In this first stage, shown in Figure 10-1, TB and MA compete over common stakeholders (Learner, Instructor, and Client). This does not lead to positive sum outcomes for TB or MA. This is shown via satisfaction labels attached to the subjects of the dependencies within scenarios 1 and 2 in Figure 10-8.

In our methodology, the evaluation phase involves the propagation of satisfaction labels on elements in *i** models as well as the calculation of *payoffs* based on satisfaction of intentional elements. Satisfaction labels are propagated over the *softgoals* of the customers based on completion of the *task* associated with Scenarios 1 and 2 in Figures 10-2, 10-4, and 10-6 respectively.

For ease of interpretation, satisfaction of intentional elements of TB and MA in Scenarios 1 and 2 from Figures 10-2, 10-4, and 10-6 are presented in Figure 10-8. The satisfaction labels in these model fragments show that when intentional elements of TB are satisfied then those in MA are denied and vice-versa.

Game Trees that depicts the *payoffs* associated with each *strategy* available to TB and MA vis-à-vis Learner, Instructor, and Client are presented in Figures 10-3, 10-5, and 10-7 respectively. The strategies that are available to TB and MA for dealing with each of these stakeholders are symmetrical (i.e., Target or Do Not Target).

Targeting entails the offering of defined value propositions to particular stakeholders (e.g., customers, suppliers) within specific markets (Ennew, 1993). For example, Learners studying in a course offered by TB can be regarded as targets by MA and, conversely, Learners participating in job-shadowing through MA can be regarded as targets by TB.

Three main strategic scenarios are possible: (i) TB and MA Target the same stakeholders within a market, (ii) only TB Targets or only MA Targets specific stakeholders within a market, (iii) neither TB nor MA Targets any stakeholders within a market.

Payoffs associated with each of these scenarios are calculated in the following way: (i) if both *players* Target then they compete with each other to acquire and retain customers by lowering their prices (e.g., cheaper for Learner and Client) and raising their costs (e.g., more lucrative for Instructors).

This scenario leads to a status quo *payoff* of zero (0) since each *player* gains some Learner, Instructor, and Client from the other *player* but also loses some Learner, Instructor, and Client to that other *player*, (ii) if only one *player* Targets then the *player* that acts has a positive *payoff* (+1) because it is able to acquire and retain customers thereby achieving its business objectives while the player that does not Target has a negative *payoff* (-1) because it foregoes economic opportunity in spite of incurring fixed and overhead costs to run its business, (iii) if neither player Targets then each earns a negative *payoff* (-1) as each foregoes economic opportunities in spite of incurring fixed as well as overhead costs to run their businesses.

It must be noted that the numerical values of *payoffs* are nominal and relative but not absolute or universal since they are meant to support the contrasting of *strategies* in terms their comparative gain or loss. In selecting a *strategy*, a rational *actor* is expected to prefer a *payoff* of 1 over a *payoff* of 0 and a *payoff* of 0 over a *payoff* of -1.

The Game Trees show that the *payoff* for Do Not Target is -1 for either *player* irrespective of the *strategy* chosen by the other *player*. However, the *payoff* for Target is 0 if both *players* Target and 1 if only one *player* decides to Target. Therefore, acting is the dominant *strategy* for TB and MA since it guarantees a higher *payoff*, compared to Do Not Target, regardless of the *strategy* chosen by the other *player*.

This analysis suggests that both TB and MA are expected to Target (i.e., recruit Learner, retain Instructor, and engage Client) leading to a *payoff* of 0 for both TB and MA.

Absence of a win-win *strategy* in the As-Is scenario triggered the Exploration phase in our methodology. The objective of this exploratory phase was a *strategy* that would support the attainment of positive *payoffs* by both TB and MA.

*i** models depicting the Intermediate scenario that resulted through the iterative and interactive application of the methodology presented in Section 8.3 are presented in Figures 10-10, 10-12, and 10-14 respectively. Corresponding Game Trees are in Figures 10-11, 10-13, and 10-15 respectively.

Exploration phase: The exploration phase in Section 8.3 presents six steps for generating a win-win *strategy* by adding or changing some elements in a relationship. In the case of TB and MA, we encouraged the founders of each startup to reconsider their assumptions of treating their three stakeholders in a generic, undifferentiated, homogeneous, and monolithic manner.

Our conceptual modeling methodology allowed TB and MA to create specialized types of *actors* based on generic types of *actors*. This enabled TB and MA to think about different and specific types of stakeholders that specialized Learner, Instructor, and Client. We followed the *i* actor* specialization technique described by López, Franch, & Marco (2012) to represent specializations of the Learner, Instructor, and Client entities.

10.5.2 Intermediate configuration: Pre-coopetitive relationship

Modeling phase: Modeling assisted the founders of TB and MA to perform a deeper examination of their stakeholders in terms of similarities and peculiarities in their objectives.

Further investigation and research by TB and MA revealed that they had different stakeholders even though those stakeholders shared certain aspects in common.

Figures 10-10, 10-12, and 10-14 show that TB dealt with Trainee, Trainer, and Agency Recruiter while MA dealt with Mentee, Mentor, and Corporate Staffing Scout. Trainee, Mentee, Instructor, Mentor, Agency Recruiter, and Corporate Staffing Scout possessed different intentional structures.

However, the commonalities in the intentional structures of Trainee and Mentee, Instructor and Mentor, as well as Agency Recruiter and Corporate Staffing Scout is depicted in the Learner, Instructor, and Client *actors* respectively.

For example, commonality in the internal intentional structures of Trainee and Mentee is depicted within Learner and is shown in Figure 10-9 (which is a model fragment of Figure 10-10).

Actor association to relate specialized entities with generalized entities is depicted via *is-a* links (per López, Franch, & Marco, 2012).

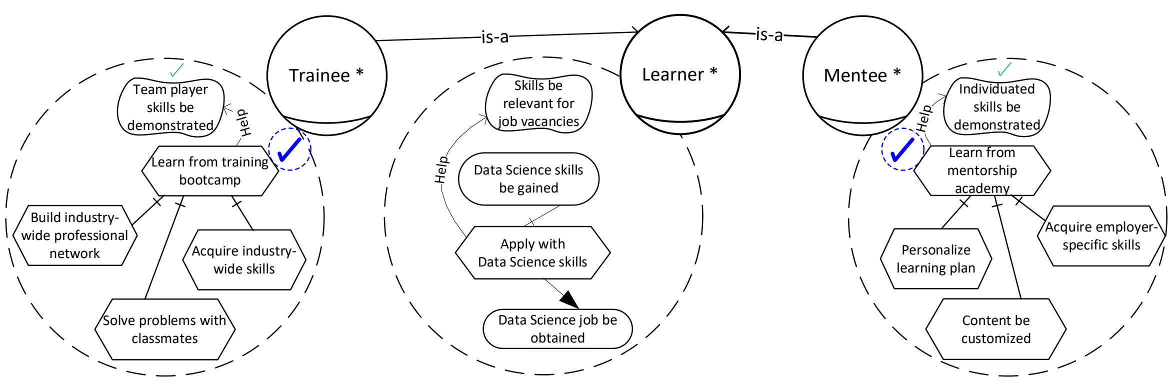

Figure 10-9 Model fragment showing commonality in the internal intentional structures of “Trainee” and “Mentee” is depicted within “Learner”. “Trainee” and “Mentee” are related to “Learner” using *is-a* link.

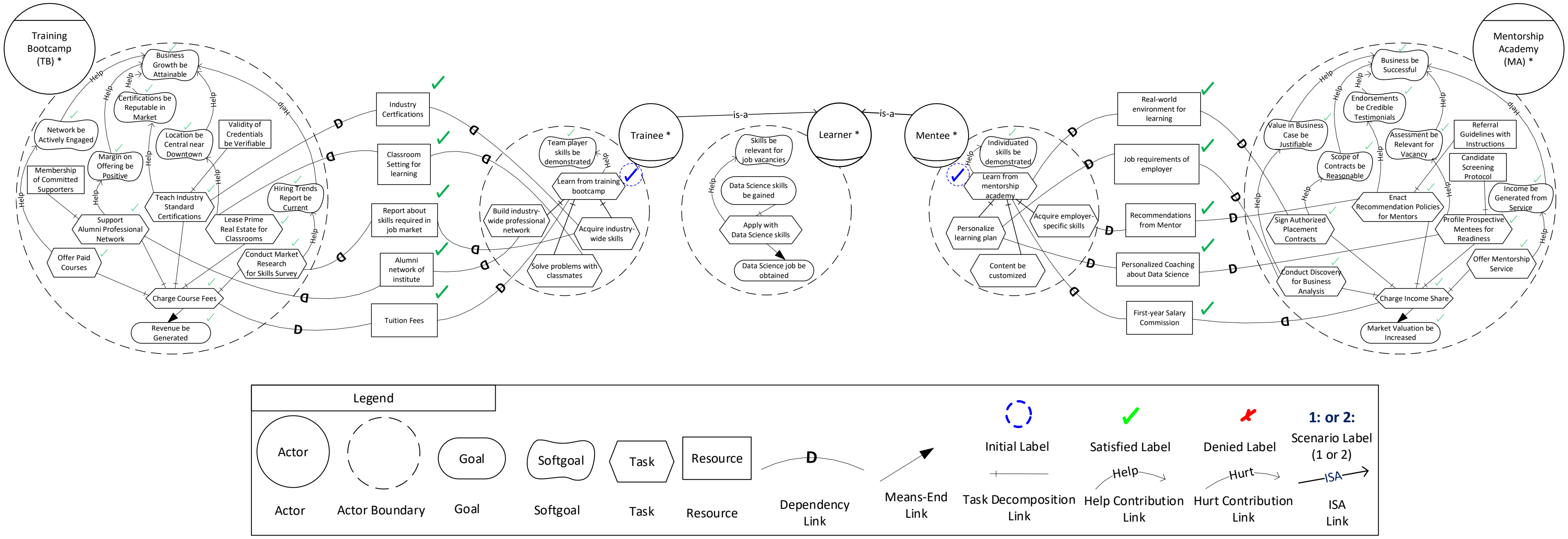

Figure 10-10 *i** model portraying relationship between TB, MA, Trainee, Mentee, and Learner in the future (i.e., Intermediate scenario)

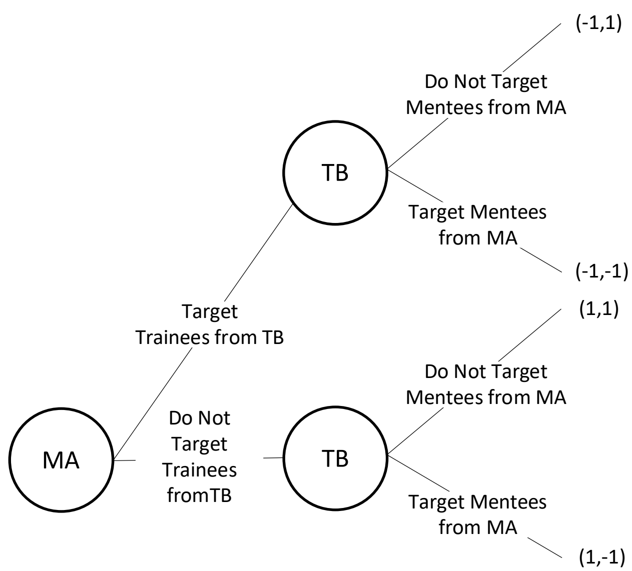

Figure 10-11 Game Tree displaying moves and countermoves available to TB, MA with respect to Trainee, and Mentee in the future (i.e., Intermediate scenario)

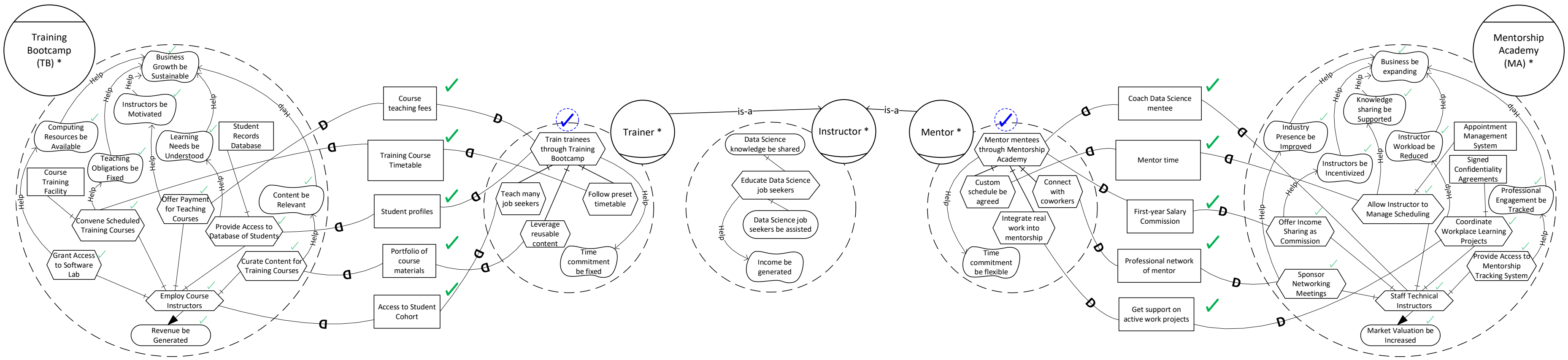

Figure 10-12 *i** model portraying relationship between TB, MA, Trainer, Mentor, and Instructor in the future (i.e., Intermediate scenario)

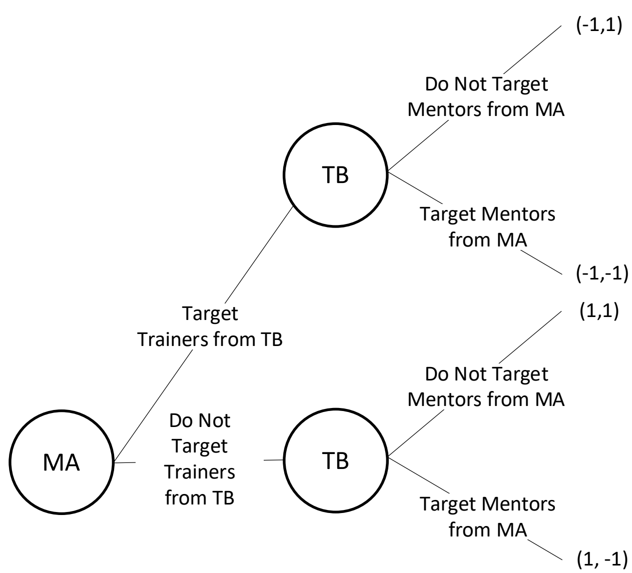

Figure 10-13 Game Tree displaying moves and countermoves available to TB, MA with respect to Trainers, and Mentor in the future (i.e., Intermediate scenario)

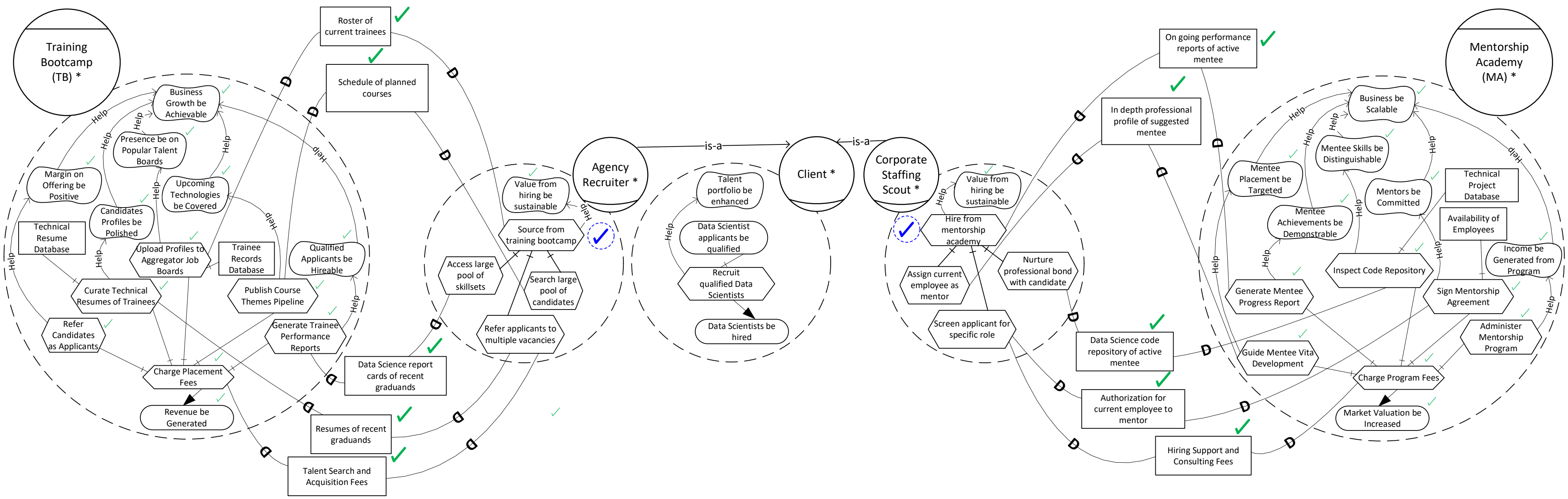

Figure 10-14 *i** model portraying relationship between TB, MA, Agency Recruiter, Corporate Staffing Scout, and Client in the future (i.e., Intermediate scenario)

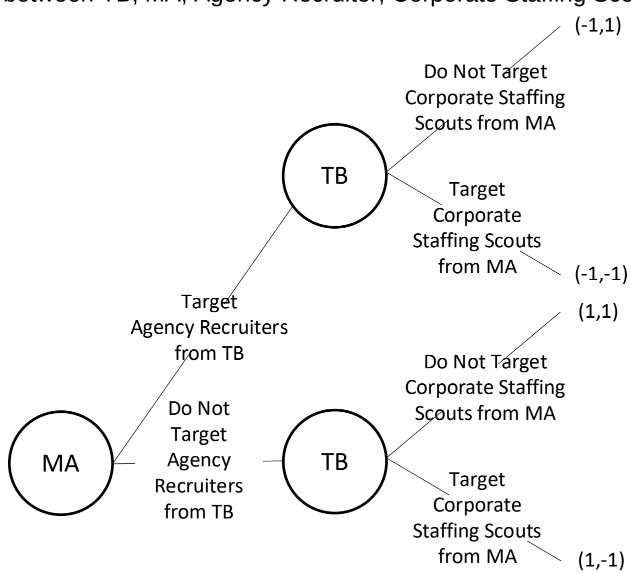

Figure 10-15 Game Tree displaying moves and countermoves available to TB, MA with respect to AR, and CSS in the future (i.e., Intermediate scenario)

Evaluation phase: Applying the evaluation phase of Section 8.3 over the models of the Intermediate configuration shows that TB and MA are not in a competitive relationship since they deal with different stakeholders.

This means that it is possible for TB and MA to co-exist so that *goals* of TB and MA are fulfilled independently of each other. In this second stage, shown in Figure 10-1, TB and MA co-exist but do not cooperate. This can potentially benefit their mutual rival if that rival can offer certain value propositions by itself that TB and MA can only offer jointly. The *strategies* that are available to TB and MA in the Intermediate configuration do not involve the same stakeholders as those in Figures 10-3, 10-5, and 10-7.

The *payoffs* in the Intermediate configuration (Figures 10-11, 10-13, and 10-15) are different from the As-Is configuration because TB and MA do not regard each other as competitors any longer, and they do not conflict over the same stakeholders.

In the As-Is scenario, a *payoff* of 0 resulted (Figures 10-3, 10-5, and 10-7) for TB and MA when both *players* Target the same stakeholders, however, in the Intermediate scenario, a negative *payoff* (-1) results for TB and MA when both *players* Target each other's stakeholders (Figure 10-16). This is because if TB attempts to poach Mentee, Mentor, or Corporate Staffing Scout from MA then TB will waste its resources by targeting the wrong stakeholders while foregoing the opportunity to engage with the right stakeholders.

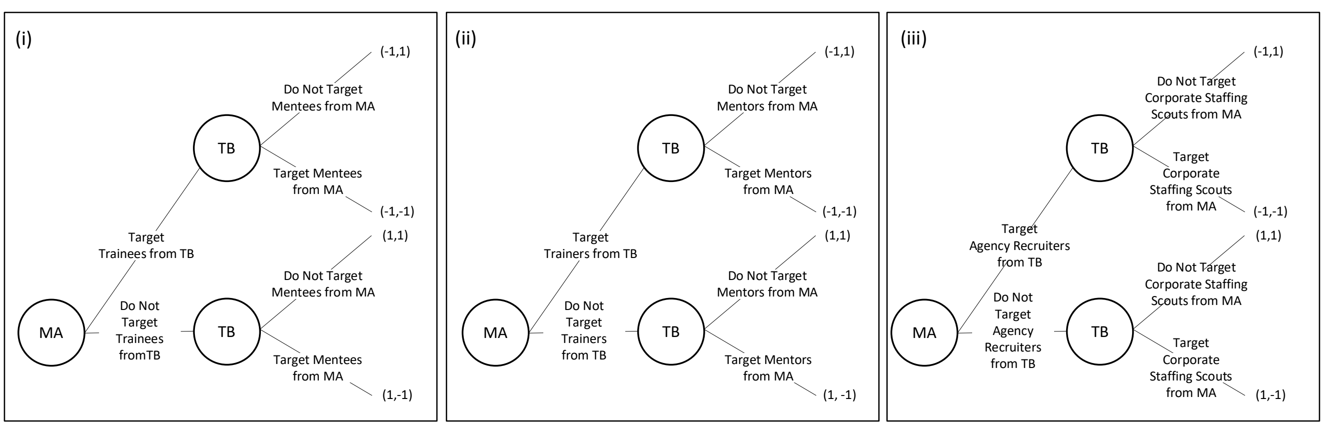

Figure 10-16 Game Trees from Figures 10-11, 10-13, and 10-15 are reproduced in (i), (ii), and (iii) respectively

Similarly, if MA attempts to poach Trainee, Trainer, or Agency Recruiter from TB then MA will waste its resources by targeting the wrong stakeholders while foregoing the opportunity to engage with the right stakeholders. Behaving in this way will put downward pressure on their margins and deplete their profitability which is a contributor to their business objectives (TB: Revenue be generated and MA: Market valuation be increased).

However, if neither TB nor MA behave in a rivalrous manner (i.e., both Do Not Target then both will earn a positive *payoff* (+1) because both will focus on engaging with stakeholders that are right for them. This is shown within Game Trees from Figures 10-11, 10-13, and 10-15 that are reproduced in Figure 10-16 for convenience.

This demonstrates the application of the methodology presented in Section 8.3 to generate a win-win *strategy*. However, while this Intermediate configuration represents a win-win strategy (i.e., one in which both players have a positive *payoff*), it does not represent a coopetitive relationship because in this Intermediate configuration both players co-exist without cooperating.

10.5.3 To-Be configuration: Coopetitive relationship

Modeling phase: Co-existence, as depicted in the Intermediate configuration, is a suitable arrangement for MA and TB when other competitors are excluded from analysis. However, the market for data science talent in Toronto is large and growing due to the surge in popularity of applied artificial intelligence in the industry. Therefore, many educational institutions offer professional development programs to learners that aspire to enter and succeed in this attractive job market.

Learner can enroll in data science educational programs at TB and MA as well as in privately-owned businesses such as in a Private College (PC). Similarly, as discussed above, graduates and alumni from these programs are placed into jobs in the industry by Corporate Staffing Scout (CS), that hire staff for their organizations, as well as Agency Recruiter (AR), that hire employees for their client organizations.

An *i** model portraying the relationship between TB, MA, PC, CL, AR, and CS in the present (i.e., Intermediary configuration) is depicted in Figure 10-17.

CL, AR, and CS source data science talent from TB, MA, and PC. TB and MA target different client segments (i.e., AR and CS respectively) but PC targets both client segments. Therefore, PC is a common rival of AR and CS. PC is a mature business and it can address a larger market as well as offer a wider range of services than TB and MA can individually as startups.

CL has a goal Data Scientists be hired which is a common objective for AR and CS. However, AR and CS adopt different means to achieve this end. CS sources Individually-mentored candidates while AR sources Classroom-trained candidates. AR can source Classroom-trained candidates from a TB or a PC and a CS can source Individually-mentored candidates from a MA or a PC.

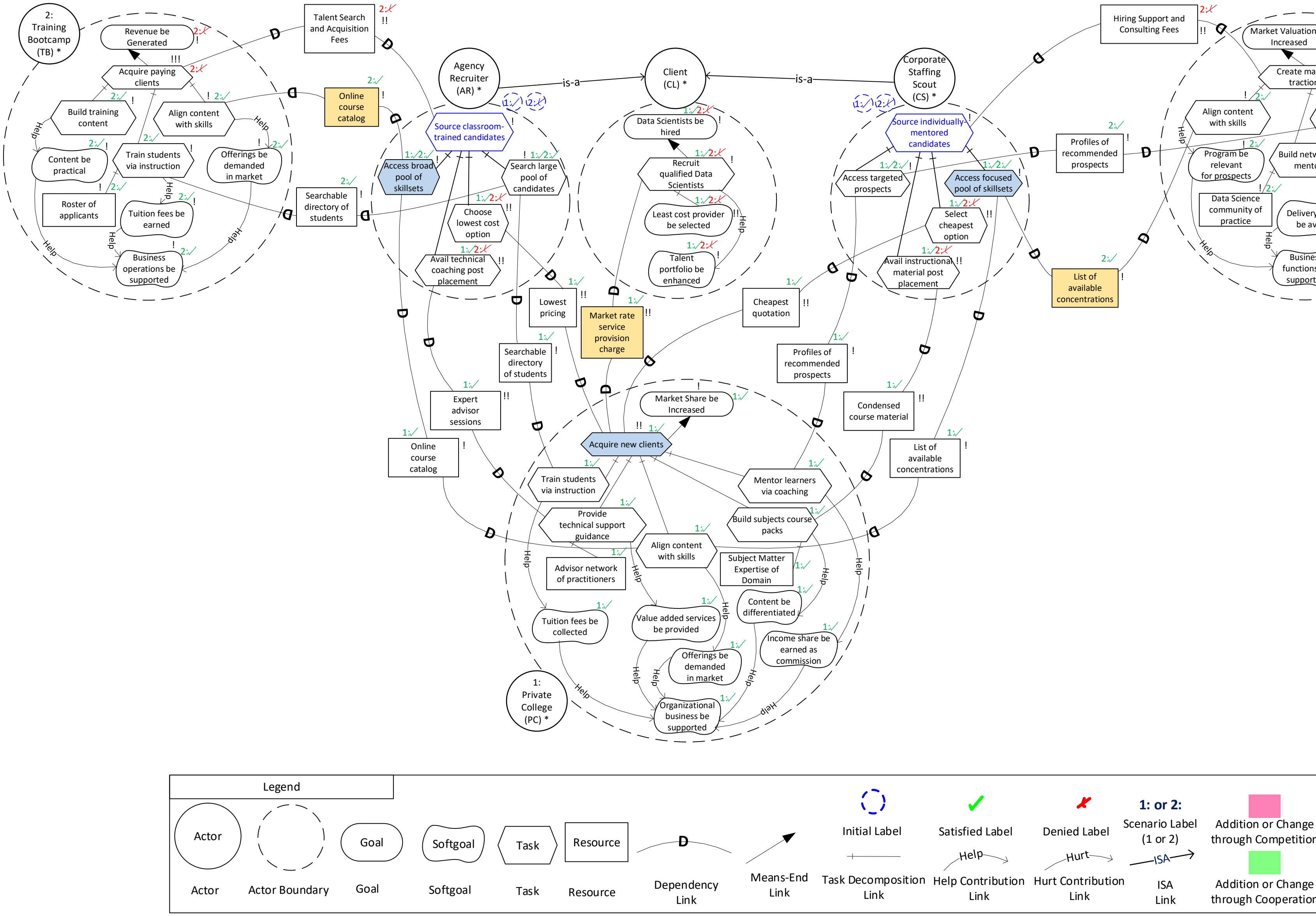

Figure 10-17 *i** model portraying relationship between TB, MA, PC, CL, AR, and CS in the present (i.e., Intermediary configuration)

To achieve its highest-level *task*, AR requires lower-level *tasks* to be performed including Access broad pool of skillsets, Avail technical coaching post placement, Choose lowest cost option, and Search large pool of candidates.

Similarly, to achieve its highest-level *task*, CS also requires lower-level tasks to be performed including Access targeted prospects, Avail instructional material post placement, Select cheapest option, and Access focused pool of skillsets. AR depends on TB for Online course catalog and Searchable directory of students while TB depends on AR for Talent search and acquisition fees which is a premium service.

AR depends on PC for Online course catalog, Searchable directory of students, Expert advisor sessions, and Lowest pricing while PC depends on CL (of which AR is a specialization) for Service provision charge based on the market rate. Similarly, CS depends on MA for Profiles of recommended prospects and List of available concentrations while MA depends on CS for Hiring support and consulting fees which is a premium service.

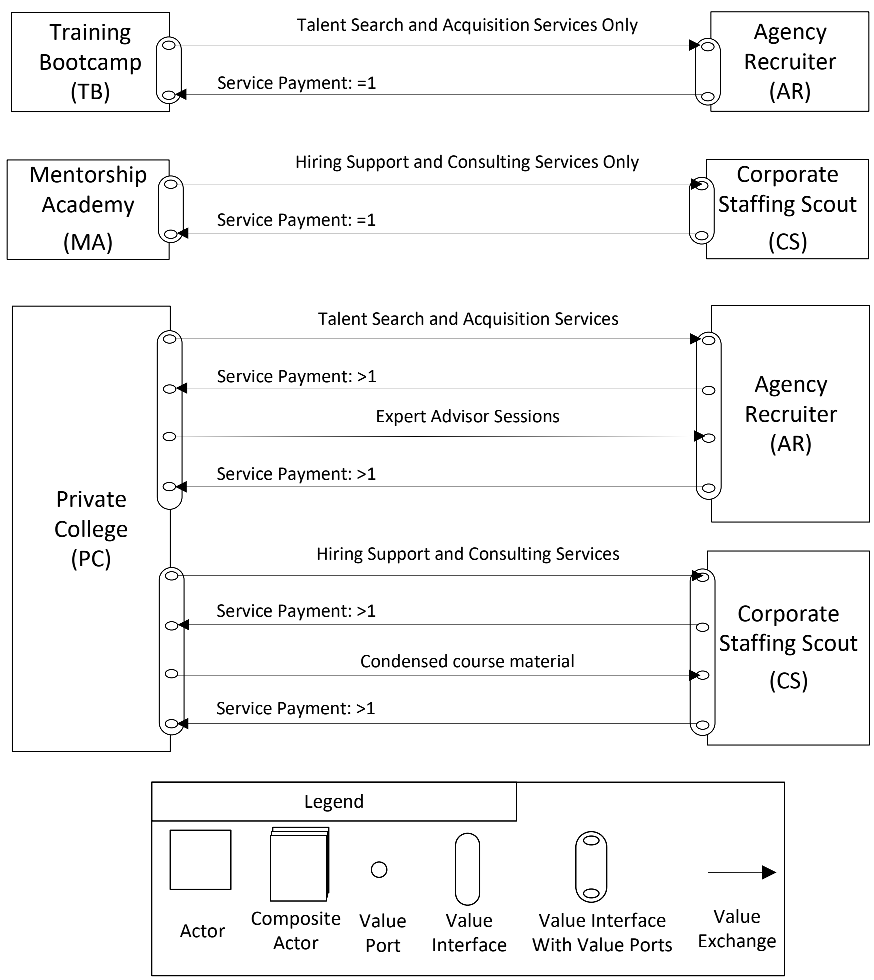

Figure 10-18 e3value diagram of present relationship between TB, MA, PC, AR, and CS (i.e., Intermediate)

CS depends on PC for Profiles of recommended prospects, List of available concentrations, Condensed course materials, and Cheapest quotation while PC depends on CL (of which CS is a specialization) for Service provision charge that is based on the market rate.

In customary *i** usage, when a receiving model element has multiple inbound *dependencies* then it means that it depends on all those *dependencies* simultaneously. However, in Figure 10-17, we show inbound *dependencies* to a model element from different *dependees* (*actors* that are depended upon) as representing separate scenarios.

This is necessary for avoiding proliferation of duplicate model elements corresponding with each scenario. For example, AR comprises a *task* Search large pool of candidates that depends on both TB and PC for Searchable directory of students.

Here, we do not wish to imply that AR depends on both TB and PC at the same time (i.e., customary *i** usage) but rather that either TB or PC can fulfil AR's requirement of a Searchable directory of students. This implies that TB and PC serve as substitutes from the perspective of AR. Similarly, MA and PC serve as substitutes from the perspective of CS.

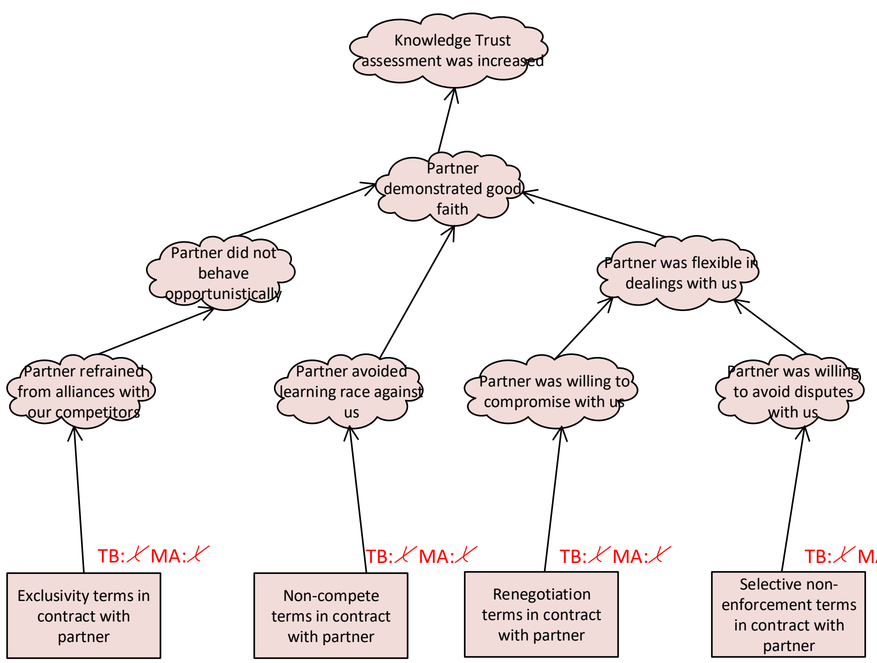

Figure 10-19 Perceived Trust Assessment between TB and MA at present (i.e., Intermediate)

An e3value diagram of the relationship between TB, MA, PC, AR, and CS in the present (i.e., Intermediate configuration) is depicted in Figure 10-18. It corresponds to the *i** model in Figure 10-17. TB provides Talent search and acquisition services only to AR and in return it obtains a Service Payment: =1.

Similarly, MA delivers Hiring support and consulting services only to CS and it too obtains a Service Payment: =1 in return. PC offers Talent search and acquisition services as well as Expert advisor sessions to AR in return for Service Payment: >1.

PC also provides Hiring support and consulting services as well as Condensed course material to CS also in return for Service Payment: >1.

Rationale for these payments is discussed in the Evaluation section below. It must be noted that these amounts of payments (i.e., *value objects*) are nominal and relative but not absolute or universal since they are meant to support the contrasting of *strategies* in terms their comparative worth for an *actor*.

The perceived trust assessment between TB and MA at present is depicted in Figure 10-19. It is an instantiation of the Calculative trust assessment segment of the *belief* catalog for trust assessment that is presented in Section 6.3.1.

It expresses the current perception of trust assessment between TB and MA. TB and MA were competitors in the past and did not have a history of cooperation with each other. Based on our advice, they had stopped competing and were co-existing in the same market.

However, they had never collaborated in the past and had not shared any of the informational *resources* that are listed in Figure 10-19. Crosses above each informational *resource*, and pink coloration of those resources as well as hierarchy of *beliefs* indicates that, there was a non-existing degree of trust assessment between TB and MA at present.

Evaluation phase: We have labeled scenarios as 1 and 2 in Figure 10-17 using the scenario labelling technique described in Section 5.2. In Scenario 1, AR and MA conduct business with PC while in Scenario 2, AR conducts business with TB while CS conducts business with MA.

AR can only perform two of its four *sub-tasks* by relying on TB (Scenario 2) but it can perform all four of the *sub-tasks* by relying on PC (Scenario 1). TB can only support two of AR's *sub-tasks* because for one *sub-task* (avail technical coaching post placement) it does not offer any support (i.e., there is no inbound dependency from TB to AR) and for the other *sub-task* (Choose lowest cost option) it does not offer a suitable value proposition because its offering is premium rather than cut rate.

Similarly, CS can only perform two of its four *sub-tasks* by relying on MA (Scenario 2) but it can perform all four of the *sub-tasks* by relying on PC (Scenario 1). MA can only support two of CS's *sub-tasks* because for one sub-task (Avail instructional material post placement) it cannot offer any support (i.e., there is no inbound dependency from MA to CS) and for the other *sub-task* (Select cheapest option) it does not offer an appropriate proposition as its offering is premium rather than economical.

Service Payment amounts for an *actor* (i.e., payee), in Figure 10-18, are calculated by applying the concepts of willingness-to-pay and opportunity-cost that are outlined in Section 7.4. Service Payment: =1 represents a baseline situation in which some but not all intentional elements of the payer are satisfied.

Service Payment: >1 represents an alternate situation in which more intentional elements of that payer are satisfied in comparison to the baseline. Therefore, the payer has a higher willingness-to-pay in the alternate situation than in the baseline.

Similarly, the Service Payment is greater in the alternate situation than in the baseline because the payee has to forego satisfaction of more intentional elements in the baseline than in the alternate scenario (i.e., payee has a lower opportunity cost in the baseline). Therefore, TB and MA earn payments of Service Payment: =1 each from AR and CS respectively because TB assists AR to perform only two of its *sub-tasks* and MA assists CS to conduct only two of its *sub-tasks*.

Using this technique, PC earns two Service Payment: >1 from AR and two Service Payment: >1 from CS because it assists AR and CS to complete four *sub-tasks* each. PC earns greater amounts than TB and MA by serving AR and CS respectively— moreover, it does so by enabling AR and CS to perform *sub-tasks* that neither TB nor MA can support alone.

Data for calculating degrees of relative dependence among *actors* TB, AR, MA, CS, PC, and CL based on the model in Figure 10-17 are presented in Table 10-1. Due to page width limitations, entries in the first four columns of Table 10-1 are abbreviated. Each abbreviation includes the first letter of each word in the relevant model element.

Depender	Dependee	Dependum	Intentional Element in Depender	Importance of Dependum (D)	Importance of Intentional Element (I)	D * I	Discount Factor	Discounted Degree of Dependence
TB	AR	TSAF	APC	2	3	6	(1/1) = 1	6
AR	TB	OCC	ABPS	1	1	1	(1/1) = 1	1
AR	TB	SDS	SLPC	1	1	1	(1/1) = 1	1
MA	CS	HSCF	CMT	2	3	6	(1/1) = 1	6
CS	MA	PRP	ATP	1	1	1	(1/1) = 1	1
CS	MA	LAC	AFPS	1	1	1	(1/1) = 1	1
PC	CL	MRSPC	ANC	2	2	4	(1/1) = 1	4
AR	PC	LP	CLCO	2	2	4	(1/1) = 1	4
AR	PC	EAS	ATCPP	2	2	4	(1/1) = 1	4
AR	PC	SDS	SLPC	1	1	1	(1/1) = 1	1
AR	PC	OCC	ABPS	1	1	1	(1/1) = 1	1
CS	PC	CQ	SCO	2	2	4	(1/1) = 1	4
CS	PC	CCM	AIMPP	2	2	4	(1/1) = 1	4
CS	PC	PRP	ATP	1	1	1	(1/1) = 1	1
CS	PC	LAC	AFPS	1	1	1	(1/1) = 1	1

Table 10-1 Data for calculating degrees of relative dependence among *actors* in Figure 10-17 (i.e, Intermediate)

Actors	Relative Dependence
TB:AR	3:1
MA:CS	3:1
PC:AR	2:5
PC:CS	2:5

Table 10-2 Degrees of relative dependence among *actors* in Figure 10-17 (i.e, Intermediate configuration)

Some *dependums* are colored yellow and their corresponding intentional elements within *dependers* are colored blue as examples in Table 10-1 as well as Figure 10-17 respectively. This is done for visual clarity so that the reader can follow the naming pattern that we have adopted due to page width constraints in Table 10-1. For example, AR refers to Agency Recruiter, OCC refers to Online course catalog, and ABPS refers to Access broad pool of skillsets.

We calculate degrees of relative dependence among these *actors* by applying the technique outlined in Section 6.5.2 to the data in Table 10-1. Degrees of relative dependence between *actors* TB, AR, MA, CS, PC, and CL are shown in Table 10-2.

TB depends on AR three times as much as AR depends on TB and MA also depends on CS three times as much as CS depends on MA. This is because, as discussed above, TB and MA do not offer practical value propositions to AR and CS respectively. Neither TB nor MA can support AR and CS in completing all of their respective *sub-tasks*. This means that the bargaining power of TB and MA relative to AR and CS respectively is weak.

By contrast, both AR and CS depend on PC two and a half times as much as PC depends on either of them. This is because PC is the only *actor* in this market that can support AR and CS to perform all of their *sub-tasks*. AR and CS do not have viable substitutes for PC in the market while AR and CS are substitutes from the perspective of PC.

The reasoning, presented in this Evaluation phase of the Intermediary configuration, suggests PC is preferred by both AR and CS in the as-is configuration as neither TB nor MA can address their needs individually. This means that TB will not be able to satisfy its top-level *goal* of Revenue be generated since it depends on a *task* Acquire paying clients which depends on Talent search and acquisition fees from AR.

Similarly, MA will not be able to satisfy its top-level *goal* of Market valuation be increased since it depends on a *task* Create market traction which depends on Hiring support and consulting fees from CS. Recognition of this inability to succeed in their targeted market segments engendered a search for viable business strategies by the founders of TB and MA that was supported by us. This search comprised of two phases and its result is explicated in the Exploration phase.

Exploration phase: An *i** model showing the result of the exploration phase leading to the To-Be configuration is presented in Figure 10-20. In the first phase, TB and MA needed a cooperative arrangement so each could help the other to fill a gap in their offering to AR and CS respectively. This search was supported by our cooperation *goal* catalog (Section 5.3.2). Intentional elements representing additions or changes that were caused by cooperation are depicted with green color in the *i** model.

The *dependums* that are generated by consulting the cooperation *goal* catalog have an importance degree of !! (2) because they are necessary for TB and MA to offer attractive value propositions to AR and CS respectively. Without these *dependums* neither TB nor MAis likely to prevail against PC.

In the Intermediary configuration (Figure 10-17), TB was unable to offer Avail technical coaching post placement by itself and MA was unable to offer Avail instructional material post placement on its own. However, TB supports MA by providing access to its Technical documentation (Technology be pooled in the cooperation goal catalog) and MA assists TB by providing Access to subject matter experts (Talent be pooled in the cooperation goal catalog) in Figure 10-20.

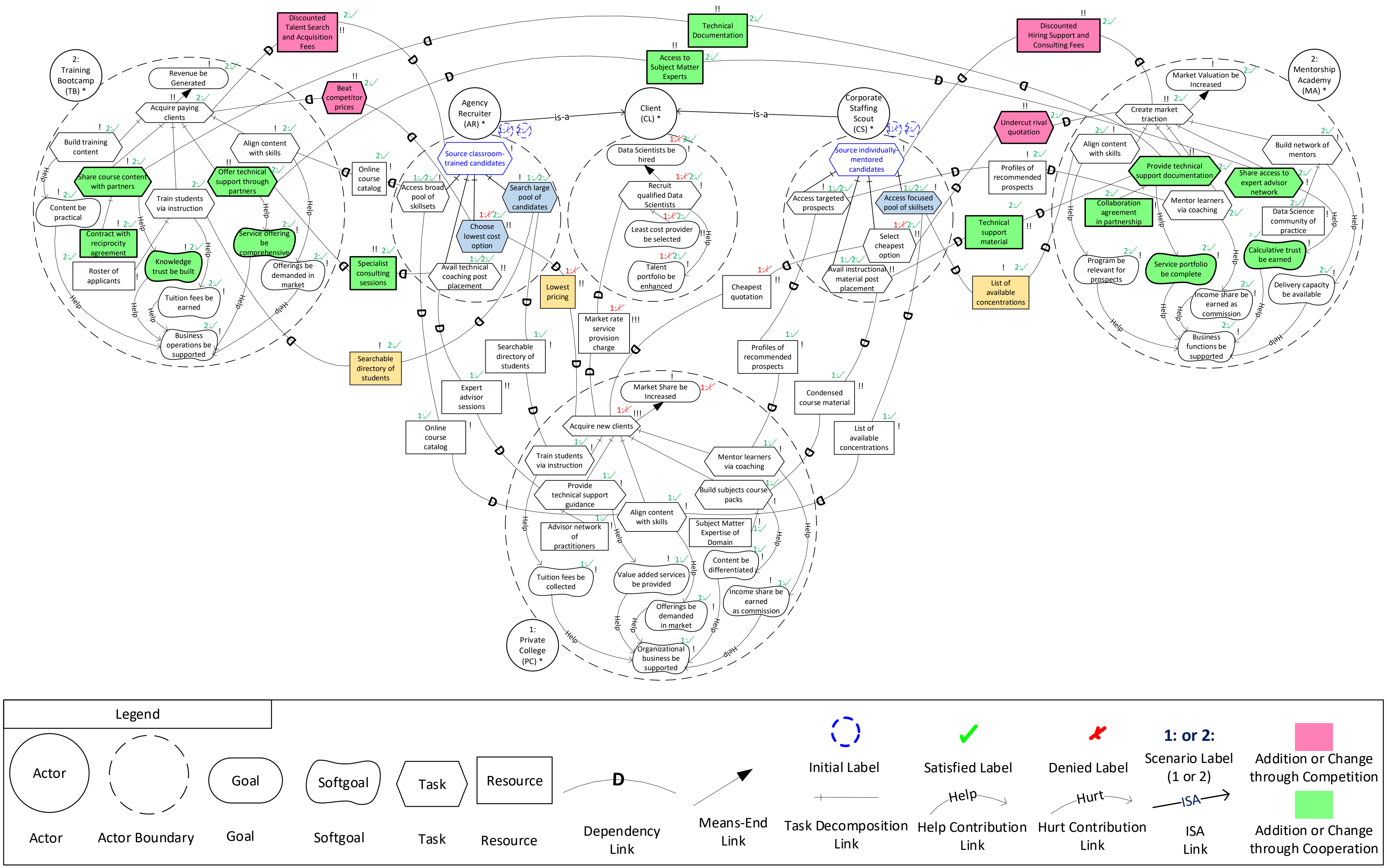

Figure 10-20 *i** model portraying relationship between TB, MA, PC, CL, AR, and CS in the future (i.e., To-Be)

By doing this, TB is able to support AR's *sub-task* of Avail technical coaching post placement and MA is able to support CS's *sub-task* of Avail instructional material post placement. This elevates the worth of value propositions by TB and MA for AR and CS respectively because these offerings were not available in the Intermediary configuration (Figure 10-17).

In the second phase, TB and MA needed to devise competitive positions whereby each could individually challenge PC in the AR and MA market segments respectively. This was supported by our competition *goal* catalog (Section 5.3.1). TB and MA recognized that AR and CS were cost-conscious and exhibited high elasticity of demand (i.e., price was the primary factor in their decision-making). Therefore, TB adopted a competitive position of Beat competitor prices (Pricing models be advantageous in the competition goal catalog) and MA adopted a competition position of Undercut rival quotation (Pricing discounts be offered in the competition goal catalog).

This allowed TB and MA to replace PC as the preferred service provider for AR and CS respectively in the To-Be configuration. TB's ability to Beat competitor prices and MA's ability to Undercut rival quotation means that TB will be able to support AR in performing its *sub-task* of Choose lowest cost option and MA will be able to support CS in performing its *sub-task* of Select cheapest option.

An e3value diagram of the relationship between TB, MA, PC, AR, and CS in the future (i.e., To-Be configuration) is depicted in Figure 10-21. It corresponds to the *i** model in Figure 10-20. It shows that TB provides Talent search and acquisition services directly to AR as well as Condensed course material indirectly to CS (i.e., through MA).

Similarly, MA delivers Hiring support and consulting services directly to CS as well as Expert advisor sessions indirectly to AR (i.e., through TB). In this configuration, PC continues to offer Talent search and acquisition services as well as Expert advisor sessions to AR. PC also provides Hiring support and consulting services as well as Condensed course material to CS.

Rationale for payments is discussed in the Evaluation section below. As noted earlier, these amounts of payments (i.e., *value objects*) are nominal and relative but not absolute or universal since they are meant for contrasting of *strategies* in terms their comparative worth for an *actor*.

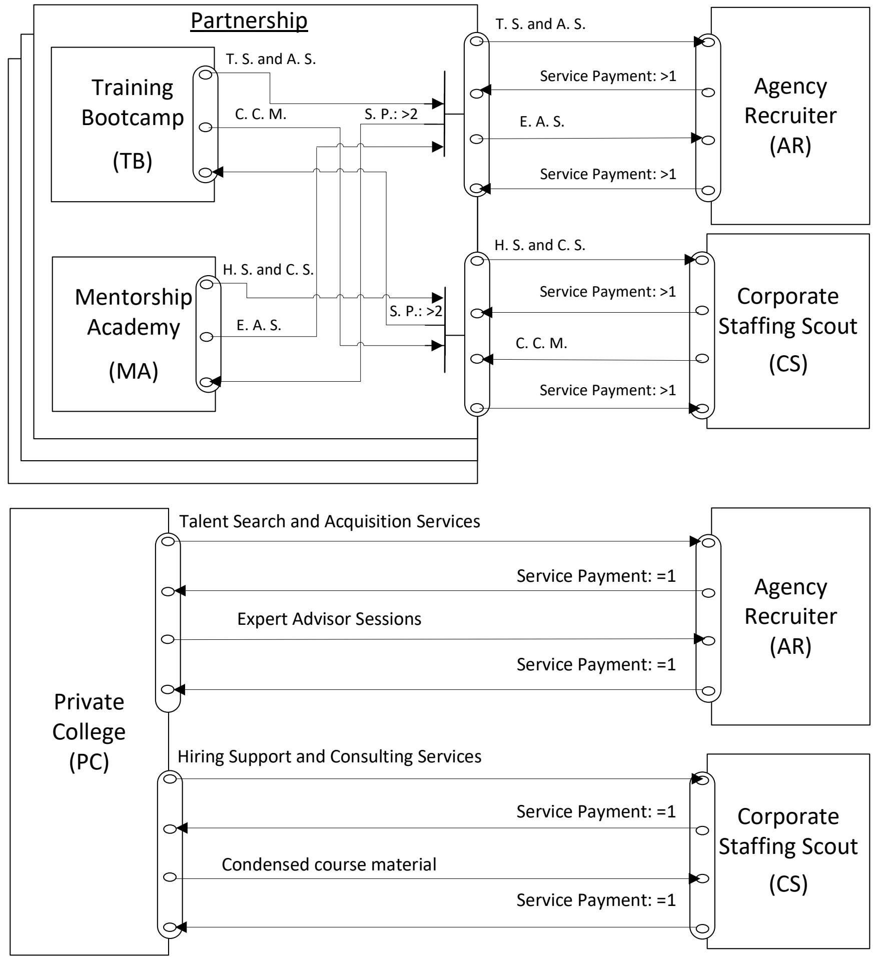

Figure 10-21 e3value diagram portraying relationship between TB, MA, PC, AR, and CS in the future (i.e., To-Be)

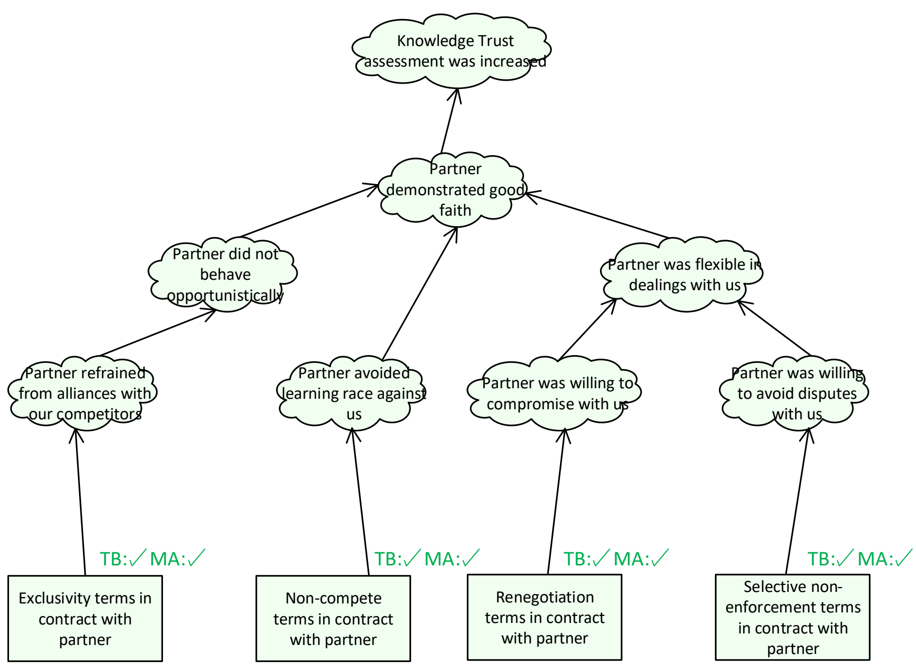

Figure 10-22 Perceived Trust Assessment between TB and MA in Ideal To-Be Scenario

Evaluation phase: In this third stage, shown in Figure 10-1, TB and MA cooperate to collaboratively offer superior value propositions than their mutual rival can by itself and then compete with each other to maximize own share of surplus from serving stakeholders collectively.

Service Payment amounts by a payer in Figure 10-21 are calculated by applying the concepts of willingness-to-pay and opportunity-cost that are outlined in Section 7.4. As noted above, Service Payment: =1 represents a baseline situation in which some, but not all, intentional elements of the payer are satisfied. Service Payment: >1 represents an alternate situation in which more intentional elements of that payer are satisfied in comparison to the baseline. Therefore, the payer has a higher willingness-to-pay in the alternate situation than in the baseline.

Similarly, the Service Payment is greater in the alternate situation than in the baseline because the payee has to forego satisfaction of more intentional elements in the baseline than in the alternate scenario (i.e., payee has a lower opportunity cost in the baseline).

PC earns Service Payment: =1 from AR and Service Payment: =1 from CS because it allows AR and CS to complete some, but not all, of their *sub-tasks*. TB and MA earn greater amounts than PC, by serving AR and CS respectively, because TB and MA jointly enable AR and CS to perform more of their *sub-tasks* than PC.

TB and MA earn Service Payment: >1 each from AR and CS respectively because TB, with cooperation from MA, assists AR to perform all of its *sub-tasks* while MA, with cooperation from TB, assists CS to also conduct all of its *sub-tasks*.

In the As-Is scenario, TB and MA competed in the market over customers but, in the To-Be scenario, TB and MA cooperate in the market and jointly serve customers. However, in the To-Be scenario, TB and MA also compete to maximize their individual share of the combined Service Payment that is received by them jointly from customers they serve together. This indicates that they are coopetitors.

Data for calculating degrees of relative dependence among *actors* TB, AR, MA, CS, PC, and CL in the To-Be scenario (Figure 10-20) are presented in Table 10-3.

Due to page width limitations, entries in the first four columns of Table 10-3 are abbreviated. Each abbreviation includes the first letter of each word in the relevant model element. Some *dependums* are colored yellow and their corresponding intentional elements within *dependers* are colored blue as examples in Table 10-3 as well as Figure 10-20 respectively.

This is done for visual clarity to allow the reader to follow this naming pattern in Table 10-3 due to page width constraints. For example, CS refers to Corporate Staffing Scout, LAC refers to List of available concentrations, and AFPS refers to Access focused pool of skillsets.

We calculate the degrees of relative dependence among these *actors* by applying the technique outlined in Section 6.5.2 to the data in Table 10-3. Degrees of relative dependence between *actors* TB, AR, MA, CS, PC, and CL are shown in Table 10-4.

AR will depend on TB two and a half times as much as TB will depend on AR and CS will also depend on MA two and a half times as much as MA will depend on CS.

Comparing the Intermediate (Table 10-2) and To-Be (Table 10-4) configurations reveals a large change in the relative dependence between *actors* TB and AR as well as MA and CS.

This is because, in the To-Be configuration, TB and MA offer practical value propositions to AR and CS respectively.

Both TB and MA can support AR and CS in completing their respective *sub-tasks* properly. This means that the bargaining power of TB and MA relative to AR and CS respectively is strong.

A large change in the relative dependence between *actors* PC and AR as well as PC and CS is revealed by comparing the Intermediate (Table 10-2) and To-Be (Table 10-4) configurations.

Both AR and CS will depend on PC about as much as PC will depend on either of them (i.e., almost 1:1). This is because PC will no longer be able to support AR and CS to perform all of their *sub-tasks*. AR and CS will have viable substitutes for PC in the market (i.e., TB and MA) while PC will lose sole access to AR and CS in the market.

The To-Be configuration with ideal calculative trust assessment between TB and MA is depicted in Figure 10-22. It is an instantiation of the Calculative trust assessment segment of the *belief* catalog for trust assessment that is presented in Section 6.3.1.

It expresses the ideal relationship between TB and MA in terms of perceptions of calculative trust assessment. This is necessary for TB and MA if they wish to also develop Knowledge trust and Bonding trust over time. TB and MA are co-existing in the present and their ability to compete with PC is premised on their cooperation.

Based on our advice, they are exploring cooperative arrangements to support each other in the same market. This will require sharing of the informational *resources* that are listed in Figure 10-22. Checkmarks above each informational *resource*, and green coloration of those resources as well as hierarchy of *beliefs* indicates that, they ought to strive for a high degree of calculative trust assessment among themselves.

Depender	Dependee	Dependum	Intentional Element in Depender	Importance of Dependum (D)	Importance of Intentional Element (I)	D * I	Discount Factor	Discounted Degree of Dependence
TB	AR	DTSAF	APC	2	2	4	(1/1) = 1	4
AR	TB	BCP	CLCO	2	2	4	(1/1) = 1	4
AR	TB	SCS	ATCPP	2	2	4	(1/1) = 1	4
AR	TB	OCC	ABPS	1	1	1	(1/1) = 1	1
AR	TB	SDS	SLPC	1	1	1	(1/1) = 1	1
MA	CS	DHSCF	CMT	2	2	4	(1/1) = 1	4
CS	MA	URQ	SCO	2	2	4	(1/1) = 1	4
CS	MA	TSM	AIMPP	2	2	4	(1/1) = 1	4
CS	MA	PRP	ATP	1	1	1	(1/1) = 1	1
CS	MA	LAC	AFPS	1	1	1	(1/1) = 1	1
PC	CL	MRSPC	ANC	3	3	9	(1/1) = 1	9
AR	PC	LP	CLCO	2	2	4	(1/1) = 1	4
AR	PC	EAS	ATCPP	2	2	4	(1/1) = 1	4
AR	PC	SDS	SLPC	1	1	1	(1/1) = 1	1
AR	PC	OCC	ABPS	1	1	1	(1/1) = 1	1
CS	PC	CQ	SCO	2	2	4	(1/1) = 1	4
CS	PC	CSM	AIMPP	2	2	4	(1/1) = 1	4
CS	PC	PRP	ATP	1	1	1	(1/1) = 1	1
CS	PC	LAC	AFPS	1	1	1	(1/1) = 1	1
TB	MA	ASME	OTSTP	2	2	4	(1/1) = 1	4
MA	TB	TD	PTSD	2	2	4	(1/1) = 1	4

Table 10-3 Data for calculating degrees of relative dependence among actors TB, AR, MA, CS, PC, and CL (To-Be)

Actors	Relative Dependence
TB:AR	2:5
MA:CS	2:5
PC:AR	9:10
PC:CS	9:10
TB:MA	1:1

Table 10-4 Degrees of relative dependence among actors TB, AR, MA, CS, PC, and CL (To-Be)

10.5.4 Discussion

Section 10.5 presented models of the changing relationship between TB and MA in three stages: (1) competitive (As-Is), (2) co-existence/pre-coopetitive (Intermediate), and (3) coopetitive (To-Be).

It showed that, in the first stage, competition over Learner, Instructor, and Client did not lead to positive sum outcomes for TB or MA.

In the second stage, TB focused on Trainee, Trainer, as well as Agency Recruiter and MA focused on Mentee, Mentor, as well as Corporate Staffing Scout. In this stage, TB and MA did not compete over Learner, Instructor, and Client. This resulted in a positive-sum outcome for TB and MA. However, TB and MA are not the only *actors* in this market and PC is a mutual rival of TB and MA.

In the second stage, TB and MA co-exist but do not cooperate. This benefits their mutual rival (PC) because PC can offer certain value propositions by itself that TB and MA can only offer jointly.

In the third stage, TB and MA cooperate to collaboratively offer superior value propositions than PC can by itself and then compete with each other to maximize own share of surplus from serving stakeholders collectively. Evolution of stages in this strategic relationship between TB and MA is depicted in Figure 10-1 and reproduced in Figure 10-23.

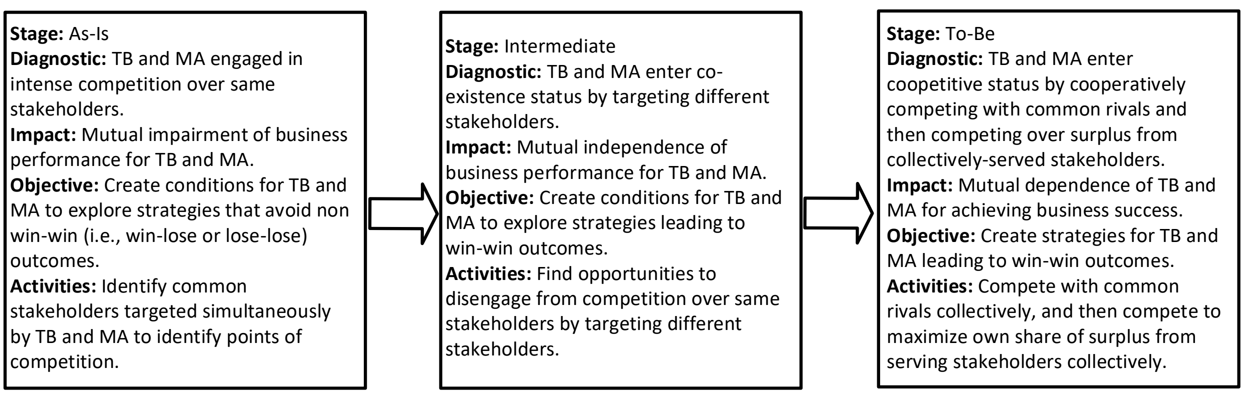

Figure 10-23 Evolution of stages in strategic relationship between TB and MA

10.6 Evaluation

We reflected on the application of our conceptual modeling framework to this empirical case from a critical perspective. This allowed us to identify areas where we encountered challenges with modeling and analysis:

- Quantities: Our framework treats quantities (e.g., *payoffs*, *importance*, etc.) in a nominal and subjective manner. This makes it difficult to elicit different types of quantities. In terms of elicitation, we found that the founders of TB and MA could state certain quantities (e.g., *importance*) relatively simply while others posed difficulty (e.g., *payoffs*). Founders were able to articulate why, from their perspective, one thing was more/less important than another with considerable ease. However, they were not able to provide clear numbers vis-à-vis various decision paths in a Game Tree. This was in spite of our showing them a defined technique (Section 8.4.1) for calculating *payoffs* based on information from the corresponding *i** model. We overcame these limitations by emphasizing that we were using quantities in a subjective and relative manner to contrast strategies. However, it is important to note that this limits the comparability of strategies of different *actors*.

- Duration of intervening time between steps: History and path dependence are important considerations in strategic decisions because they impel and impede choices. As discussed in Chapter 8, decisions about reciprocity are based upon prior dealings and past actions by *actors*. Our framework supports modeling and analysis of discrete time progression through the use of Game Trees. We use Game Tree modeling to represent and reason about sequential moves. However, our framework does not accommodate depiction of the duration of intervening time between steps. One limitation that emerges from an inability to articulate duration of intervening time between steps is that it is not possible to discern whether differences in elapsed time between two steps in a Game Tree result in different *payoffs*. Therefore, it is not reasonable to compare different sequences of steps in a Game Tree at face value without accounting for the duration of intervening time between steps. This is a challenge because different decisions (i.e., leading to *moves* in a Game Tree) may only be viable after specific durations and it would be misleading to portray decisions without providing this information.
- Allocentric perspectives: Decisions about cooperation and competition necessitate information that is possessed by partners and rivals respectively. A focal organization (e.g., TB) may have partial access to information that is possessed by its partner (e.g., MA) but it is unlikely that this focal organization has access to this information in totality. It is even less likely that a focal organization has complete information that is possessed by its rival (PC). Moreover, the accuracy and timeliness of such information is questionable because: (1) there may be lags and latencies in information transfer from a partner, and (2) a rival may spread disinformation. In this empirical case, risk 1 is mitigated because the researchers obtained information from both partners directly. However, risk 2 is still present because PC details were based on information about PC that was available to MA and TB.

10.7 Results

The founders of TB and MA are currently piloting strategic positions in the market of data science professional development programs in Toronto. Our models and analyses were favorably received by the founders of both startups. They are incorporating our recommendations and suggestions in their strategic planning processes. During our empirical study, we noted comments from founders of both startups regarding the usefulness and usability of our models to meet their strategic analysis needs. We applied content analysis techniques (Huberman & Miles, 2002) to summarize their feedback for understanding their perceived strengths and weaknesses of our framework:

- Perceived Strengths:
  - Spatial efficiency: Founders of both startups indicated that visual models were helpful for them because they could be used to render pertinent details about a decision-under consideration on one or two sheets. By contrast, expressing similar volume of information in text (for emailing or record-keeping) would require many pages. They regarded this spatial efficiency of visual models as a benefit and stated that they would consider using diagrams to represent strategic information.
  - Knowledge catalogs: Founders of both startups found all four knowledge catalogs to be useful. They stated that competition and cooperation *goal* catalogs were most useful and the knowledge sharing *goal* catalog was also quite useful. They felt that the trust assessment *belief* catalog was usable but that it covered topics about which they normally consulted with their legal advisors.
  - Trade-off analysis: Founder$_{MA1}$ indicated that they found support in our framework for contrasting various options for fulfilling some objective to be advantageous. They stated that strategic decisions require the contrasting of many options in terms of some criteria. The ability to evaluate various options in terms of differences in their impact on various objectives was regarded as helpful.
  - Compositional analysis: Founder$_{MA1}$ found the modularity of our conceptual modeling framework to be beneficial. The ability to focus on a single facet of a decision for analysis at a time aligned with the way in which strategic decisions were considered in MA. Results of individual granular analyses could be composed into an aggregate analysis when needed for a holistic review.
  - Reusable patterns: Founder$_{TB1}$ found the reusable patterns related to resource-based view (Appendix 1) to be useful. They indicated that these patterns simplified the consideration of value, scarcity, inimitability, and non-substitutability of resources. They also stated that these patterns helped to declutter visual models by obviating the need for depicting non-VRIN resources (discussed in Chapter 5). They also noted that availability of reusable model patterns accelerated model analysis.
- Perceived Weaknesses:
  - Complicated application: Founders of both startups indicated that, even as clients, it took considerable time and effort on their part to understand the semantics and syntax of our modeling framework. They indicated that to build such models themselves they would need to learn *i**, e3value, and Game Tree, along with our extensions and modifications to these modeling languages. This would require them to invest significant resources which was impractical for startups in hypercompetitive and fast-changing markets. They suggested that a "user-friendly" tool, similar to the Business Model Canvas (Osterwalder, 2004), could simplify adoption of our framework.
  - Manual analysis: Founders of both startups indicated that tracing the impact of *contribution* links within an actor and dependencies across actors manually was a tedious and error-prone activity. They noted that diagrams were already developed using software tools (e.g., Visio, draw.io/diagrams.net,

and Lucid Chart). Thus, they recommended that the computation of the impacts of *contribution* and dependency links should be automated to reduce user burden as well as avoid human errors.

- Dense visualization: Founder$_{TB1}$ noted that some of our *i** models were saturated with information (i.e., Figures 10-17, and 10-20). Each diagram depicted copious information that was accumulated over many iterations. They suggested that splitting these *i** models into smaller segments (i.e., by *actor* or by *sub-task* in *depender*) will improve their visual interpretability.
- Manual versioning: Founder$_{MA1}$ indicated that change tracking in different versions of a model was not automated. Identifying the differences between different versions of a model required a user to manually compare the intentional elements and links across different versions. They indicated this to be a time-consuming and error-prone process because some changes were obvious while other changes were subtle. They suggested that tool support for tracking changes to models over different versions would improve usability of our framework.
- Information availability: Founders of both startups noted that many details about their partners and rivals is not always available. Partners may agree to share some, but not all, details about their organization and competitors do not disclose any information. This makes it difficult to build strategic models because strategic decision-making requires access to details about partners and competitors. These founders accepted that this limitation does not apply exclusively to our framework but rather it is a more general challenge with strategic decision-making.
- Information sharing: Prior to the commencement of this empirical case, the founders of both startups were notified that we, the researchers, were planning to advise both startups. At the beginning of our empirical study, the founders of each startup regarded the other startup only as a competitor. As a result of our interventions, their relationship evolved over time into coopetition. To create opportunities for a win-win strategy, we needed to share mutually relevant information with founders of both startups. This was necessary to motivate cooperation within an originally competitive relationship. However, due to a lack prior cooperation among the startups at the start of this empirical study, the founders of both startups were reluctant to share their information with the other startup. Founders of both startups indicated that they were sensitive because their information could be used by their hitherto rival to create a strategic advantage over them. As a mutually trusted intermediary, we were able to slowly engender confidence in the founders of both startups to permit sharing of their information. Founders of both startups noted that this presence of a mutually trusted intermediary lessened the hesitation on their part about the sharing of their information and sowed the seeds for cooperation.

11. Conclusions

11.1 Summary of Results

In this section we summarize our results in the context of the Research Objectives stated in Section 1.4. At the outset of our research, we established three concrete Research Objectives:

RO 1. Understand the main characteristics that are relevant for modeling strategic coopetition. Ascertain key factors that are necessary for analyzing abstract patterns and decontextualized representations of strategic coopetition.

Results for RO 1: The primary result of this research is a conceptual modeling framework for analyzing and designing coopetitive strategies. It focuses on strategic relationships between organizations that have partially convergent and partially divergent interest structures. It encapsulates a multidisciplinary notion of strategic coopetition that is drawn from many fields including game theory, strategic management, and economics. It enables the development of conceptual models that are useful for generating and discriminating win-win strategies within coopetitive relationships. Chapter 3 details the main characteristics that are relevant for modeling strategic coopetition. These characteristics are: Actors, Complementarity, Reciprocity, Trustworthiness, and Interdependence.

RO 2. Identify key requirements of each characteristic that are necessary for modeling strategic coopetition. Determine the relationships between the requirements of each characteristic. Understand the implications of each requirement on the analysis of strategic coopetition.

Results for RO 2: Chapter 3 explains the requirements for expressing and evaluating the main characteristics that are pertinent for modeling strategic coopetition. Three requirements for each of the five characteristics are identified leading to a total of fifteen specific requirements. The implications of each requirement on the analysis of strategic coopetition are indicated in Table 3-1 and described in Sections 3.2.1 (Actors), 3.2.2 (Complementarity), 3.2.3 (Reciprocity), 3.2.4 (Trustworthiness), and 3.2.5 (Interdependence).

RO 3. Develop constructs, metamodels, and methods to enable analysis of strategic coopetition. Develop a conceptual modeling framework by using, extending, and combining existing modeling languages.

Results for RO 3: Our conceptual modeling framework comprises of five facets which are useful for expressing and evaluating different characteristics of coopetitive relationships. Each facet has been presented in terms of:

- Ontology: Concepts and semantics for applying and combining relevant modeling languages (i.e., *i**, e3value, and Game Tree).
- Language: Notation and syntax rules for utilizing and extending pertinent modeling languages (i.e., *i**, e3value, and Game Tree).

- Method: Construction steps and guidelines for developing and evaluating models that represent relevant aspects of coopetitive relationships (i.e., Actors, Complementarity, Reciprocity, Trustworthiness, and Interdependence).
- Analysis Techniques: Approaches and procedures for evaluating pertinent aspects of coopetitive relationships (i.e., Actors, Complementarity, Reciprocity, Trustworthiness, and Interdependence).

RO 4. Develop instantiations to test and illustrate application of conceptual modeling framework on coopetitive relationships.

Results for RO 4: Chapter 5 through 10 present instantiations of our modeling framework to demonstrate the expressiveness and analytical power of our modeling framework for representing real-world scenarios. The usability and usefulness of our framework has been demonstrated with respect to two industrial cases.

- The chapter on the Microsoft and Amazon case is based on content that was sourced from published literature. Our modeling framework was shown to satisfactorily distil the essence of voluminous textual content into a portfolio of conceptual model diagrams.
- The chapter on start ups in the data science professional development market is the result of an empirical study. Our modeling framework was used to develop conceptual models that were shown to adequately represent the pursuit and discovery of a win-win strategy by coopeting actors.

RO 5. Propose design catalogs of knowledge to support the generation of win-win strategies and positive-sum outcomes. Compile content in design catalogs from academic, scholarly, and research publications.

Results for RO 5: We present four knowledge catalogs that encompass domain knowledge that is relevant for developing and assessing models of strategic coopetition. These catalogs depict textual knowledge from source documents in a diagrammatic form and their hierarchical structure reflects relationships among ideas from the literature. Competition (5.3.1) and Cooperation (5.3.2) catalogs include a relatively large number of strategic objectives at multiple levels but not their operationalizations due to the broad spectrum of possible choices for realizing each objective. Knowledge-sharing (5.3.3) and Trustworthiness (6.3.1) catalogs include strategic objectives as well as their operationalizations due to the relatively narrower range of objectives as well as possible options for achieving them.

We instantiated contents from these knowledge catalogs within models that are presented in the illustrations in Chapters 5 and 6 as well as the cases in Chapters 9 and 10. We found the scope of coverage of these catalogs to be comprehensive because during the : (i) Modeling phase, we were able to map model elements to content in these catalogs; and (ii) Exploration phase, we did not need to consult any other sources of knowledge, besides these catalogs, to populate these models. As indicated in Sections 5.3 and 6.3, source documents for these catalogs were identified through an exploratory literature review therefore these catalogs are complete.

11.2 Contributions

We identified fifteen concrete requirements (five characteristics with three requirements each) through the literature review that is presented in Section 2. These are described in a catalog of coopetition modeling requirements that is presented in Section 3.2. In this section we summarize the contributions of our research in the context of these requirements from Section 3.2. Five sample questions for each of the five characteristics that would need to be answered for analyzing strategic coopetition are listed in Sections 3.2.1-3.2.5. In this section, we also indicate the adequacy of our conceptual modeling framework to support the answering of questions listed in Sections 3.2.1-3.2.5. Support in our framework to satisfy modeling and analysis requirements described in Section 3.2 is described in Table 11-1. Recall that our conceptual modeling framework for analyzing strategic coopetition extends *i** (from Yu, 2011) and combines it with e3value (from Gordijn, Akkermans, & Van Vliet, 2001) as well as Game Tree (from Dixit & Nalebuff, 2008). References to *i**, e3value, and Game Tree in Tables 11-1 are related to these sources.

Characteristics	Requirements	Modeling and Analysis Support
Actor	2 Actors or Dyad	*i**, which is the core modeling language in our framework, supports the depiction of two *actors*.
	>2 Actors or Network	*i** also supports the depiction of three or more *actors*.
	Actor Intention	*i**, which is a *goal* and *actor* modeling language, supports the representation of the internal intentional structure of *actors*.
Complementarity	Resource / Asset / Object	*i** ontology includes the notion of *resource* and we build upon this concept to discriminate between strategic and commodity *resources* (this is described in Section 5.4 with additional details provided in Appendix 1).
	Value Added	*i** and e3value are used in concert to depict the amount and source of value added by an activity in a value chain (this is described in Section 7.4.1).
	Added Value	*i** and e3value are used in conjunction to depict the amount and source of added value of an *actor* in a multi-party economic relationship (this is described in Section 7.4.2).
Interdependence	Dependency	*i** supports the depiction of *dependers*, *dependees*, and *dependums*. We extend the *i** metamodel to include the *complete* attribute in *actor*, *role*, and *agent* entities. This attribute supports the indication of all dependencies that are needed by an *actor*, *role*, and *agent*. This *complete* attribute is described in Section 5.1.
	Importance of Dependency	We also extend the *i** metamodel to include *importance* attribute in intentional elements that can serve as *dependums*. This attribute supports the relative prioritization of *dependencies* from the perspective of *dependers*. This *importance* attribute is described in Section 5.1.
	Relative Dependence	We propose an *i**-based technique for estimating the relative dependence between *actors*. Given any two *actors*, this technique considers three factors for

		approximating relative dependence between them: (i) importance of *dependum* in *dependency* links among *deepener* and *dependee* in that pair of *actors*, (ii) importance of each intentional element within a *depender* to which *dependums* are connected, and (iii) the importance of substitutes for each intentional element within a *depender* to which *dependencies* are connected. This technique is described in Section 6.5.2.
Trustworthiness	Types of trust assessment	We propose a *belief* catalog that is centered on the typology of trust developed by Child, Faulkner, & Tallman (2006). This *belief* catalog includes a hierarchy of twenty six beliefs that occupy four levels and fourteen informational *resources* that underly these *beliefs* (Section 6.3.1).
	Determinants of trust assessment	The informational *resources* that underly the *beliefs* in this catalog are the determinants of trust assessments. We propose a technique to perform trust assessments using the *beliefs* and informational *resources* that are included in this catalog (Section 6.5.1).
	Importance of Determinants	By extending the *i** metamodel to include *importance* attribute in intentional elements, we support the portrayal of the *importance* of determinants of trust assessments as they are represented as informational *resources* in *i** (Section 5.1).
Reciprocity	Task	*i** supports the depiction *tasks* which can be decomposed into subsidiary parts to show multiple levels of aggregation/granularity.
	Sequence	*i** and Game Tree are used in concert to depict progression of previous to next steps as well as transitions between these steps (Section 8.1).
	Outcome	*i** and Game Tree are used in conjunction to calculate *payoffs* based on satisfaction/denial of *i* goals* and *softgoals* as well confirmation/contradiction of *i* beliefs*. Section 8.4.1 proposes a technique for calculating *payoffs* and Section 8.4.2 presents a technique for evaluating *payoffs*.

Table 11-1 Support in our Framework to Satisfy Modeling and Analysis Requirements

Next, we outline support in our framework for answering questions that are relevant for analyzing strategic coopetition. Support for ‘Actors’ question-answering requirements (Table 3-2) is described in Table 11-2.

Actors	
Sample Question	**Question Answering Support**
Which actors are involved in a coopetitive relationship?	*i** modeling supports the depiction of actors, agents, and roles engaged in a coopetitive relationship.
What are the goals of each coopeting actor?	*i** modeling also supports the portrayal of the internal intentional structures of each actor, agent, and role.
Why do actors depend on each other in a coopetitive relationship?	*Dependums* (objects of *dependency*) between *dependers* (*actors* that depend) and *dependees* (*actors* that are depended on) can be expressed in *i** models.
Are actors coopeting directly or indirectly (i.e., via intermediary actors)?	*i** modeling can be used to understand the *dependencies* among *actors*. This is relevant for recognizing the nature of relationship

	(e.g., competitive, cooperative, coopetitive) between each pair of *actors*.
How do actors judge and compare options for achieving their goals?	Satisfaction analysis of *goals* and *softgoals* can be used to compare options for achieving objectives. Details are provided in Section 5.5.2.

Table 11-2 Question-Answering Support in our Framework for 'Actors' Characteristic of Coopetition

Support for 'Complementarity' question-answering requirements (Table 3-3) is described in Table 11-3.

Complementarity	
Sample Question	**Question Answering Support**
Does complementarity exist between focal actors in a coopetitive relationship?	Corresponding *i** and e3value models can be used jointly to detect presence and magnitude of synergy among *actors*. Details are provided in Section 7.4.
Can focal actors co-create value surplus?	Corresponding *i** and e3value models can be used together to generate opportunities for *actors* to co-produce synergy. Exploration technique is described in Section 7.3.
Can each actor appropriate a portion of surplus value?	*i** modeling can be used to analyze internal intentional structure of each *actor* as well as *dependencies* among *actors*. This is relevant for comprehending the ability of each *actor* to appropriate a share of the surplus value. Exploration technique is described in Section 7.3.
Are gains from synergy equally available to each actor?	*i** modeling can be used to analyze internal intentional structure of each *actor* as well as *dependencies* among *actors*. This is pertinent for understanding the equal/unequal availability of surplus value to each *actor*. Details are provided in Section 7.4.
How can an actor increase its share of the co-created value surplus?	*i** modeling can be used to analyze internal intentional structure of each *actor* as well as *dependencies* among *actors*. This is relevant for recognizing the ability of each *actor* to grow its portion of the surplus value. Exploration technique is described in Section 7.3.

Table 11-3 Question-Answering Support in our Framework for 'Complementarity' Characteristic of Coopetition

Support for 'Reciprocity' question-answering requirements (Table 3-4) is described in Table 11-4.

Reciprocity	
Sample Question	**Question Answering Support**
Is each actor capable of reciprocating?	*i** modeling can be used to analyze internal intentional structure of each *actor* as well as *dependencies* among *actors*. This is pertinent for understanding structural enablers of reciprocality. *i* goal* satisfaction analysis can be used to identify impediments to reciprocation. Details are provided in Section 7.4.
Is reciprocality mutually beneficial for each actor in a coopetitive relationship?	Corresponding *i** and Game Tree models can be used jointly to assess positive payoffs (i.e., rewards) for reciprocating *players*. *i* goal* satisfaction analysis can be used to generate *payoffs*. Game Tree can be used to estimate the magnitude of *payoffs* for each *player*. Technique for estimating *payoffs* for each *player* is provided in Section 8.4.1.
How can reciprocation be disadvantageous for any actor?	Corresponding *i** and Game Tree models can be used jointly to evaluate negative payoffs (i.e., penalties) for reciprocating *players*. *i* goal* satisfaction analysis can be used to generate *payoffs*. Game Tree can be used to compare the magnitude of *payoffs* for different decision *paths*. Technique for contrasting *payoffs* for each *decision* path is provided in Section 8.4.2.
Is symmetrical/asymmetrical reciprocation advantageous/disadvantageous?	Corresponding *i** and Game Tree models can be used jointly to analyze payoffs for reciprocating *players*. *i* goal* satisfaction analysis can be used to generate *payoffs*. Game Tree can be used to

	compare the magnitude of *payoffs* for different decision *paths*. Technique for comparing *payoffs* for each *decision* path is provided in Section 8.4.2.
Which types of barriers can impede an actor's ability to reciprocate vis-à-vis another actor?	*i** modeling can be used to analyze internal intentional structure of each *actor* as well as *dependencies* among *actors*. This is pertinent for understanding structural inhibitors to reciprocation. *i* goal* satisfaction analysis can be used to identify impediments to reciprocality by assessing the achievement or denial of *goals* and *softgoals* under presence/absence of reciprocation.

Table 11-4 Question-Answering Support in our Framework for 'Reciprocity' Characteristic of Coopetition

Support for 'Trustworthiness' question-answering requirements (Table 3-5) is described in Table 11-5.

Trustworthiness	
Sample Question	**Question Answering Support**
What kind of trust exists between actors in a coopetitive relationship?	We propose a *belief* catalog that is centered on the typology of trust developed by Child, Faulkner, & Tallman (2006). This *belief* catalog includes a hierarchy of twenty six beliefs that occupy four levels and fourteen informational *resources* that underly these *beliefs* (Section 6.3.1). We also propose a technique to perform trust assessments using the *beliefs* and informational *resources* that are included in this catalog (Section 6.5.1).
Which factors contribute to a coopeting actor's perception of the trust assessment of another actor?	We propose a *belief* catalog that is centered on the typology of trust developed by Child, Faulkner, & Tallman (2006). This *belief* catalog includes a hierarchy of twenty six beliefs that occupy four levels and fourteen informational *resources* that underly these *beliefs* (Section 6.3.1).
Are perceptions of trust assessments among actors symmetrical in a coopetitive relationship?	Instantiations of the *belief* catalog of trust assessment of each *actor* vis-à-vis another *actor* can be used to compare their perceptions of trust. A technique for calculating trust assessments is presented in Section 6.5.1 and a *belief* catalog of trust assessments is presented in Section 6.3.1.
Do all cooperative actions by an actor increase trust?	*i* goal* satisfaction analysis can be used to identify cooperative actions based on achievement of *goals* and *softgoals* of an *actor* based on the actions of another *actor*. Instantiations of the *belief* catalog of trust assessment of each *actor* vis-à-vis another *actor* can be used to compare their perceptions of trust. A technique for calculating trust assessments is presented in Section 6.5.1 and a *belief* catalog of trust assessments is presented in Section 6.3.1.
Do all competitive actions by an actor decrease trust?	*i* goal* satisfaction analysis can be used to identify competitive actions based on denial of *goals* and *softgoals* of an *actor* based on the actions of another *actor*. Instantiations of the *belief* catalog of trust assessment of each *actor* vis-à-vis another *actor* can be used to compare their perceptions of trust. A technique for calculating trust assessments is presented in Section 6.5.1 and a *belief* catalog of trust assessments is presented in Section 6.3.1.

Table 11-5 Question-Answering Support in our Framework for 'Trustworthiness' Characteristic of Coopetition

Support for 'Interdependence' question-answering requirements (Table 3-6) is described in Table 11-6.

Interdependence	
Sample Question	**Question Answering Support**
Is perceived relative dependence between coopeting actors symmetrical?	We propose a technique for estimating the relative dependence of one *actor* on another *actor* (Section 6.5.2). This technique can be used to compare the perceived relative dependence between *actors*.

Is interdependence mutually beneficial for actors in a coopetitive relationship?	The technique presented in Section 6.5.2 can be used to determine the level of perceived dependence among *actors*. Interdependence can be identified when one or more bidirectional dependencies exist between *actors*. *i* goal* satisfaction analysis can be used to assess the achievement or denial of *goals* and *softgoals* based on interdependence between *actors*.
Can independence reduce any of the risks or uncertainties stemming from interdependence?	The technique presented in Section 6.5.2 can be used to determine the level of perceived dependence among *actors*. Independence can be identified when no bidirectional dependencies exist among *actors*. *i* goal* satisfaction analysis can be used to assess the achievement or denial of *goals* and *softgoals* based on independence among *actors*.
How can an actor increase or decrease its dependence on another actor?	*i** modeling can be used to analyze internal intentional structure of each *actor* as well as *dependencies* among *actors*. New dependencies can be introduction to achieve dependence and existing *dependencies* can be removed to achieve independence. *i* goal* satisfaction analysis can be used to analyze the impact of introduction or removal of dependencies on the satisfaction of *goals* and *softgoals*.
Which types of barriers can impede an actor's ability to increase or decrease its dependence on another actor?	*i** modeling can be used to analyze internal intentional structure of each *actor* as well as *dependencies* among *actors*. This is pertinent for understanding structural inhibitors to introduction of new *dependencies* as well as removal of existing *dependencies*. *i* goal* satisfaction analysis can be used to identify impediments to introduction/removal of dependencies by assessing the achievement or denial of *goals* and *softgoals* with new dependencies and without existing dependencies.

Table 11-6 Question-Answering Support in our Framework for 'Interdependence' Characteristic of Coopetition

Next, we present a mapping between characteristics, requirements, and facets of our framework with their applications in the published study (Chapter 9), and empirical case (Chapter 10) in Table 11-7.

Characteristics	Requirements	Framework Facet	Published Study (Ch. 9)	Empirical Case (Ch. 10)
Actor	2 Actors or Dyad	Basic Actors	✓	✓
	>2 Actors or Network		✓	✓
	Actor Intention		✓	✓
Complementarity	Resource / Asset / Object	Value	✓	✓
	Value Added		✓	✓
	Added Value		✓	✓
Interdependence	Dependency	Differentiated Actors	✗	✓
	Importance of Dependency		✗	✓
	Relative Dependence		✗	✓
Trustworthiness	Types of trust assessment	Differentiated Actors	✗	✓
	Determinants of trust assessment		✗	✓
	Importance of Determinants		✗	✓
Reciprocity	Task	Sequential moves	✓	✓
	Sequence		✓	✓
	Outcome		✓	✓

Table 11-7 Requirements and facets of our framework that are applied in published study and empirical case

11.3 Limitations

We remained vigilant throughout our research to identify limitations that could raise concerns about quality, rigor, and validity of our research. A critical reflection, performed upon the conclusion of our research, revealed potential limitations that are indicated in this section.

11.3.1 Threats to internal validity

We have explicated the design and implementation of our case study in Chapter 9 and empirical case in Chapter 10. Details about the case study in Chapter 9 were obtained from various research papers in peer-reviewed literature. The source material for this case was obtained from research papers that appeared in scholarly publications. It could be argued that the quality of these publications differ because their acceptance rates and impact factor are not the same. Therefore, the credibility of some source material that is referenced in Chapter 9 can be called into questioned as well as any results that accrue to them. To account for this possibility, we were careful to only select research papers with broadly similar citation counts. We also sourced these papers from publications that, after accounting for the time of publication of each paper, were roughly comparable in terms of reputation. Additionally, it could be argued that an exploratory literature review was used to identify source material and that this could have missed critical sources containing relevant information for this case that would captured through a systematic literature review. However, as noted by Badger et al. (2000) it is possible to conduct a rigorous and comprehensive literature review even though it may not necessarily be systematic in a technical sense.

Details about the empirical case in Chapter 10 were obtained through field work in two coopeting organizations. These organizations were approached because their decision-makers were members of our professional network. Moreover, decision-makers of these organizations agreed to participate in our research because they knew us through prior advisory engagements. It could be argued that it would not be possible for us to demarcate our pre-existing knowledge about these organizations because these organizations had previous consulted with us about some topics that overlap with our research. This could mean that it would not be possible for us to separate knowledge that was obtained exclusively for this research from our pre-existing knowledge and this would undermine the replicability of our study. To address this possibility, we recorded meticulous notes of each meeting with these decision-makers and only included those details in our models that were recorded in our notes. Moreover, we shared our models with the decision-makers to confirm that they were satisfied that the only details that were included in our models were those that they had willingly contributed to our research. These decision-makers had an interest in ensuring that only those details that were shared with us within the context of this research were included in our models. This is because the disclosure of any details about their organizations, that were not shared explicitly for the purposes of this research, could be deleterious for them.

11.3.2 Threats to external validity

We have presented models in four illustrations and two cases to demonstrate the versatility of our framework for depicting a variety of coopetitive relationships. These applications cover multiple industries (i.e., pharmaceutical, software, education) as well as segments (i.e., large organizations, startups). However, the economy is comprised of many other industries. Therefore, it could be argued that our findings do not generalize to industries that are not covered in our models because each of them are peculiar. Additionally, it can be argued that our models only cover coopetition within the same segment (i.e., between startups or between large enterprises) but not across segments (i.e., between startups and large enterprises). This could be used to argue that our results do not apply to situations involving organizations from different sectors.

It can also be argued that our models only demonstrate coopetitive relationships with two focal actors even though other actors may be involved. This could be used to suggest that our findings only apply to dyadic coopetition but not network coopetition. Furthermore, in the economy, many organizations are not driven by profit-motive (e.g., government, charities) and such organizations behave differently from for-profit corporations. However, each of the organizations that are modeled in our illustrations and cases are for-profit corporations. Therefore, it could be argued that our conceptual modeling framework is not suitable for modeling those organizations even though coopetition is commonplace among non-profit organizations. Each of the possible critiques that are listed in this section can be addressed by conducting further empirical studies in the industry. the generalizability of the findings and results presented in this thesis can be validated by applying our modeling framework to coopeting organizations in multiple industries, segments, and sectors (i.e., for-profit, non-profit).

The usability of our conceptual modeling framework was tested separately by two subjects[43] and the usefulness of our conceptual modeling framework was tested by decision-makers in two coopeting startups[44]. Subjects were asked to critically reflect on the guidelines, metamodels, and methodologies that they were provided for modeling and decision-makers were asked to critique conceptual models representing their coopetitive relationship. It could be argued that the inferences made on the basis of these inputs is insignificant because only two subjects participated in the usability testing and only two organizations took part in usefulness testing. This potential criticism of our work can be addressed by conducting usability and usefulness tests with a larger number of participants (i.e., subjects and decision-makers). Additionally, other industry professionals such as management consultants and strategy advisors can also be engaged in this testing.

[43] This is described in Chapter 9
[44] This is described in Chapter 10

11.4 Research Significance

This section details the significance of our research to the domains of conceptual and visual modeling. The results and findings of our research show that conceptual modeling of strategic coopetition can benefit from further study. As noted in Section 3.3, conceptual modelling researchers have proposed many frameworks for modeling and analyzing interorganizational strategy, but none of these frameworks focus exclusively on coopetition. Some propositions focus on modeling of interorganizational competition based on Porter's (1979) Five Forces Model (e.g., Carvallo, & Franch, 2012; Pijpers, & Gordijn, 2007). However, these techniques do not account for cooperative aspects that are crucial for understanding coopetition in an interorganizational relationship. Some propositions concentrate on modeling of information systems based on Porter's (1985) Value Chain Model (e.g., Giannoulis, Petit, & Zdravkovic, 2011; Weigand, 2016). However, these techniques only account for value added of an activity in a value chain but do not accommodate added value of an actor to a multi-party economic relationship. The latter conception of value is critical for understanding complementarity in coopetitive relationships.

Some propositions focus on modeling of links between connected business strategies of multiple organizations (e.g., Pijpers, Gordijn, & Akkermans, 2008; Weigand, et al., 2007). However, even though these techniques depict value exchanges between organizations—they do not portray other characteristics of coopetition such as trustworthiness, interdependence, and reciprocity. Some propositions concentrate on modeling of strategic planning systems such as Balanced Scorecard and Strategy Maps (e.g., Giannoulis, Petit, & Zdravkovic, 2011; Babar, Wong, & Gill, 2011). However, these techniques can only be used to depict the business model of an organization (i.e., its internal logic) rather than its competitive and cooperative relationships with other organizations (i.e., its external interface). Some propositions focus on modeling of Christensen's (2006) Disruptive Innovation model (Samavi, Yu, & Topaloglou, 2008; Steenstra, & Erkoyuncu, 2014) to show transformational change in organizations. However, these techniques do not trace the effects of change to competitive or cooperative causes.

Some proposals focus on modeling of strategic competition based on Henderson (1981, 1983) and accommodate considerations related to various facets of competition (Sales, Porello, Guarino, Guizzardi, & Mylopoulos, 2018; Sales, Guarino, Guizzardi, & Mylopoulos, 2018). However, these techniques also leave out analysis of cooperation from strategic relationships. These examples show that, within the research community, there is considerable research interest on strategic management topics. However, almost all previous research has focused on competition and cooperation separately with an "Either/Or" lens. We posit that our approach of treating competition and cooperation with an "And/Both" perspective is advantageous for coopetition analysis.

As noted in Sections 2.1-2.4, strategic management researchers have also proposed various techniques for understanding simultaneous cooperation and competition with the use of visual models. Some researchers have proposed a technique for understanding coopetition in terms of customers, suppliers, complementors, and substitutors as well as players, added value, rules, tactics, and scope (Brandenburger & Nalebuff, 1995, 1996; Nalebuff & Brandenburger, 1997). While exclusively focused on coopetition, these techniques are not founded on conceptual modeling, do not offer metamodels, and do not define how they may be fully or partially supported by automated analysis. Our framework offers a modeling ontology[45] for coopetition (i.e., a set of concepts with well-defined relationships among them).

Researchers have also proposed game-theoretic techniques to understand coopetition such as biform games (e.g., Brandenburger, & Stuart, 2007) and extended-form games (e.g., Dixit & Nalebuff, 2008; Okura & Carfi, 2014). Such techniques can be used to select appropriate moves/countermoves by comparing payoffs for players resulting from various decision paths. However, these techniques elide the internal intentional structures of players thereby making it difficult, for a modeler, to understand the basis by which payoffs for players were approximated or estimated. Each player may evaluate a decision path differently based on its idiosyncratic preferences and priorities. Hence, a modeler that wishes to reason about the perceived payoffs for any player must recognize the peculiar intentionality of that player.

Researchers have also proposed Structural Equation Modelling (SEM) techniques to explain simultaneous cooperation and competition (e.g., Bouncken, & Fredrich, 2011, 2012, 2016). These techniques learn mathematical approximations, from observational data about coopetitive relationships, to detect and relate observable and latent variables. These models can also be visualized. However, SEM-estimated models only reflect patterns in their training data. Therefore, each SEM model offers limited applicability because the generalizability of an individual SEM model is limited by the degree of variance in the training dataset. Moreover, SEM techniques learn models from the "bottom-up" (i.e., based on observations) and do not support counter-factual reasoning that is predicated on "top-down" analysis (i.e., based on an ontology).

These examples show that, within the research community, there is considerable research interest on conceptual and visual modeling of interorganizational strategy. However, none of this research has focused directly on modeling of strategic coopetition and almost all previous research on modeling of competition or cooperation has focused solely on ontology-free analysis or analysis that obviates actor intentionality. We posit that our approach of modeling coopetition with reference to a modeling ontology, and in the context of actor intentions, is beneficial for analyzing simultaneous cooperation and competition.

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[45] We acknowledge that our conceptual modeling framework does not offer a formal ontology because it does not include axiomatization or formal logic.

11.5 Future Directions

Our research yielded the first conceptual modeling framework for analyzing strategic coopetition in a structured and systematic manner. This framework represents the first step in this line of research and additional work is needed to elaborate and refine it in order to enlarge its potential and elevate its applicability. This framework also creates new pathways for information science research into conceptual modeling of strategic coopetition.

Testing our framework in real-world organizational settings

In this thesis, we demonstrate the practical applicability of our framework by presenting four illustrations and two cases from the real-world. In each of these illustrations and cases, we apply our framework to identify and generate win-win strategies. The purpose of these illustrations and cases was to provide an initial test on the usability and usefulness of our framework in real-world scenarios of strategic coopetition. However, these illustrations and cases do not account for all variations of coopetitive relationships in the real-world. Similarly, they do not depict the full range of coopetition settings in which our framework could be utilized. Therefore, further testing is needed to assess the strengths and weaknesses of our framework with reference to a wide range of coopetition in the real-world. This real-world testing should concentrate on the utility of our modeling framework in contrast to ad-hoc or unsystematic/unstructured analysis. So far, testing has only been performed by us and it will be fruitful to partner with researchers and management practitioners so that further testing can be performed by other users.

Links to existing organizational processes

We present self-contained methodologies for each facet of our framework and assume that users of our framework can connect these methodologies with their organizational processes. However, different users may have more or less capability to build such connections without guidance or assistance. Therefore, it will be beneficial to: (1) identify organizational processes that can be supported by our framework, and (2) propose connection points for linking these methodologies with those processes. This will improve the adoption of our framework in the industry as it will accelerate the infusion of insights from our framework into existing processes. User will not need to spend time in finding connection points between existing processes in their organizations and the methodologies in our framework. They will be able to refer to templates of commonly used connection patterns. For example, organizations use contracts and legal agreements to set the terms and conditions of coopetitive relationships. Our framework could be used to build models that support the contract negotiation and agreement formation processes. Similarly, many organizations have well defined knowledge sharing programs. Our framework can be used to develop models for updating such programs when they relate to coopetitors.

Knowledge catalogs

Our framework comprises four catalogs that are relevant for analyzing and designing coopetitive strategies. We offer goal catalogs that encapsulate knowledge about competition, cooperation, and information sharing as well as a belief catalog that is comprised of knowledge about trust. Each of these catalogs can be enhanced by adding fresh content and updating existing content. Fresh content can be added on a continual basis by scanning the scholarly literature for new knowledge about these topics while existing content can be updated by expanding the portfolio of original sources with supplementary support. New content may lead to insertion of new nodes in the *goal* and *belief* catalogs and it may also include the addition of new sources to substantiate the content within existing nodes. Coopetition is a fast-growing area of research (Czakon, Klimas, & Mariani 2020) and maintaining these catalogs as evergreen compilations of latest knowledge shall improve their usefulness. These catalogs can also be complemented by additional cross-industry and industry-specific catalogs about topics that are relevant for strategic coopetition. Examples of cross-industry topics include power, influence, and control. Similarly, examples of industry-specific topics include specific catalogs for pharmaceutical, software, and travel industries.

Software tooling

Many modeling tools are available for developing *i**, e3value, and Game Tree models. However, our framework is not supported by any of these tools because they only support standard versions of these modeling languages but our framework extends and integrates these modeling languages. Exploration of extension mechanisms for existing tools, and interface mechanisms such as piStar extension features for iStar (Pimentel & Castro, 2018) and iStarML for interfacing and model interchange among tools (Cares et al 2011) will be beneficial. A dedicated software tool that comprises features and functions for building models of strategic coopetition using our framework will reduce barriers for other researchers to engage in this line of research. Additionally, popular modeling tools such as Visio, draw.io/diagrams.net, and Lucid Chart support the development of static diagrams but do not support dynamic visualization that is useful for meaningfully interacting with diagrams. Features and functions needed for dynamic visualization might include expanding/collapsing, revealing/hiding, enlarging/shrinking, and coloring/discoloring parts of a diagram. Moreover, popular modeling tools such as Visio, draw.io/diagrams.net, and Lucid Chart are geared towards development of visual diagrams but they are not well suited for performing fully or semi-automated analysis of these models. Various components of our framework are conducive to automated analysis and software tools that support such analysis can lessen the manual effort involved in searching for win-win strategies. Examples of components that support automated analysis are identification of decision paths in Game Trees with highest *payoff*, calculation of value-added and added-value in e3value models, and calculation of relative dependence between actors using the formula presented in Section 6.5.2.

Quantities and Calculation techniques

An important future direction of our research is to improve mechanisms for analyzing quantities. Our conceptual modeling framework relies on many quantities (e.g., *importance*, *payoff*, etc.) to support a variety of analyses. However, currently each of these quantities are nominal. Our framework will be enhanced with the development of a methodical approach for reasoning precisely with ordinal and interval quantities. Additionally, in our framework, we present one technique each for calculating numerical quantities (e.g., *payoffs*, relative *dependence*). Each technique is predicated on certain assumptions that may or may not be relevant in a particular setting. For example, our technique for calculating relative *dependence* considers the importance of *dependencies* between actors. Other researchers have also proposed techniques for calculating relative dependence in different ways (e.g., Scheer, Miao, & Palmatier's (2015) technique considers resource value and switching cost). Similarly, Game Theorists have proposed many methods for calculating *payoffs* under different circumstances. Our technique for calculating the *payoff* associated with a decision path in a Game Tree takes into account the importance of *i* softgoals*, *goals*, and *beliefs* that are related to that *payoff*. There may be scenarios in which some of these factors are unnecessary and other scenarios in which additional factors are required for calculating *payoff*. An expanded portfolio of calculation techniques, that apply to different application scenarios, will improve the usefulness of our framework. Time can also be regarded as a quantity and our framework supports the analysis of time in terms of sequences of discrete steps. It will be useful to explore research that offers techniques for reasoning about model evolution over time (e.g., Grubb & Chechik, 2016).

*i** 2.0 core support

*i** is the core modeling language in our framework and we have adopted original *i** (Yu, 2011) instead of *iStar* 2.0 (Dalpiaz, Franch, & Horkoff, 2016). We chose original *i** to take advantage of the separation between *means-ends* (OR) and *task-decomposition* (AND) links. In original *i**, *goals* (means) are related to *tasks* (ends) with *means-ends* (OR) links while parent *tasks* are related to their child elements (i.e., *task* with sub-*task*, sub-*goal*, sub-*softgoal*, *resource*) with *task-decomposition* (AND) links. *iStar* 2.0 core is designed to provide a simpler and more learnable experience to modelers. In addition to other changes, *iStar* 2.0 is different from original *i** because it: (1) replaces *is-part-of* and *plays links* with *participates-in* link, (2) removes the *goal* and *softgoal* dichotomy by replacing *softgoals* with *quality*, (3) replaces *means-end* and *task decomposition* links with a *refinement* link, and (4) introduces *neededBy* and *qualification* links to associate *tasks* and *goals* with *resources* and *qualities* respectively (Dalpiaz, Franch, & Horkoff, 2016). It will be useful to determine how well the reduced set will meet the needs of coopetition modeling and analysis. It will also be useful to fork a new branch of our framework that comports with the semantics and syntax of *iStar* 2.0 core to benefit from its reduced and simplified set of entities and relations.

12.References

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Appendix

Appendix 1: Assessing Value, Rarity, Inimitability, and Substitutability of Resources

The ability to distinguish strategic resources from ordinary resources is relevant for the analysis of competition and cooperation between enterprises. Barney (1991) argues that a resource that is valuable, rare, imperfectly imitable, and non-substitutable serves as a source of competitive advantage. Child, Faulkner, & Tallman (2006) note that access to such resources also forms the basis of many cooperative relationships. Resources that are characterized by these properties are commonly referred to as VRIN resources. A resource is considered valuable if it can be used to generate value, benefit, or utility. It is considered to be rare if it is scarce for other actors; imperfectly imitable if it has inelastic supply; and non-substitutable if comparable value, benefit, or utility cannot be generated from any other resources.

Barney (2001) notes that "it is almost as though once a firm becomes aware of the valuable, rare, costly to imitate, and non-substitutable resources it controls, the actions the firm should take to exploit these resources will be self-evident." Barney & Arikan (2001) and Barney, Ketchen Jr, & Wright (2011) posit that a resource must possess each of the VRIN properties to be strategic. We present abstract patterns to differentiate VRIN and non-VRIN (i.e., ordinary) resources using *i** modeling. The following decontextualized representations can be used to separately detect whether elements in an *i** model possess any or all of these VRIN properties. The following ensemble is not exhaustive and VRIN properties can also be assessed and inspected using other model configurations.

A model element without a subscript in its name indicates a generic class while a model element with a subscript in its name denotes a concrete instance of a class in Figures A1-1, A1-2, A1-3, and A1-4. For example, "Strategy" denotes any strategy while "Strategy_1" denotes a particular strategy and "Strategy_2" denotes another strategy that is different from "Strategy_1". In this example, "Strategy" can be regarded as the superset of all strategies that includes the elements "Strategy_1" and "Strategy_2". Two or more actors (e.g., "Actor_1" and "Actor_n") may pursue the same (e.g., "Strategy_1") or the same actor (e.g., "Actor_1") may strive to fulfill different strategies (e.g., "Strategy_1" and "Strategy_2"). This naming scheme helps to separate generic classes from their concrete instantiations to support finer-grained analysis.

- Valuable: Barney (1991) asserts that resources are valuable if a firm can utilize those resources to operationalize its strategies. Two patterns for recognizing valuable resources in different settings are depicted in Figure A1-1. An actor ("Actor_1") that has a top-level softgoal ("Softgoal") that can be achieved by either of two strategies ("Strategy_1" and "Strategy_2") is shown in Figure A1-1a. Each of these strategies requires a specific resource for its completion ("Resource_x" for "Strategy_1" and "Resource_y" for "Strategy_2"). Therefore, both "Resource_x" and "Resource_y" are valuable because either of them can be used to attain “Softgoal” through either of “Strategy$_1$” and “Strategy$_2$”. Each of these resources (“Resource$_x$” and “Resource$_y$”) are controlled by “Actor$_1$” in Figure A1-1a.

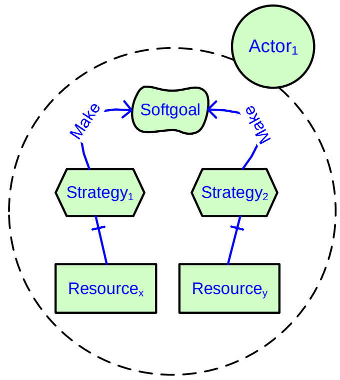


Figure A1-1a. Value of *Resources* in a scenario with a single *Actor*

A pattern that is similar to the pattern in Figure A1-1a is depicted in Figure A1-1b. However, unlike in Figure A1-1, the resources (“Resource$_x$” and “Resource$_y$”) are not controlled by “Actor$_1$” but rather by other actors (“Resource$_x$” by “Actor$_2$” and “Resource$_y$” by “Actor$_n$”). Therefore, “Actor$_1$” depends on “Actor$_2$” for “Resource$_x$” and on “Actor$_n$” for “Resource$_y$”. The presence of these dependencies does not impact the assessment of these resources as valuable because they are still required for the completion of particular strategies (“Resource$_x$” for “Strategy$_1$” and “Resource$_y$” for “Strategy$_2$”) even though they are controlled by other actors (“Resource$_x$” by “Actor$_2$” and “Resource$_y$” by “Actor$_n$”).

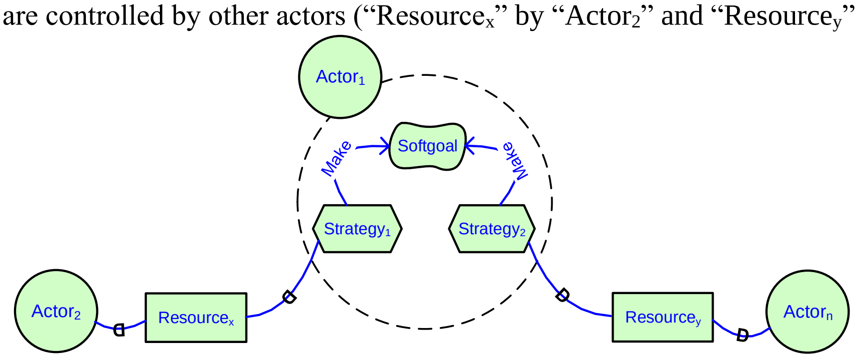


Figure A1-1b. Value of *Resources* in a scenario with three *Actors*

- Scarce: Barney (1991) claims that resources are scarce when their demand exceeds their supply. In a practical sense this means that a scarce resource is only available to some, but not all, actors that wish to obtain it. Five patterns for recognizing scarce resources in different settings are depicted in Figure A1-2. Two scenarios with identical model configuration but different satisfaction/denial labels are depicted in Figures A1-2a and A1-2b. Two scenarios with identical model configuration but different satisfaction/denial labels are depicted in Figures A1-2c, A1-2d, and A1-2e. Model configuration portrayed in Figure A1-2a and Figure A1-2b is different from model configuration shown in Figures A1-2c, A1-2d, and A1-2e.

Two *actors* ("$Actor_1$" and "$Actor_n$") that depend on a common *actor* ("$Actor_2$") for access to the same *resource* ("$Resource_x$") are depicted Figure A1-2a and Figure A1-2b. The attribute *complete* for "$Actor_1$" and "$Actor_n$" is '*true*' signifying that neither "$Actor_1$" nor "$Actor_n$" know of any other source for accessing "$Resource_x$". Two outcomes are possible in this configuration: either both *dependers* ("$Actor_1$" and "$Actor_n$") successfully obtain the *dependum* ("$Resource_x$") from the *dependee* ("$Actor_2$") or that only one *depender* ("$Actor_1$" or "$Actor_n$") successfully obtains the *dependum* ("$Resource_x$") while the other *depender* is unsuccessful in obtaining that *dependum* ("$Resource_x$") from the *dependee* ("$Actor_2$").

The first outcome is shown in Figure A1-2a while the second outcome is shown in Figure A1-2b using format 2 of the scenario labeling technique described in Section 5.2 and depicted in Figure 5-6. The label on the left side of the forward slash represents the satisfaction or denial of an element in Scenario 1 while the label on the right side of the forward slash represents the satisfaction or denial of an element in Scenario 2. A scenario in which the labels above each *dependum* are '*satisfied*' for both *dependers* is shown in Figure A1-2a. This means that both *dependers* ("$Actor_1$" and "$Actor_n$") successfully obtain the *dependum* ("$Resource_x$") from the *dependee* ("$Actor_2$"). This indicates that "$Resource_x$" is not scarce for "$Actor_1$" and "$Actor_n$".

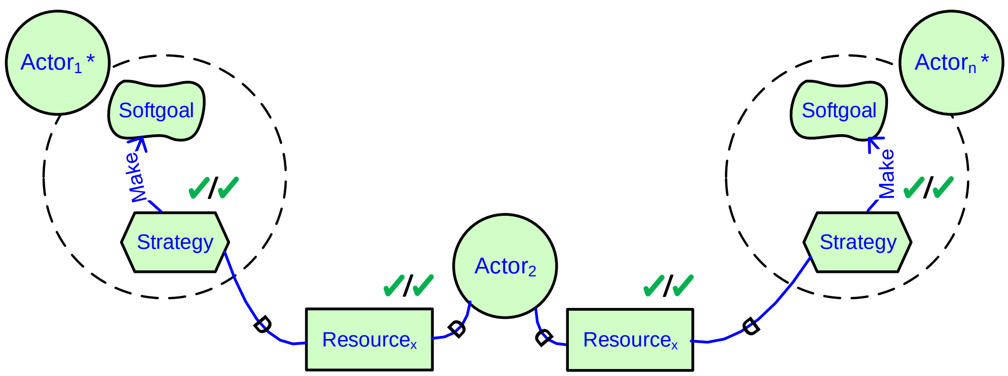


Figure A1-2a. Non-scarcity of a *Resource* in a scenario with three *Actors*

A scenario in which the labels above each *dependum* are not '*satisfied*' for both *dependers* is shown in Figure A1-2b. Labels on the left side of the forward slash are opposite from the labels on the right side of the forward slash. It shows that only one of the *dependers* ("$Actor_1$" or "$Actor_n$") successfully obtains the *dependum* ("$Resource_x$") from the *dependee* ("$Actor_2$") while the other *depender* ("$Actor_1$" or "$Actor_n$") is unable to obtain that *dependum* ("$Resource_x$") from that *dependee* ("$Actor_2$"). This configuration represents the scarcity of "$Resource_x$" from the perspective of "$Actor_1$" and "$Actor_n$" as only one of those *actors* can obtain it thereby depriving the other *actor*. This indicates that "$Resource_x$" is scarce for "$Actor_1$" and "$Actor_n$".

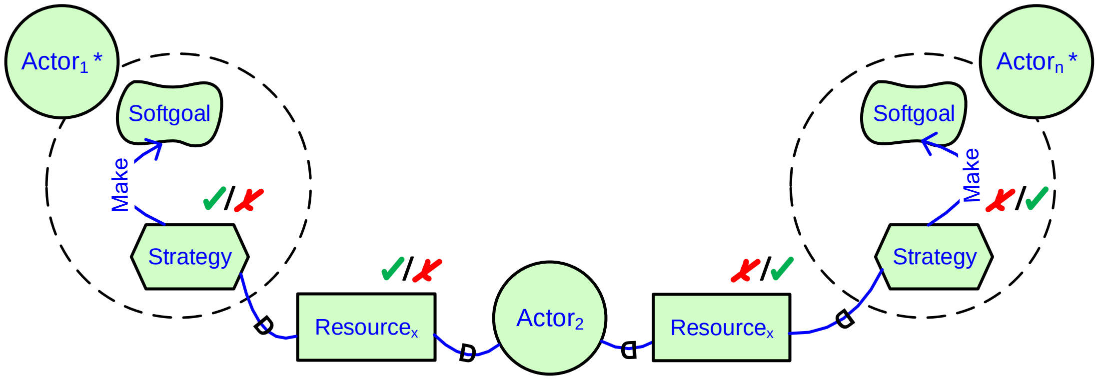


Figure A1-2b. Scarcity of a *Resource* in a scenario with three *Actors*

Figures A1-2c, A1-2d, and A1-2e depict two *actors* (“Actor$_1$” and “Actor$_n$”) that depend on common *actors* (“Actor$_2$” and “Actor$_3$”) for access to the same *resource* (“Resource$_x$”). The attribute *complete* for “Actor$_1$” and “Actor$_n$” is ‘*true*’ signifying that neither “Actor$_1$” nor “Actor$_n$” know of any other sources for accessing “Resource$_x$”. Two outcomes are possible in this configuration: either both *dependers* (“Actor$_1$” and “Actor$_n$”) successfully obtain the *dependum* (“Resource$_x$”) from either of the *dependees* (“Actor$_2$” or “Actor$_3$”) or that only one *depender* (“Actor$_1$” or “Actor$_n$”) successfully obtains the *dependum* (“Resource$_x$”) while the other *depender* is unsuccessful in obtaining that *dependum* (“Resource$_x$”) from either of the *dependees* (“Actor$_2$” or “Actor$_3$”).

Figure A1-2c shows the first outcome while Figure A1-2d shows the second outcome using format 2 of the scenario labeling technique described in Section 5.2 and depicted in Figure 5-6. The label on the left side of the forward slash represents the satisfaction or denial of an element in Scenario 1 while the label on the right side of the forward slash represents the satisfaction or denial of an element in Scenario 2. Figure A1-2c shows a scenario in which the labels above each *dependum* are ‘*satisfied*’ for both *dependers*. This means that both *dependers* (“Actor$_1$” and “Actor$_n$”) successfully obtain the *dependum* (“Resource$_x$”) from the *dependees* (“Actor$_2$” and “Actor$_3$”). This indicates that “Resource$_x$” is not scarce for “Actor$_1$” and “Actor$_n$”.

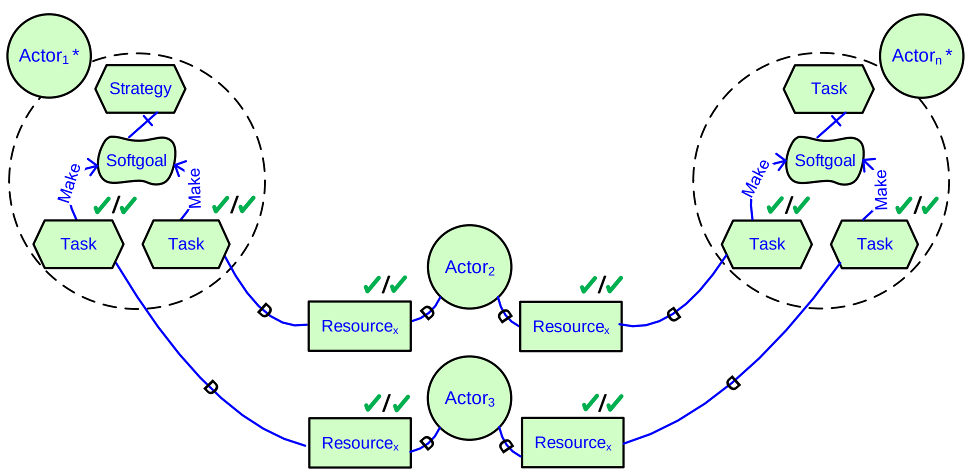


Figure A1-2c. Non-scarcity of *Resources* in a scenario with four *Actors*

A scenario in which the labels above each *dependum* are not '*satisfied*' for both *dependers* is shown in Figure A1-2d. Labels on the left side of the forward slash are opposite from the labels on the right side of the forward slash. It shows that only one of the *dependers* ("$Actor_1$" or "$Actor_n$") successfully obtains the *dependum* ("$Resource_x$") from the *dependees* ("$Actor_2$" and "$Actor_3$") while the other *depender* ("$Actor_1$" or "$Actor_n$") is unable to obtain that *dependum* ("$Resource_x$") from those *dependees* ("$Actor_2$" and "$Actor_3$"). This configuration represents the scarcity of "$Resource_x$" from the perspective of "$Actor_1$" and "$Actor_n$" as only one of those *actors* can obtain it thereby depriving the other *actor*. This indicates that "$Resource_x$" is scarce for "$Actor_1$" and "$Actor_n$".

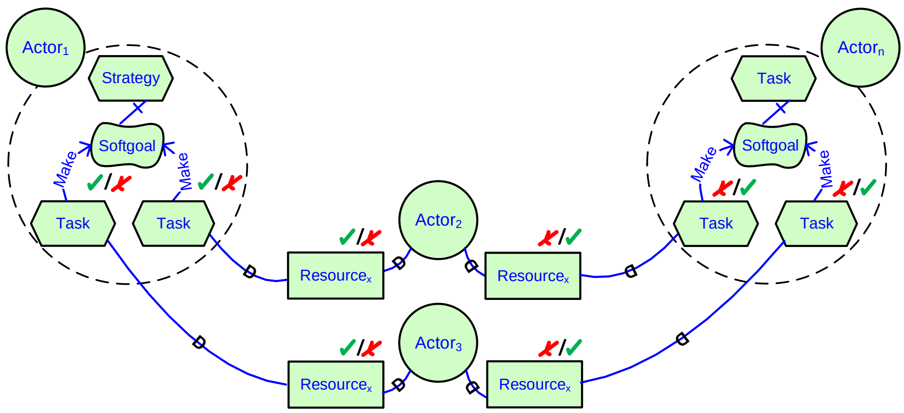


Figure A1-2d. Scarcity of *Resources* in a scenario with four *Actors*

A scenario in which the labels above each *dependum* are '*satisfied*' for both *dependers* only with respect to different *dependees* is shown in Figure A1-2e. The label on the left side of the forward slash represents the satisfaction or denial of an element for in Scenario 1 while the label on the right side of the forward slash represents the satisfaction or denial of an element in Scenario 2. It shows that when one of the *dependers* ("$Actor_1$" or "$Actor_n$") successfully obtains the *dependum* ("$Resource_x$") from a *dependee* ("$Actor_2$" or "$Actor_3$") then the other *depender* ("$Actor_1$" or "$Actor_n$") is only able to obtain that *dependum* ("$Resource_x$") from the other *dependee* ("$Actor_2$" or "$Actor_3$"). This means that both *dependers* ("$Actor_1$" and "$Actor_n$") successfully obtain the *dependum* ("$Resource_x$") albeit from different *dependees* ("$Actor_2$" and "$Actor_3$"). This indicates that "$Resource_x$" is not scarce for "$Actor_1$" and "$Actor_n$".

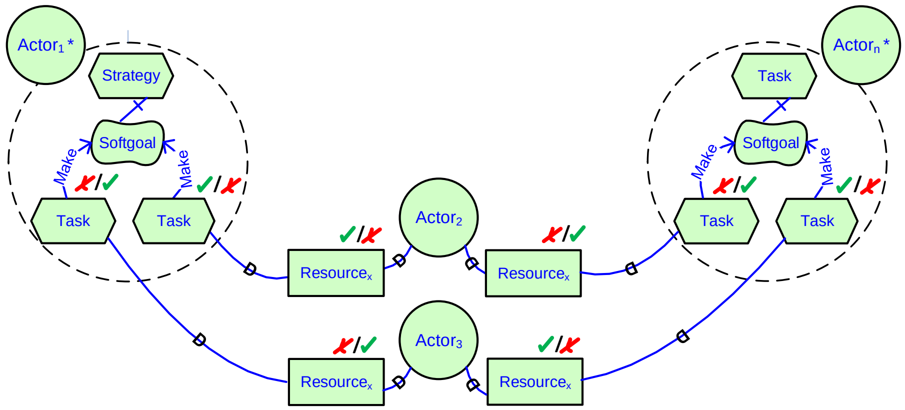


Figure A1-2e. Scarcity of *Resources* in a scenario with four *Actors*

- Imperfectly imitable (Inelastic supply): Barney (1991) states that a resource is imperfectly imitable when its supply is inelastic. This inelasticity of supply can be the result of path dependency, causal ambiguity, and social complexity associated with the way in which a resource is produced, transferred, and applied. These factors make it impossible for an actor to fully understand the processes that are necessary for generating, exchanging, and utilizing a resource. Four patterns for recognizing imperfectly inimitable resources in different settings are shown in Figure A1-3a.

  Two *actors* (“$Actor_1$” and “$Actor_n$”) that depend on a common *actor* (“$Actor_2$”) for access to the same *resource* (“$Resource_x$”) are depicted in Figures A1-3a, A1-3b, A1-3c, and A1-3d. The *dependee* (“$Actor_2$”) operationalizes (“Task” in “$Actor_2$”) its know-how (“Resource” in “$Actor_2$”) to provide “$Resource_x$” to “$Actor_1$” and “$Actor_n$”. Two outcomes are possible in this configuration: either the dependee (“$Actor_2$”) can supply the *dependum* (“$Resource_x$”) to both *dependers* (“$Actor_1$” and “$Actor_n$”) successfully or that the dependee (“$Actor_2$”) can only supply the *dependum* (“$Resource_x$”) to one of the *dependers* (“$Actor_1$” or “$Actor_n$”). In the latter case, the dependee (“$Actor_2$”) cannot supply the *dependum* (“$Resource_x$”) to both *dependers* (“$Actor_1$” and “$Actor_n$”) because it has neither the know-how nor the ability to supply the *dependum* (“$Resource_x$”) to both *dependers* (“$Actor_1$” and “$Actor_n$”). The first outcome is shown in Figures A1-3a and A1-3b while the second outcome is shown in Figures A1-3c and A1-3d. The attribute *complete* for “$Actor_2$” is ‘*false*’ signifying that “$Actor_2$” may also know of other ways of providing “$Resource_x$” to “$Actor_1$” and “$Actor_n$” in Figures A1-3a and A1-3b. Conversely, the attribute *complete* for “$Actor_2$” is ‘*true*’ signifying that “$Actor_2$” does not know of any other way of providing “$Resource_x$” to “$Actor_1$” and “$Actor_n$” in Figures A1-3c and A1-3d.

  A scenario in which the labels above each *dependum* are ‘*satisfied*’ for both *dependers* is shown in Figure A1-3a. This means that the *dependee* (“$Actor_2$”) is able to operationalize its know-how (“Resource” in “$Actor_2$”) in some way (“Task” in “$Actor_2$”) to provide the *dependum* (“$Resource_x$”) to both *dependers* ("Actor$_1$" and "Actor$_n$") successfully. This indicates that "Resource$_x$" does not have inelastic supply from "Actor$_2$".

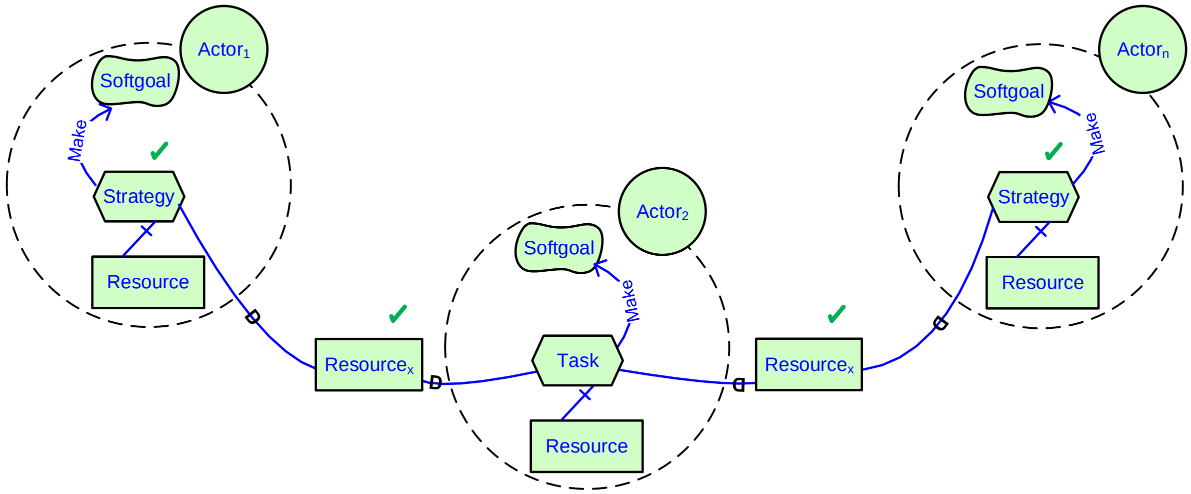


Figure A1-3a. Elastic Supply of a *Resource* in a scenario with three *Actors*

A scenario in which the labels above each *dependum* are '*satisfied*' for both *dependers* is shown in Figures A1-3b. This means that the *dependee* ("Actor$_2$") is able to operationalize different know-how in different ways to provide the *dependum* ("Resource$_x$") to both *dependers* ("Actor$_1$" and "Actor$_n$") successfully. "Actor$_2$" operationalizes ("Task$_1$" in "Actor$_2$") its know-how ("Resource$_1$" in "Actor$_2$") to provide "Resource$_x$" to "Actor$_1$" and operationalizes ("Task$_n$" in "Actor$_2$") different know-how ("Resource$_n$" in "Actor$_2$") to provide "Resource$_x$" to "Actor$_n$". This indicates that "Resource$_x$" does not have inelastic supply from "Actor$_2$".

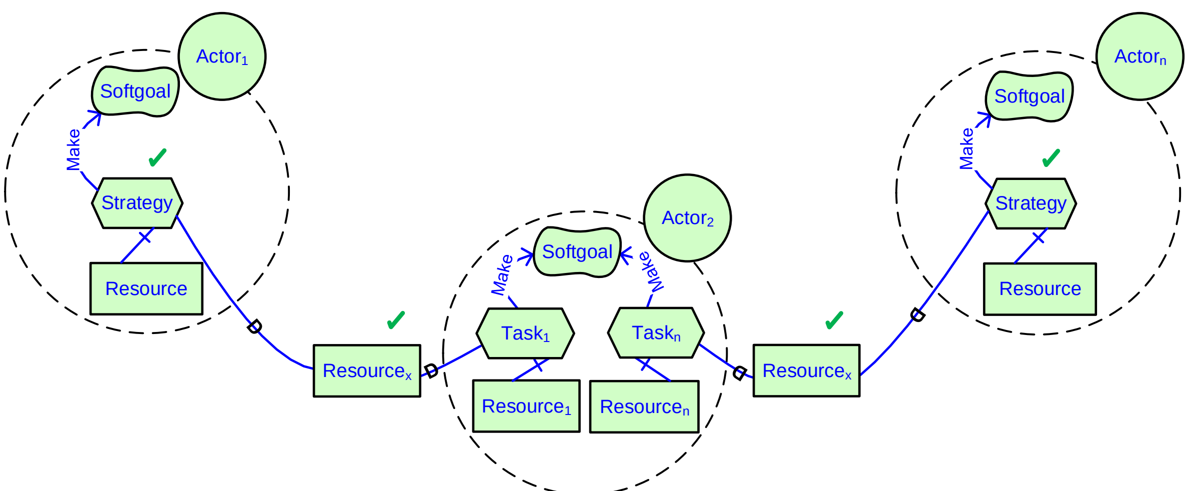


Figure A1-3b. Elastic Supply of a *Resource* in a scenario with three *Actors*

A scenario in which the labels above each *dependum* are not '*satisfied*' for both *dependers* is shown in Figures A1-3c. It shows that the *dependee* ("Actor$_2$") is able to provide the *dependum* ("Resource$_x$")

to only one of the *dependers* ("Actor$_1$") successfully and is not able to provide the *dependum* ("Resource$_x$") to the other *depender* ("Actor$_n$"). This is because the "Actor$_2$" can only operationalize ("Task$_1$" in "Actor$_2$") its know-how ("Resource" in "Actor$_2$") solely to be able provide "Resource$_x$" to "Actor$_1$". The *dependum* ("Resource$_x$") from "Actor$_n$" to "Actor$_2$" does not link to any operationalization within "Actor$_2$" and this shows that "Actor$_2$" does not know of any way to operationalize any know-how to be able to provide "Resource$_x$" to "Actor$_n$" in Figure A1-3c. This indicates that "Resource$_x$" has inelastic supply from "Actor$_2$".

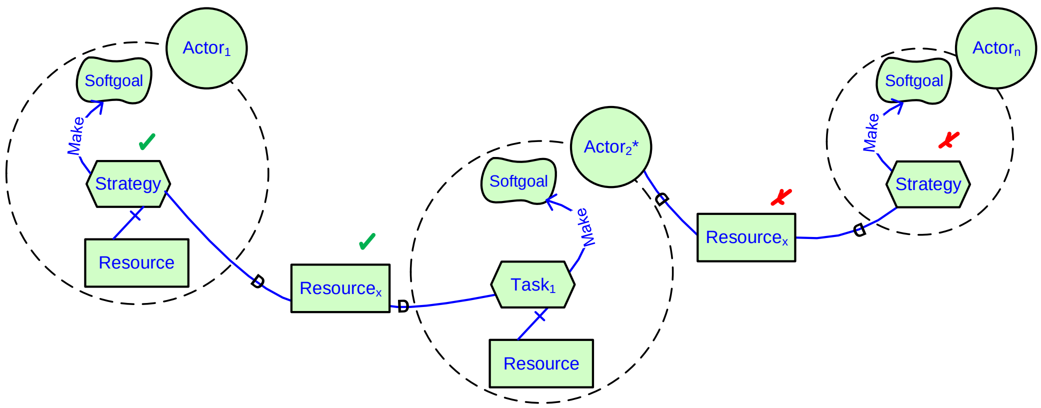


Figure A1-3c. Inelastic Supply of a *Resource* in a scenario with three *Actors*

A scenario in which the labels above each *dependum* are not '*satisfied*' for both *dependers* is shown in Figure A1-3d. It shows that the *dependee* ("Actor$_2$") is able to provide the *dependum* ("Resource$_x$") to only one of the *dependers* ("Actor$_n$") successfully and is not able to provide the *dependum* ("Resource$_x$") to the other *depender* ("Actor$_1$"). This is because the "Actor$_2$" can only operationalize ("Task$_n$" in "Actor$_2$") its know-how ("Resource" in "Actor$_2$") solely to be able provide "Resource$_x$" to "Actor$_n$". The *dependum* ("Resource$_x$") from "Actor$_1$" to "Actor$_2$" does not link to any operationalization within "Actor$_2$" and this shows that "Actor$_2$" does not know of any way to operationalize any know-how to be able to provide "Resource$_x$" to "Actor$_1$" in Figure A1-3d. This also indicates that "Resource$_x$" has inelastic supply from "Actor$_2$".

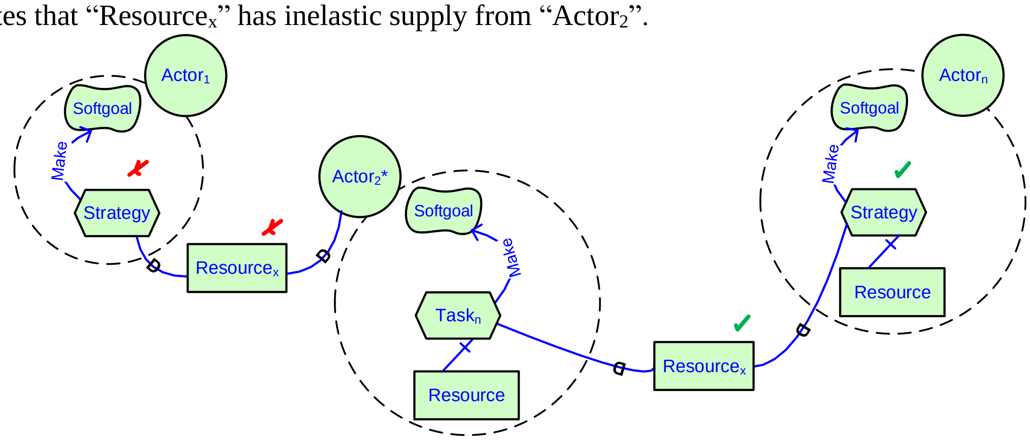


Figure A1-3d. Inelastic Supply of a *Resource* in a scenario with three *Actors*

- Non-substitutable: Barney (1991) posits that a resource is non-substitutable/non-equifinal when only that resource can be used to implement a strategy and no other resource(s) can be used to implement that strategy. Three patterns for recognizing non-substitutable resources in different settings are presented in Figure A1-4. The attribute *complete* for "$Actor_1$" and "$Actor_n$" is '*true*' signifying that neither "$Actor_1$" nor "$Actor_n$" know of any other ways of achieving their respective strategies ("$Strategy_a$" in "$Actor_1$" and "$Strategy_a$" in "$Actor_n$") in Figure A1-4a, A1-4b, and A1-4c. "$Actor_1$" can choose from two operationalizations in Figure A1-4a for achieving its "$Strategy_a$": (i) "$Task_x$" which relies on "$Resource_x$" from "$Actor_2$"; and (ii) "$Task_y$" which relies on "$Resource_y$" from "$Actor_2$".

  "$Actor_1$" can choose to perform "$Task_x$" by using "$Resource_x$" or "$Actor_n$" can choose to perform "$Task_y$" by using "$Resource_y$". The availability of two operationalizations to achieve the same strategy indicates that "$Resource_x$" and "$Resource_y$" are substitutable for "$Actor_1$". This logic also extends to another *actor* that is endeavoring to implement the same strategy ("$Strategy_a$" in "$Actor_n$"). "$Actor_n$" can also decide between completing "$Task_x$" by using "$Resource_x$" or "$Actor_n$" can decide to complete "$Task_y$" by using "$Resource_y$". The availability of two operationalizations to achieve the same strategy indicates that "$Resource_x$" and "$Resource_y$" are also substitutable for "$Actor_n$".

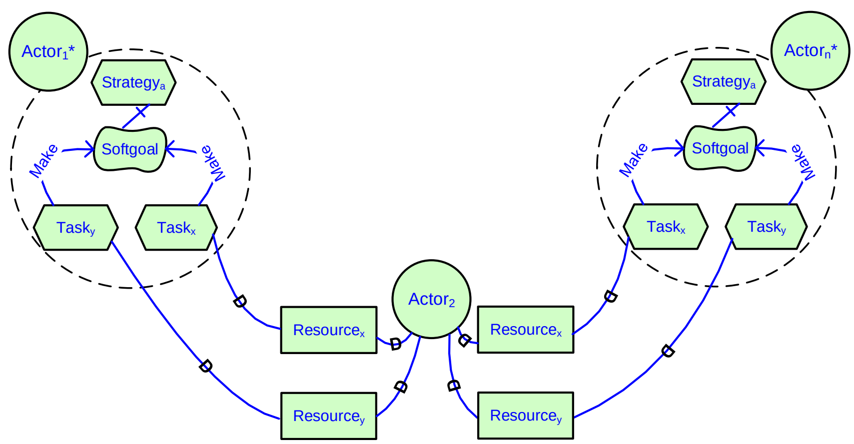


Figure A1-4a. Substitutability of *Resources* in a scenario with three *Actors*

Figure A1-4a and Figure A1-4b are similar to however Figure A1-4b includes a new *dependee* ("$Actor_3$"). "$Actor_1$" and "$Actor_n$" can choose from two operationalizations for achieving the same strategy ("$Strategy_a$" in "$Actor_1$" and "$Strategy_a$" in "$Actor_n$"): (i) "$Task_x$" which relies on "$Resource_x$" from "$Actor_2$"; and (ii) "$Task_y$" which relies on "$Resource_y$" from "$Actor_3$". In this configuration, as in the previous configuration (Figure A1-4a), the availability of two operationalizations to achieve the same strategy indicates that "$Resource_x$" and "$Resource_y$" are substitutable for "$Actor_1$" and "$Actor_n$". The presence of an additional *dependee* ("$Actor_3$") does not impact the substitutability of "$Resource_x$" or "$Resource_y$" for "$Actor_1$" and "$Actor_n$".

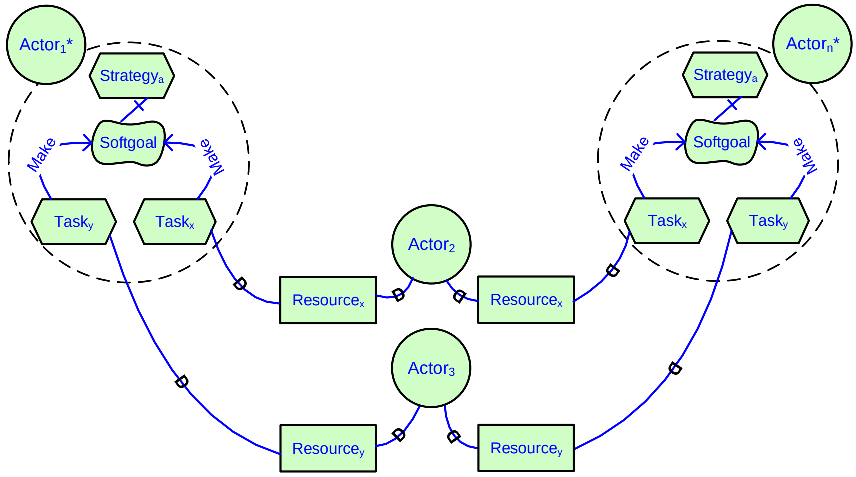


Figure A1-4b. Substitutability of *Resources* in a scenario with four *Actors*

Only one operationalization is available to "Actor$_1$" for achieving its "Strategy$_a$" – "Task$_x$" which relies on "Resource$_x$" from "Actor$_2$" in Figure A1-4c. To achieve "Strategy$_a$", "Actor$_1$" must perform "Task$_x$" by using "Resource$_x$". The availability of a sole operationalization to achieve a strategy indicates that "Resource$_x$" is non-substitutable for "Actor$_1$". This is also the case with "Actor$_n$" because it too does not know of any other way to achieve its strategy ("Strategy$_a$" for "Actor$_n$") than to complete "Task$_x$" by using "Resource$_x$". This means that "Resource$_x$" is also non-substitutable for "Actor$_n$".

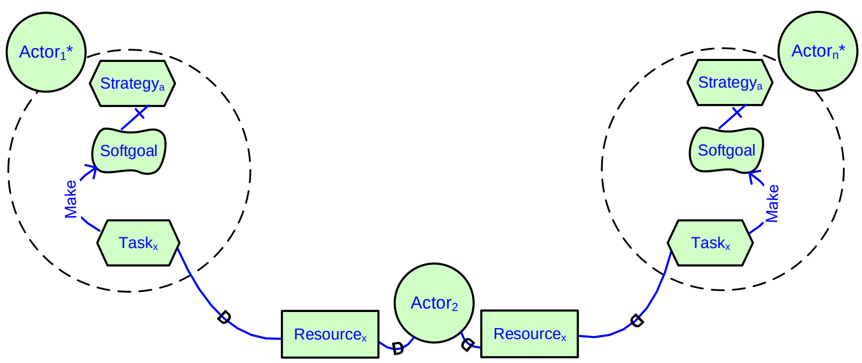


Figure A1-4c. Non-Substitutability of a *Resource* in a scenario with three *Actors*

Appendix 2: Approval Letters of Human Participant Research Ethics Protocol

The following two pages contain approval letters of human participant research ethics protocol granted by the Office of Research Ethics at the University of Toronto.

1. RIS Protocol Number: 36841

   Protocol #: 11174

   Status: Delegated Review App

   Version: 0002

   Sub Version: 0000

   Approved On: 29-Nov-18

   Expires On: 28-Oct-19
2. RIS Protocol Number: 36841

   Protocol #: 17552

   Status: Delegated Review App

   Version: 0001

   Sub Version: 0000

   Approved On: 28-Oct-19

   Expires On: 28-Nov-20

UNIVERSITY OF TORONTO

OFFICE OF THE VICE-PRESIDENT, RESEARCH AND INNOVATION

RIS Protocol Number: 36841

Approval Date: 29-Nov-18

PI Name: Vikram Pant

Division Name:

Dear Vikram Pant:

Re: Your research protocol application entitled, "Strategic Coopetition – A Conceptual Modeling Framework for Analysis and Design"

The Social Sciences, Humanities & Education REB has conducted a Delegated review of your application and has granted approval to the attached protocol for the period 2018-11-29 to 2019-10-28.

Please note that this approval only applies to the use of human participants. Other approvals may be needed.

Please be reminded of the following points:

- An **Amendment** must be submitted to the REB for any proposed changes to the approved protocol. The amended protocol must be reviewed and approved by the REB prior to implementation of the changes.
- An annual **Renewal** must be submitted for ongoing research. Renewals should be submitted between 15 and 30 days prior to the current expiry date.
- A **Protocol Deviation Report** (PDR) should be submitted when there is any departure from the REB-approved ethics review application form that has occurred without prior approval from the REB (e.g., changes to the study procedures, consent process, data protection measures). The submission of this form does not necessarily indicate wrong-doing; however follow-up procedures may be required.
- An **Adverse Events Report (AER)** must be submitted when adverse or unanticipated events occur to participants in the course of the research process.
- A **Protocol Completion Report** (PCR) is required when research using the protocol has been completed. For ongoing research, a PCR on the protocol will be required after 7 years, (Original and 6 Renewals). A continuation of work beyond 7 years will require the creation of a new protocol.
- If your research is funded by a third party, please contact the assigned Research Funding Officer in Research Services to ensure that your funds are released.

Best wishes for the successful completion of your research.

		Protocol #:11174			
Status:Delegated Review App	Version:0002	Sub Version:0000	Approved On:29-Nov-18	Expires On:28-Oct-19	Page 12 of 12

OFFICE OF RESEARCH ETHICS
McMurrich Building, 12 Queen's Park Crescent West, 2nd Floor, Toronto, ON M5S 1S8 Canada
Tel: +1 416 946-3273 ● Fax: +1 416 946-5763 ● ethics.review@utoronto.ca ● http://www.research.utoronto.ca/for-researchers-administrators/ethics

Figure A2-1a. RIS Protocol Number: 36841, Protocol #: 11174

UNIVERSITY OF TORONTO

OFFICE OF THE VICE-PRESIDENT, RESEARCH AND INNOVATION

RIS Protocol Number: 36841

Approval Date: 28-Oct-19

PI Name: Vikram Pant

Division Name:

Dear Vikram Pant:

Re: Your research protocol application entitled, "Strategic Coopetition – A Conceptual Modeling Framework for Analysis and Design"

The Social Sciences, Humanities & Education REB has conducted a Delegated review of your application and has granted approval to the attached protocol for the period 2019-10-28 to 2020-11-28.

Please note that this approval only applies to the use of human participants. Other approvals may be needed.

Please be reminded of the following points:

- An **Amendment** must be submitted to the REB for any proposed changes to the approved protocol. The amended protocol must be reviewed and approved by the REB prior to implementation of the changes.
- An annual **Renewal** must be submitted for ongoing research. Renewals should be submitted between 15 and 30 days prior to the current expiry date.
- A **Protocol Deviation Report** (PDR) should be submitted when there is any departure from the REB-approved ethics review application form that has occurred without prior approval from the REB (e.g., changes to the study procedures, consent process, data protection measures). The submission of this form does not necessarily indicate wrong-doing; however follow-up procedures may be required.
- An **Adverse Events Report (AER)** must be submitted when adverse or unanticipated events occur to participants in the course of the research process.
- A **Protocol Completion Report** (PCR) is required when research using the protocol has been completed. For ongoing research, a PCR on the protocol will be required after 7 years, (Original and 6 Renewals). A continuation of work beyond 7 years will require the creation of a new protocol.
- If your research is funded by a third party, please contact the assigned Research Funding Officer in Research Services to ensure that your funds are released.

Best wishes for the successful completion of your research.

		Protocol #:17552			
Status:Delegated Review App	Version:0001	Sub Version:0000	Approved On:28-Oct-19	Expires On:28-Nov-20	Page 13 of 13

OFFICE OF RESEARCH ETHICS
McMurrich Building, 12 Queen's Park Crescent West, 2nd Floor, Toronto, ON M5S 1S8 Canada
Tel: +1 416 946-3273 ● Fax: +1 416 946-5763 ● ethics.review@utoronto.ca ● http://www.research.utoronto.ca/for-researchers-administrators/ethics

Figure A2-1b. RIS Protocol Number: 36841, Protocol #: 17552

Appendix 3: Guidelines for modeling and analysis of *i**, e3value, and Game Tree models

The following pages contain guidelines for modeling and analysis of strategic coopetition using *i**, e3value, and Game Tree models.

*i** Guidelines	Type	Number	Kind	Phase
Do not include an Actor within another Actor	Concept	4.1.5	Negative	M1
Softgoal Dependency should not be met directly by a Goal.	Concept	4.3.4.1	Negative	M7
Use the Dependency link to indicate a Strategic Dependency relationship between Actors.	Concept & Evaluation	4.3.6	Positive	M7
Use the "D" symbol notation to denote a Dependency Link.	Notation	4.3.7	Positive	M7
Do not use Dependency Links inside an Actor.	Concept	4.3.8	Negative	M7
Ensure that both sides of a Dependency Link point in the same direction.	Concept	4.3.9	Positive	M7
Do not reuse Dependums in more than one Dependency Relation.	Concept & Evaluation	4.3.10	Negative	M7
Do not use a Dependency Link between two actors without showing the Dependum.	Concept	4.3.11	Negative	M7
Avoid or minimize drawing intersecting Links and overlapping Links with other Links and elements' text.	Layout	4.3.12	Negative	M1-M7
Make both sides of a Dependency Link look like a single, continuous curve as it passes through the Dependum.	Layout	4.3.13	Positive	M7
Spread the connection points of Dependency Links out on an Actor.	Layout	4.3.14	Positive	M7
Keep elements horizontal and straight.	Layout	4.3.15	Positive	M1-M7
Do not tilt or twist elements.	Layout	4.3.15	Negative	M1-M7
Avoid or minimize overlapping boundaries of Actors where possible.	Layout	5.1.1	Negative	M1,M2
Keep Dependency Links outside the boundaries of Actors.	Layout	5.1.2	Positive	M7
Use the conventional Actors' boundaries (circles) unless other shapes can improve the overall layout.	Layout	5.1.3	Positive	M1
Use a Softgoal for quality criterion and use a (hard) goal for a sharply defined objective.	Concept	5.2.1.1	Positive	M3,M5
Do not confuse Softgoal with optional, less important Goals.	Concept	5.2.1.2	Negative	M3,M5
To indicate that a Goal can be achieved by performing several sub-tasks, model the decomposition by introducing a Task.	Concept	5.2.1.3	Positive	M3,M4
Use multiple Means-End Links from Tasks to a Goal to indicate alternatives.	Concept	5.2.1.4	Positive	M3,M4
Don't mix Goals and Tasks in the Means-Ends links.	Concept	5.2.1.5	Negative	M3,M4
Use precise language to name a Goal or a Task.	Naming	5.2.1.6	Positive	M3,M4
A Goal can only be decomposed using Means-Ends Links.	Concept	5.2.1.7	Positive	M4
Do not confuse between a Softgoal and a Task.	Concept	5.2.2.1	Negative	M4,M5
Use the proper *i** Softgoal notation.	Notation	5.2.2.2	Positive	M5
Softgoals and Goals should be decomposed.	Concept & Evaluation	5.2.2.3	Positive	M3,M5

Do not confuse between a Task and a Resource.	Concept	5.2.3.1	Negative	M4
Use a Resource when the Actor asks for the provision of a clearly defined and concrete resource.	Concept	5.2.4.1	Positive	M1,M2
Model a human or system as a resource only if you want to ignore their goals and intentions.	Concept	5.2.4.2	Positive	M1,M2
Avoid overlapping elements inside or outside Actors.	Layout	5.2.6	Negative	M1-M7
Connect each Strategic Dependency Link in an SR model to the correct element within the actor.	Layout	5.2.7	Positive	M1,M7
Adopt or follow a consistent direction for the goal refinement/decomposition hierarchy as much as possible.	Layout	5.2.8	Positive	M4,M6
Do not draw SR model elements outside the boundaries of the corresponding actors.	Layout	5.2.9	Negative	M1,M2
Do not have unconnected elements within an Actor as this is indicative of an incomplete model.	Layout	5.2.10	Negative	M1-M7
Means-Ends are only used to link a Task to a Goal.	Concept	5.3.1	Positive	M3,M4
Be consistent with the direction of the Task Decomposition Link between a Task and sub Task or Resource.	Concept	5.4.1	Positive	M4
Be consistent with the direction of the Task Decomposition Link between a Task and a Softgoal.	Concept	5.4.2	Positive	M4,M6
Do not extend Decomposition Links beyond the boundaries of actors.	Concept	5.4.3	Negative	M1,M4
Don’t use the Task Decomposition Link or Means-End Link to refine Softgoals.	Concept	5.4.4	Negative	M4,M6
Use Contribution Links from any element only to a Softgoal element.	Concept	5.5.10	Positive	M6
Avoid introducing ad hoc or improvised link types. If you must, define their syntax and semantics as extensions to *i**.	Concept	5.5.11	Negative	M1-M7
Use the OR Contribution Links to indicate alternatives for satisfying a Softgoal.	Concept	5.5.12	Positive	M5,M6
Don’t use Correlation or Contribution Links between actors.	Concept	5.5.13	Negative	M2,M6
Don’t use Correlation or Contribution Links from a Task to a Task.	Concept	5.5.14	Negative	M4,M6
Use Contribution Links to refine a broad softgoal or non-functional requirement (NFR) into smaller components.	Concept	5.8.1	Positive	M6
To facilitate systematic refinement, use Type and Topic naming convention for Softgoals.	Naming	5.8.2	Positive	M5
Where Type and Topic structure is used, be consistent in each refinement step to refine either by Type or by Topic.	Naming	5.8.3	Positive	M5,M6
Avoid including non standard elements or notations in the model.	Naming	6.1	Negative	M1-M7
Be consistent when using colors in the models.	Naming	6.2	Positive	M1-M7
Use a suitable font size for the element name.	Naming	6.3	Positive	M1-M7
Select concise but informative phrases to name the elements.	Naming	6.4	Positive	M1-M7
Don’t extend the text of the name of the element beyond the element’s border.	Layout	6.5	Negative	M1-M7
Do not use Verbs in the names of Actors, Agents and Positions.	Naming	6.6	Negative	M1,M2

Use clear names without ambiguous and unknown abbreviations or acronyms.	Naming	6.7	Positive	M1-M7
Split a large and complex model into consistent pieces to facilitate easier presentation and rendering.	Layout	7.1	Positive	M1-M7
Don't zoom into a section of an Actor without showing the incoming and outgoing links with other Actors of the model.	Layout	7.2	Negative	M1-M7
Employ a systematic evaluation procedure	Evaluation	9.2.1	Positive	E1,E2
Formulate the analysis question before giving initial evaluation labels to elements	Evaluation	9.2.2.1	Positive	E1,E2
Give initial labels to the elements in a manner consistent with the analysis question	Evaluation	9.2.3.1	Positive	E1,E2
Give initial labels to all leaf elements, even if they are not directly involved in the analysis question	Evaluation	9.2.3.2	Positive	E1,E2
Contributions from multiple elements typically require human judgment	Evaluation	9.2.4.3	Positive	E1,X1-X5
Model the As-Is state of the knowledge domain and system without the presence of the new system To-Be introduced.	Methodology	10.1.1	Positive	M1-M7
Do not include the new system To-Be introduced in the model of the As-Is state of the knowledge domain and system.	Methodology	10.1.1	Negative	M1-M7
Model the To-Be state of the knowledge domain under analysis including the new To-Be system.	Methodology	10.1.2	Positive	X1-X5
Start the modeling with the SD model to capture the stakeholders and their associated dependencies and interactions.	Methodology	10.1.3	Positive	M1,M2,M7
Employ SR models to expand on the SD models and add the intentionality and rational dimension to the analysis.	Methodology	10.1.4	Positive	M1-M7
Do not include internal intentional graphs of Actors in the SD model.	Methodology	10.1.4	Negative	M1,M2,M7
Start an SD model with the actors, then add Dependency Links (Resources, Tasks, Goals, then Softgoals) consecutively.	Methodology	10.2.1	Positive	M1-M7
Use the leaf-level tasks as the system requirements, not the high level Goals and Softgoals.	Methodology & Layout	10.3	Positive	M1-M7

Table A3-1. *i** guidelines for modeling and analysis of strategic coopetition

Adapted from Source: *i** wiki at http://istar.rwth-aachen.de/tiki-index.php?page=*i**+Guide

*i** with e3value Guideline	Type	Sample Usage	Page in Source	Kind	Phase
Start idea exploration with the alternative that is most likely to be successful, but also investigate other alternatives, using knowledge from previous iterations.	Methodology	BvdR05	33	Positive	M1-M9
Do not ignore knowledge from previous iterations while exploring new ideas for alternatives to achieve objectives.	Methodology	BvdR05	33	Negative	M1-M9
Start idea exploration for improving an existing or AS-IS situation by first modelling and evaluating the current situation.	Methodology	BvdR05	33	Positive	M1-M9,E1-E5,X1-X5

Do not model the TO-BE situation prior to adequately modeling the AS-IS situation first	Methodology	BvdR05	33	Negative	M1-M9,E1-E5,X1-X5
Exploration of new ideas for TO-BE situation is triggered by identification of new opportunities.	Concept	BvdR05	34	Positive	X1-X5
Explore ideas for exploring new alternatives in terms of TO-BE situation by: (i) gathering information about the domain (ii) writing down a short description of the idea (iii) modelling one or more alternatives (iv) evaluating generated alternatives.	Methodology	BvdR05	34	Positive	X1-X5
Do not ignore domain knowledge or subject matter expertise when exploring new ideas for alternatives to achieve objectives.	Methodology	BvdR05	34	Negative	X1-X5
Add identified parties involved to the SD model as Actors.	Concept	BvdR05	35	Positive	M1-M2
Do not add identified parties in e3value to the SD model as Goals.	Concept	BvdR05	35	Negative	M1-M2
Do not add identified parties in e3value to the SD model as Tasks.	Concept	BvdR05	35	Negative	M1-M2
Do not add identified parties in e3value to the SD model as Resources.	Concept	BvdR05	35	Negative	M1-M2
Do not add identified parties in e3value to the SD model as Softgoals.	Concept	BvdR05	35	Negative	M1-M2
Assign abstract Actors (i.e., Roles) that focus on creating value to the concrete Actors (i.e., Agents) in the SD model.	Concept	BvdR05	35	Positive	M1-M2
Add Goal, Softgoal and Resource Dependency relationships, representing Objects of economic value, between Actors.	Concept	BvdR05	36	Positive	M7
Add Softgoal Dependency relationships, representing quality attributes of Objects of economic value, between Actors.	Concept	BvdR05	37	Positive	M7
If necessary, divide the SD model into several models, which only contain part of all the Actors involved, Depending on the complexity of the alternative.	Layout	BvdR05	37	Positive	M1,M2,M7
Do not create visually complicated or graphically complex model when it is possible to create simpler and smaller models that can fit together	Layout	BvdR05	37	Negative	M1-M9
Determine if an *i** Actor maps to an e3value Actor or a Market Segment.	Concept	BvdR05	38	Positive	M1,M2,M8
Composite e3value Actor represents a higher-level Actor that is composed of several lower-level Actors.	Concept	BvdR05	38	Positive	M8
Add a composite e3value Actor for multiple *i** Actors that are a part of a larger Actor.	Concept	BvdR05	38	Positive	M8
Do not add a composite e3value Actor for multiple *i** Actors that are not parts of the same Actor.	Concept	BvdR05	38	Negative	M8

Determine the detail of the e3value Actor model(s) based on the detail of the *i** SD model(s).	Methodology	BvdR05	39	Positive	M1,M2,M8
Do not create e3value and *i** SD models with inconsistent levels of detail	Methodology	BvdR05	39	Negative	M1,M2,M8
Create e3value Objects based on the names of the Dependencies between *i** Actors.	Naming	BvdR05	39	Positive	M7,M8
Do not create e3value Objects, that are based on the names of the Dependencies between *i** Actors, using other or different names.	Naming	BvdR05	39	Negative	M7,M8
Add Value Interfaces to each e3value Actor based on the Dependencies between corresponding *i** Actors.	Notation	BvdR05	40	Positive	M7,M8
Relate Value Interfaces of each e3value Actor via Value Exchanges in the opposite direction of the Dependencies between the corresponding *i** Actors.	Notation	BvdR05	40	Positive	M7,M8
Do not relate Value Interfaces of each e3value Actor via Value Exchanges in the same direction as the Dependencies between the corresponding *i** Actors.	Notation	BvdR05	40	Negative	M7,M8
If, while converting the *i** SD model to an e3value Actor model, problems or inconsistencies between the two models arise then adjust the SD model using the guidelines indicated above.	Methodology	BvdR05	41	Positive	M1,M2,M8
Add strategic Goals and Tasks to *i** Actors, accompanied by the Softgoals indicating quality attributes of those strategic intentions, and the Softgoals that contribute, constrain or enable the strategic Goals and Tasks to be satisfied.	Methodology	BvdR05	42	Positive	M3,M5
Add Tasks, possibly deconstructed into sub-tasks, to each Actor; these Tasks aim at reaching the strategic elements internal to the Actors.	Methodology	BvdR05	42	Positive	M4
Assign the Dependencies that represent economic value between Actors, taken from the SD model, to the Tasks internal to those Actors in the SR model that need those to be satisfied in order to be carried out.	Methodology	BvdR05	43	Positive	M7
Assign the Softgoal Dependencies between Actors, taken from the SD model, that represent quality attributes of Objects of economic value, to the strategic Goals, Tasks, and Softgoals internal to those Actors in the SR model.	Methodology	BvdR05	43	Positive	M7
If new Dependencies are identified while constructing an SR model, add these to the corresponding SD model.	Methodology	BvdR05	44	Positive	M7

Do not omit new Dependencies that are identified while constructing an SR model from the corresponding SD model.	Methodology	BvdR05	44	Negative	M7
Determine which level of decomposition of Tasks internal to *i** Actors should be mapped to Value Activities in the Value Activity model.	Evaluation	BvdR05	44	Positive	M4,M9
Assign Value Interfaces to each e3value Value Activity based on the intentional elements that the corresponding *i** Task Depends on and is willing to satisfy in return.	Methodology	BvdR05	45	Positive	M3,M5,M9
Relate Value Interfaces of Value Activities internal to the same e3value Actor based on the Dependencies between the corresponding *i** Tasks, which are internal to the corresponding *i** Actor.	Notation	BvdR05	46	Positive	M7,M9
Relate Value Interfaces of Value Activities willing to exchange Value Objects with other Actors-indicated by a task within an Actor sharing Dependencies with a Task internal to another Actor in the SR model to Value Interfaces at Actor boundary.	Notation	BvdR05	46	Positive	M7,M9
If, while converting the *i** SR model to an e3value Activity model, problems or inconsistencies between the two models arise then adjust the SR model using the guidelines indicated above.	Methodology	BvdR05	47	Positive	M1-M9
In evaluating an e3value Activity model, focus on the e3value constructs corresponding to all Softgoals in the *i** SR model.	Evaluation	BvdR05	47	Positive	E1-E5
In evaluating an e3value Activity model, do not merely focus on the e3value constructs corresponding to higher-level Softgoals in the *i** SR model, but also on the low-level Softgoals that explain the rationale in more detail.	Evaluation	BvdR05	47	Negative	E1-E5
Satisfy all labels in the *i** SR model.	Evaluation	BvdR05	48	Positive	E1-E5
Do not leave any labels in the *I** SR model unsatisfied.	Evaluation	BvdR05	48	Negative	E1-E5
Import the e3value Activity model analysis results into the *i** SR model by labelling the corresponding Softgoals internal to Actors concerning economic value.	Naming	BvdR05	48	Positive	E1-E5
Propagate the labels, imported from the e3value Activity model evaluation to the Goals, intentions and Dependencies within the *i** SR model ,using a qualitative labelling algorithm.	Notation	BvdR05	49	Positive	E1-E5
Do not use a quantitative assessment mechanism to evaluate the satisfaction of elements in an *i** SR model.	Evaluation	BvdR05	49	Negative	E1-E5
Do not judge implementation alternative's viability only on higher-level Softgoal labels,	Evaluation	BvdR05	49	Negative	E1-E5

but also on checkmark labels of lower-level Softgoals in the *i** SR model.					
Use Goals, intentions and Dependencies labelled weakly satisfied, conflict/irresolvable, undecided, weakly denied, and denied to identify points of improvement for new implementation alternatives to be explored in a next iteration.	Methodology	BvdR05	49	Positive	E3,E5
Detect if the Value Added by any Activity can be increased by assessing e3value and *i** SR models.	Evaluation	ICSOB17	10-11	Positive	E3
Value Added of an Activity refers to the incremental increase in the worth of a Value Object attributable to that Activity.	Concept	ICSOB17	10-11	Positive	E3
Value Added of an Activity does not refer to the increase in the overall worth of the value network attributable to the presence of any actor.	Concept	ICSOB17	10-11	Negative	E3
Detect if the Added Value of any Actor can be increased by assessing e3value and *i** SR models.	Evaluation	ICSOB17	12-13	Positive	E5
Added Value of an Actor refers to the increase in the overall worth of the value network attributable to the presence of that Actor.	Concept	ICSOB17	12-13	Positive	E5
Added Value of an Actor does not refer to the incremental increase in the worth of a Value Object attributable to any Activity	Concept	ICSOB17	12-13	Negative	E5
Iterate over steps until Value Added of Activities and Added Value of Actors is increased as desired.	Methodology	ICSOB17	10-13	Positive	M1-M9,E1-E5,X1-X5
Do not stop iterating over steps until Value Added of Activities and Added Value of Actors is increased as needed.	Methodology	ICSOB17	10-13	Negative	M1-M9,E1-E5,X1-X5
Create a new configuration by: (i) adding/removing some Actor, (ii) generating a change in some Actor's Goal, (iii) additional alternatives for achieving Goals of some Actor, (iv) Softgoals of some Actor, (v) change in relationships among two Actors in *i** SR model	Methodology	ICSOB17	4-10	Positive	X1-X5

Table A3-2. *i** with e3value guidelines for modeling and analysis of strategic coopetition

🡅 Adapted from sources:
(1) [BvdR05] B. van der Raadt, "Business-Oriented Exploration of Web Services Ideas Combining Goal-Oriented and Value-Based Approaches," Master's Thesis, Vrije Universiteit Amsterdam and University of Toronto, Amsterdam, 2005. http://jucmnav.softwareengineering.ca/ucm/pub/UCM/VirLibVanDerRaadtThesis05/RaadtMscThesis05.pdf
(2) [ICSOB17] Pant, V., Yu, E. (2017). "Modeling Strategic Complementarity and Synergistic Value Creation in Coopetitive Relationships". In: *8th International Conference on Software Business (ICSOB)* 2017. https://link.springer.com/chapter/10.1007/978-3-319-69191-6_6

*i** with Game Tree Guidelines	Type	Sample Usage	Page in Source	Kind	Phase
Text in names of corresponding model elements in *i** SR model and Game Tree should be consistent	Naming	ICSOB18	10	Positive	M1,M2,M5,M6
Do not use inconsistent names to refer to corresponding model elements in *i** SR model and Game Tree	Naming	ICSOB18	10	Negative	M1,M2,M5,M6
Represent Players as Nodes	Concept	BIR18	3	Positive	M2
Represent Decisions as Edges	Concept	BIR18	3	Positive	M6
Do not represent Players as Edges	Concept	BIR18	3	Negative	M2
Do not represent Decisions as Nodes	Concept	BIR18	3	Negative	M6
Represent an Actor in *i** SR model as a Player in a Game Tree	Concept	BIR18	3	Positive	M1-M3
Do not represent a Goal from *i** SR model as a Player in the Game Tree	Concept	BIR18	3	Negative	M2
Do not represent a Task from *i** SR model as a Player in the Game Tree	Concept	BIR18	3	Negative	M2
Do not represent a Resource from *i** SR model as a Player in the Game Tree	Concept	BIR18	3	Negative	M2
Do not represent a Softgoal from *i** SR model as a Player in the Game Tree	Concept	BIR18	3	Negative	M2
In *i** SR model, represent Stakeholders that are Concrete Actors as Agents	Concept	ICSOB18	6	Positive	M1,M3
In *i** SR model, represent Stakeholders that are Abstract Actors as Roles	Concept	ICSOB18	6	Positive	M1,M3
In *i** SR model, do not represent Stakeholders that are Concrete Actors as Roles	Concept	ICSOB18	6	Negative	M1,M3
In *i** SR model, do not represent Stakeholders that are Abstract Actors as Agents	Concept	ICSOB18	6	Negative	M1,M3
In Game Tree, represent Focal Player as First Mover	Methodology	ICSOB18	6	Positive	M2
In *i** SR model, denote additional actors that pertain to the relationship under study	Methodology	BIR18	10	Positive	M3
In *i** SR model, do not include extraneous actors that do not pertain to the relationship under study	Methodology	BIR18	10	Negative	M3
Depict objectives with clear cut satisfaction criteria of each actor as Goals in *i** SR model	Concept	BIR18	3	Positive	M4
Do not depict objectives without clear cut satisfaction criteria of each actor as Goals in *i** SR model	Concept	BIR18	3	Negative	M4
Express alternatives for achieving each Goal in *i** SR model as Tasks	Concept	BIR18	3	Positive	M5
Represent a Decision (e.g., move or counter-move) in a Game Tree as a Task in *i** SR model	Concept	BIR18	5	Positive	M6
Do not represent a Decision (e.g., move or counter-move) in a Game Tree as a Actor in *i** SR model	Concept	BIR18	5	Negative	M6
Do not represent a Decision (e.g., move or counter-move) in a Game Tree as a Goal in *i** SR model	Concept	BIR18	5	Negative	M6
Do not represent a Decision (e.g., move or counter-move) in a Game Tree as a Resource in *i** SR model	Concept	BIR18	5	Negative	M6
Do not represent a Decision (e.g., move or counter-move) in a Game Tree as a Softgoal in *i** SR model	Concept	BIR18	5	Negative	M6

An Edge is used generally to connect two Players	Concept	ICSOB18	6	Positive	M6
Rarely and in some cases an Edge can be used to connect the same Player if the same Player makes consecutive moves	Concept	ICSOB18	6	Positive	M6
Do not use an edge to connect any other entities than Players in a Game Tree	Concept	ICSOB18	6	Negative	M6
In Game Tree, represents a Decision Path as a unique continuous flow of Edges connecting the root Node to a specific Payoff	Layout	ICSOB18	6	Positive	M6
In Game Tree, Depict a Decision Path as a continuous sequential flow of Edges connecting root Node to a specific payoff	Layout	ICSOB18	6	Positive	M6
A terminal Edge shows the payoffs corresponding with a particular Decision path	Notation	ICSOB18	6	Positive	E2
Only terminal Edges are connected with a Player on one side	Notation	ICSOB18	6	Positive	M6
Do not connect a terminal Edge to Players on both sides	Notation	ICSOB18	6	Negative	M6
Do not have a terminal Edge without a Payoff on one side	Notation	ICSOB18	6	Negative	M6
Decision Path in a graph should go only in one direction from root Node towards leaf Nodes	Layout	BIR 2018	9	Positive	M6
Decision Path should be acyclic without any closure or loops	Layout	BIR 2018	9	Positive	M6
Do not include cycles or closures or loops in Decision Path in a Game Tree	Layout	BIR 2018	9	Negative	M6
Multiple options of moves and countermoves are depicted as Tasks and Sub-Tasks in the same *i** model	Concept	ICSOB18	8	Positive	M5
Moves are labeled with categorical integers	Naming	ICSOB18	9	Positive	M5,M6
Options for counter-moves are labeled with their own categorical integers that are prefixed with the label of the move that they correspond to	Naming	ICSOB18	9	Positive	M5,M6
There is no limit to the number of counter-move options that can correspond to a move	Concept	ICSOB18	9	Positive	M5,M6
A counter-move to an earlier move can itself serve as a move to a future counter-move	Concept	ICSOB18	9	Positive	M5,M6
Corresponding model elements in *i** SR model and Game Tree should be named with the same identifiers	Naming	ICSOB18	10	Positive	M1-M9
Do not name corresponding model elements in *i** SR model and Game Tree with different identifiers	Naming	ICSOB18	10	Negative	M1-M9
Softgoals for each actor should be portrayed with priorities in *i** SR model	Notation	ICSOB18	3	Positive	M7
Relative importance of each softgoal is depicted in *i** SR model with one or more exclamation marks	Notation	ICSOB18	3	Positive	M7
In *i** SR model, single exclamation mark (!) is evaluated as having relatively lower priority than Double exclamation marks (!!)	Evaluation	ICSOB18	3	Positive	E1,E2
Depict contributions from Tasks to Softgoals in *i** SR model	Notation	ICSOB18	5	Positive	M8
Depict contributions from Softgoals to other Softgoals in *i** SR model	Notation	ICSOB18	5	Positive	M8

In *i** SR model, do not depict any entity as making contribution to a Goal	Notation	ICSOB18	5	Negative	M8
In *i** SR model, do not depict any entity as making contribution to a Task	Notation	ICSOB18	5	Negative	M8
In *i** SR model, do not depict any entity as making contribution to a Resource	Notation	ICSOB18	5	Negative	M8
Express Dependencies among Actors in *i** SR model	Concept	ICSOB18	6	Positive	M9
Evaluate goal satisfaction by propagating labels in *i** SR model	Evaluation	ICSOB18	8	Positive	E1
Compute Payoffs for each Decision Path in Game Tree	Evaluation	ICSOB18	10	Positive	E2
Do not leave out Payoff for any Player involved in a decision path	Evaluation	ICSOB18	10	Negative	E2
Do not use different sequences for listing Payoffs associated with different decision paths	Evaluation	ICSOB18	10	Negative	E2
Depict Payoffs in Game Trees on the side of terminal Edge that is not connected to a Player	Notation	ICSOB18	3	Positive	E2
In Game Tree, do not depict Payoffs on the side of terminal Edge that is connected to a Player	Notation	ICSOB18	3	Negative	E2
Calculate Payoffs in Game Tree by evaluating satisfaction and denial of associated softgoals in *i** SR model	Evaluation	ICSOB18	10	Positive	E1,E2
While calculating associated Payoffs in Game Tree consider the relative priorities of softgoals in *i** SR model	Evaluation	ICSOB18	10	Positive	E1,E2
Detect presence of win-win, win-lose, and lose-lose strategies in Game Tree by comparing outcomes for each Player	Evaluation	BIR18	5,9	Positive	E3
Assess strategy that only contains positive payoffs for each Player Win-Win	Evaluation	BIR18	2	Positive	E3
Assess strategy that contains atleast one positive and atleast one negative payoff for Players as Win-Lose	Evaluation	BIR18	2	Positive	E3
Assess strategy that only contains negative payoffs for each Player as Lose-Lose	Evaluation	BIR18	2	Positive	E3
Iterate over steps until desired number of Win-Win strategies is created	Methodology	BIR18	10	Positive	X1-X5
Create a new configuration by: (i) adding/removing some actor, (ii) generating a change in some actor's goal, (iii) additional alternatives for achieving goals of some actor, (iv) softgoals of some actor, (v) change in relationships among two actors in *i** SR model	Methodology	BIR18	10	Positive	X1-X5

Table A3-3. *i** with Game Tree guidelines for modeling and analysis of strategic coopetition

🡅 Synthesized from sources:
(1) [BIR18] Pant, V., & Yu, E. (2018, September). Getting to Win-Win in industrial collaboration under coopetition: a strategic modeling approach. In: *International Conference on Business Informatics Research* (pp. 47-66). Springer, Cham. https://link.springer.com/chapter/10.1007/978-3-319-99951-7_4
(2) [ICSOB18] Pant, V., & Yu, E. (2018, June). Generating win-win strategies for software businesses under coopetition: a strategic modeling approach. In: *International Conference of Software Business* (pp. 90-107). Springer, Cham. https://link.springer.com/chapter/10.1007/978-3-030-04840-2_7

Appendix 4: Samples of sketches and diagrams of *i**, e3value, and Game Tree models by subjects in research

The following pages contain samples of sketches and diagrams of *i**, e3value, and Game Tree models that were developed by subjects at various stages in this research.

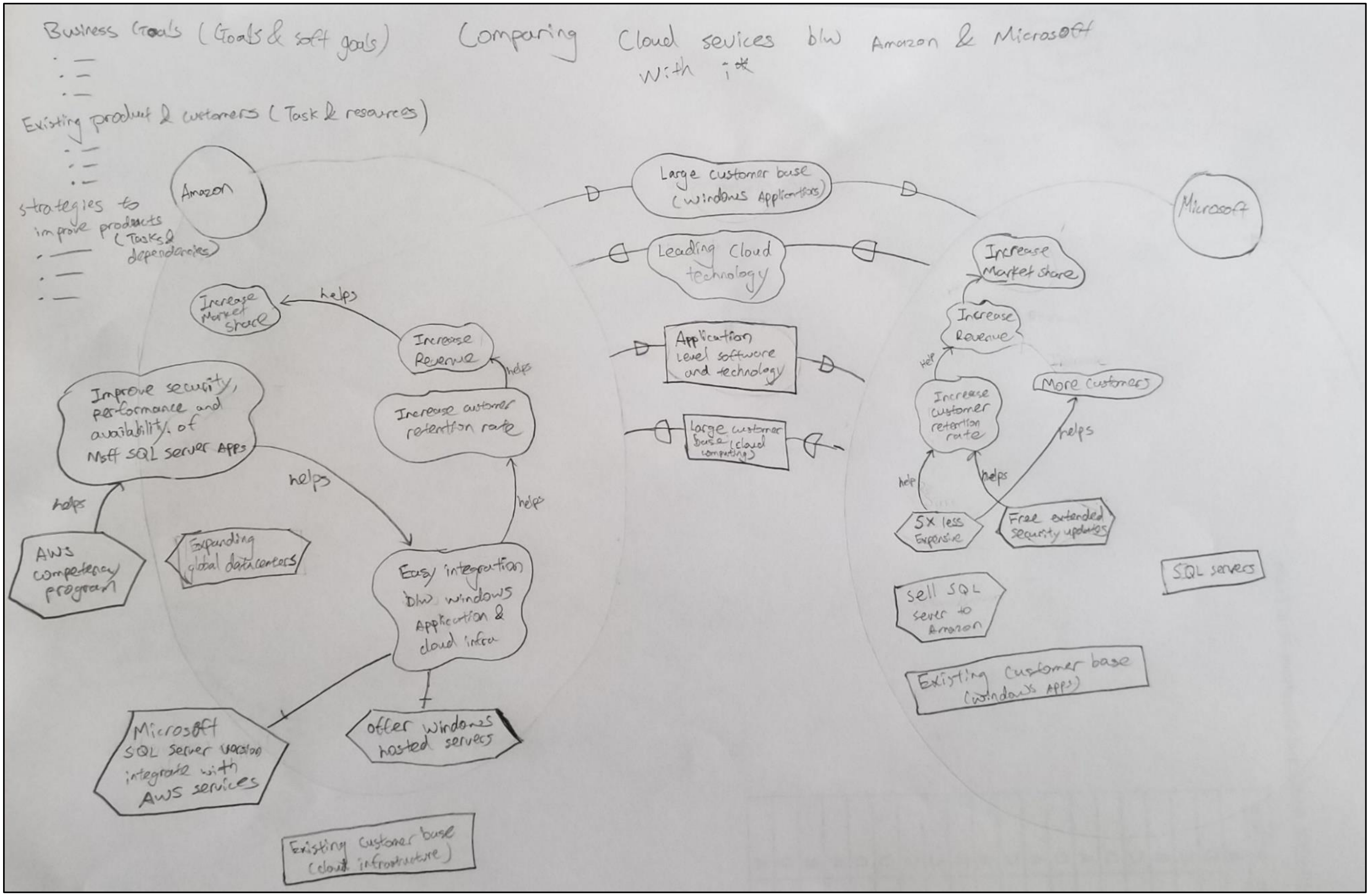


Figure A4-1. First hand-drawn sketch of *i** model by Subject 2 in our research

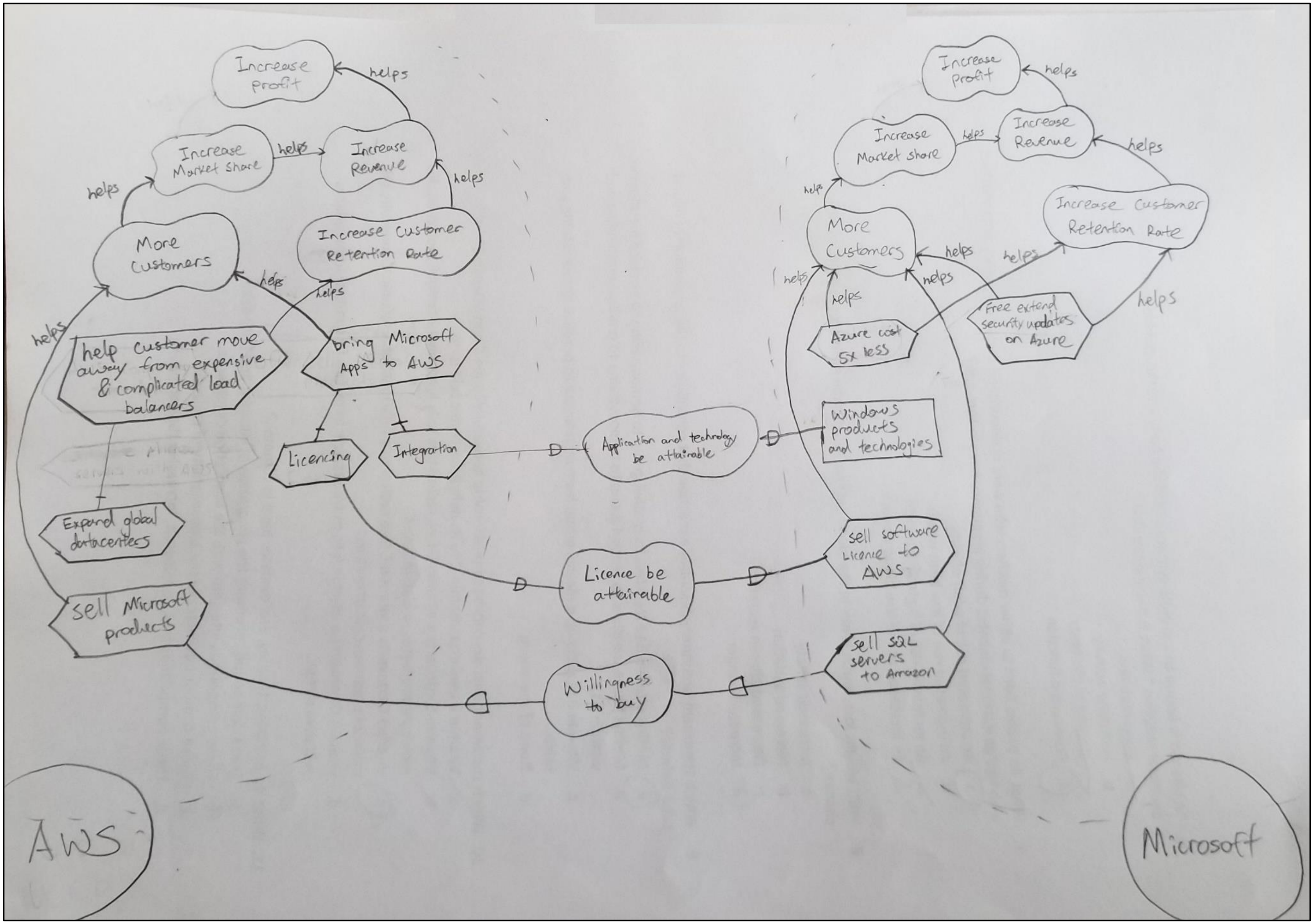


Figure A4-2. Second iteration of hand-drawn sketch of *i** model by Subject 2

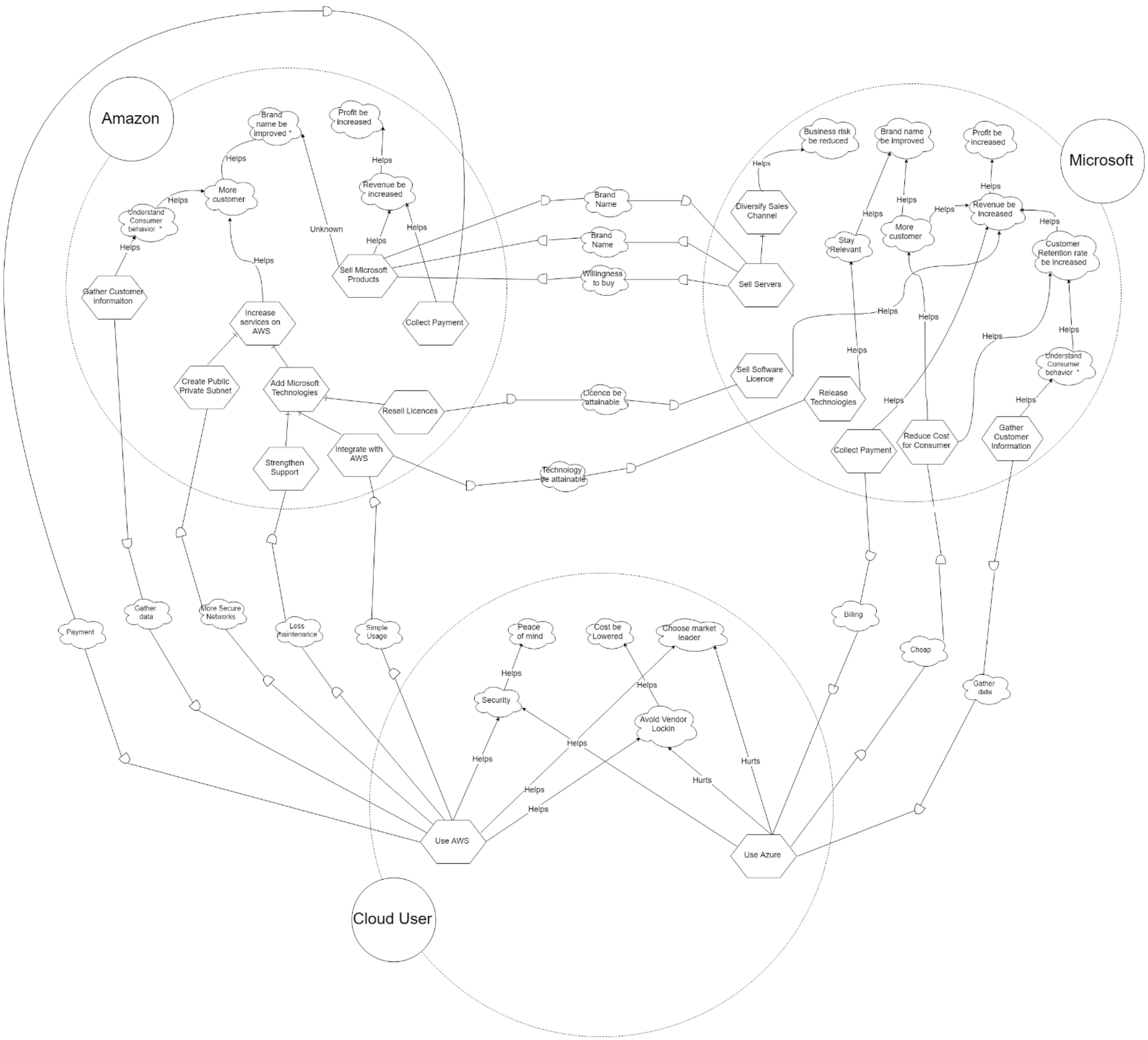


Figure A4-3. Early *i** model of Microsoft and Amazon case developed by Subject 2 using software tool

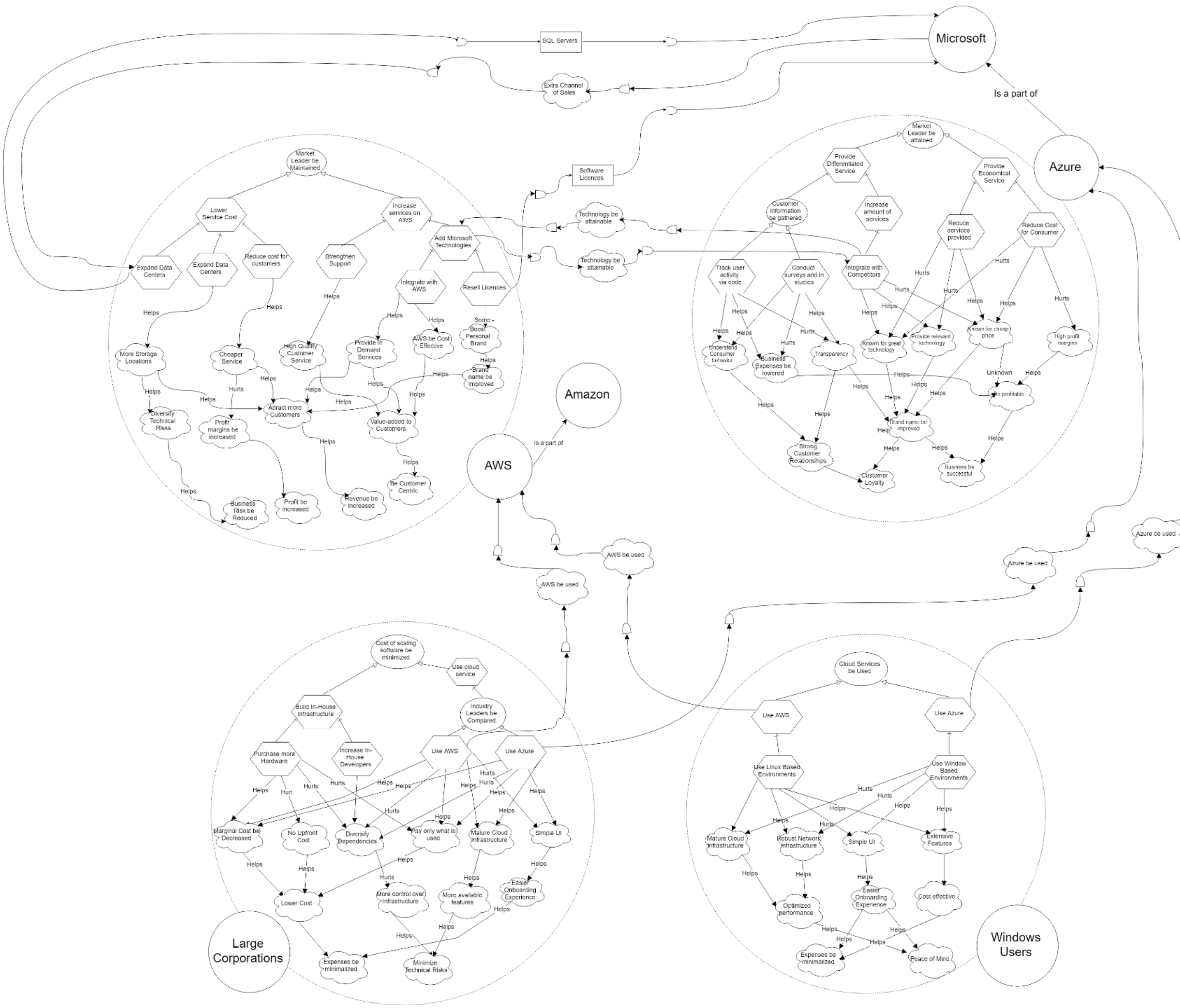


Figure A4-4. More detailed *i** model of Microsoft and Amazon case developed by Subject 2 during their participation in our research

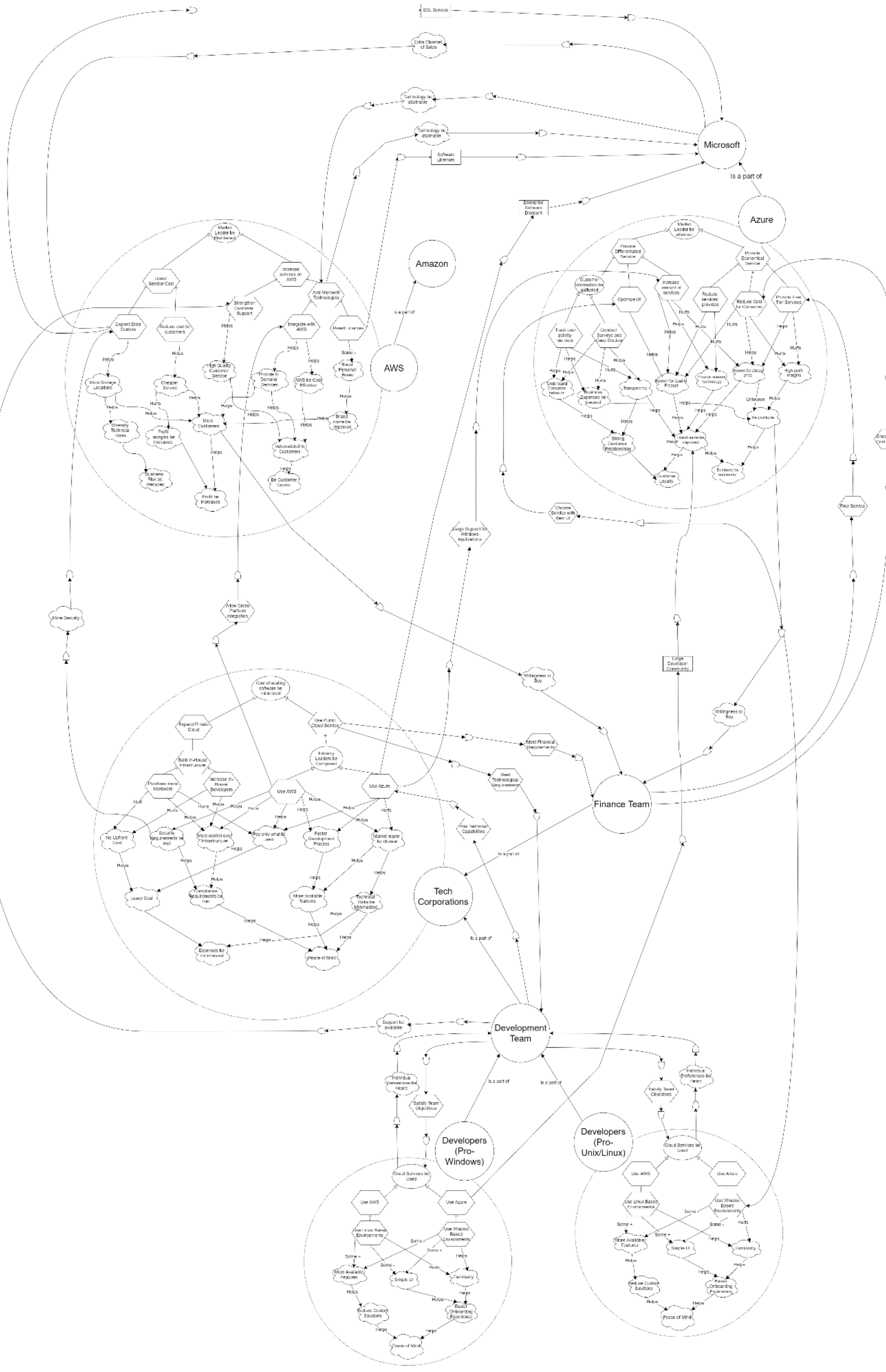


Figure A4-5. Final *i** model of Microsoft and Amazon case developed by Subject 2 during their participation in our research

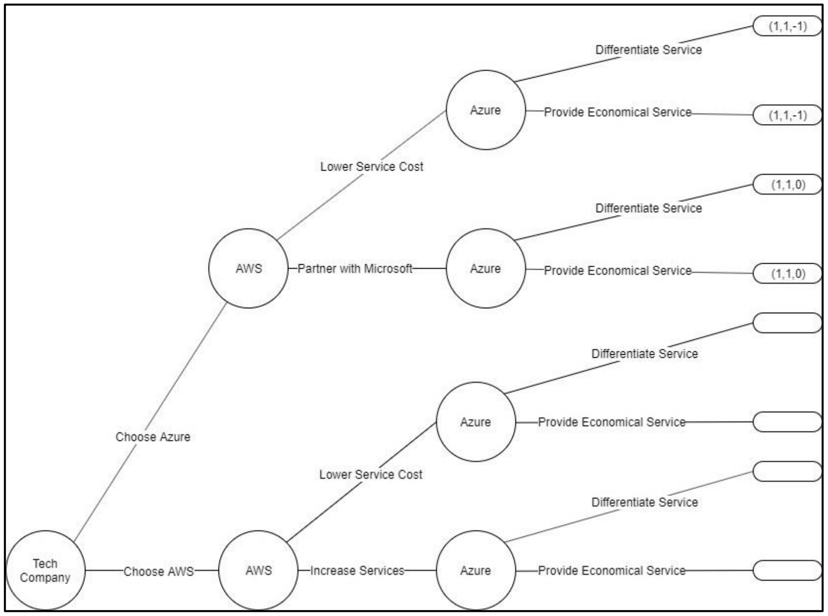


Figure A4-6. Game Tree model developed by Subject 2 during their participation in our research

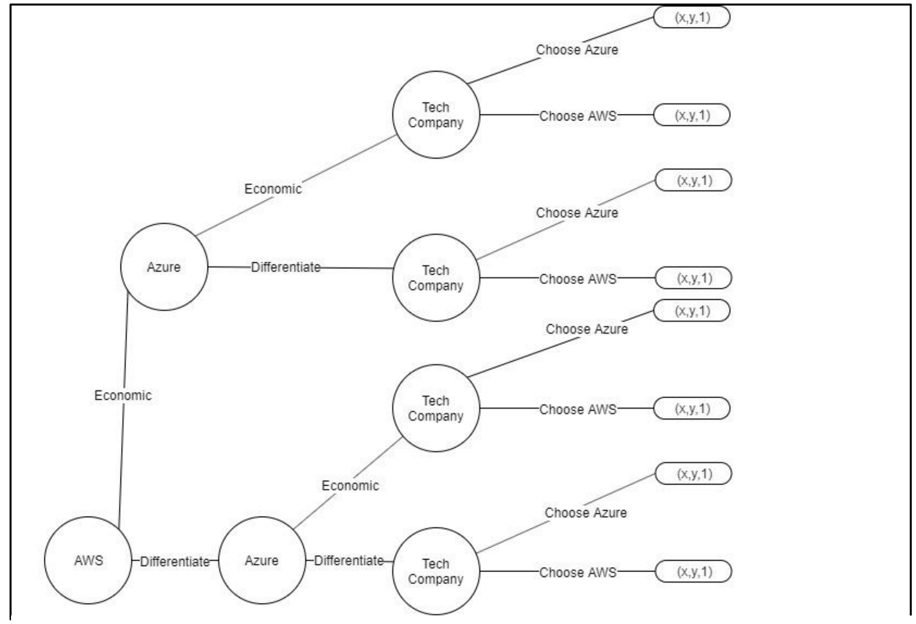


Figure A4-7. Final Game Tree model developed by Subject 2 during their participation in our research

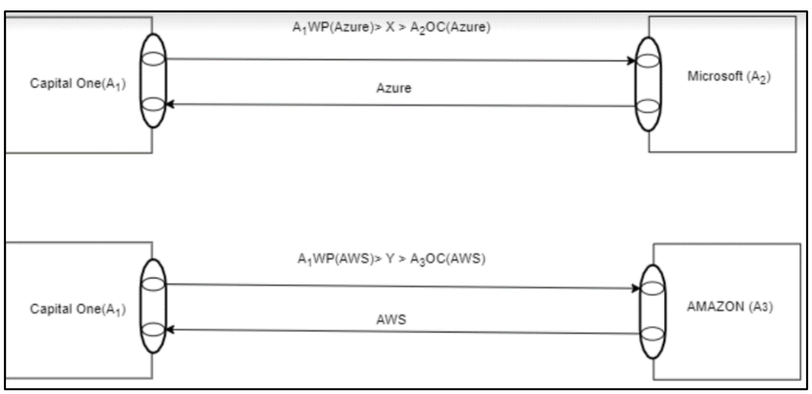


Figure A4-8. e3value model developed by Subject 2 during their participation in our research

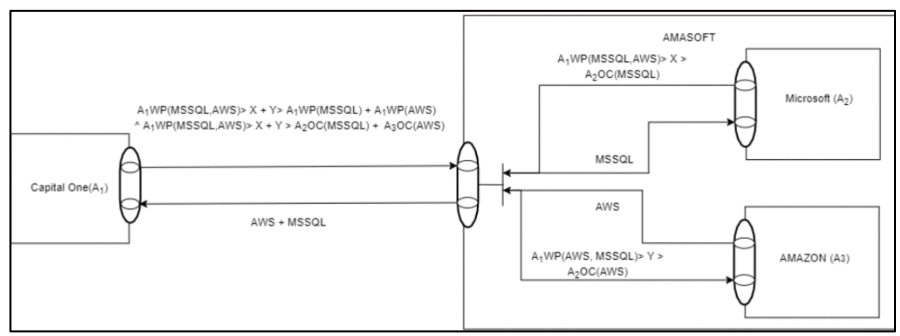
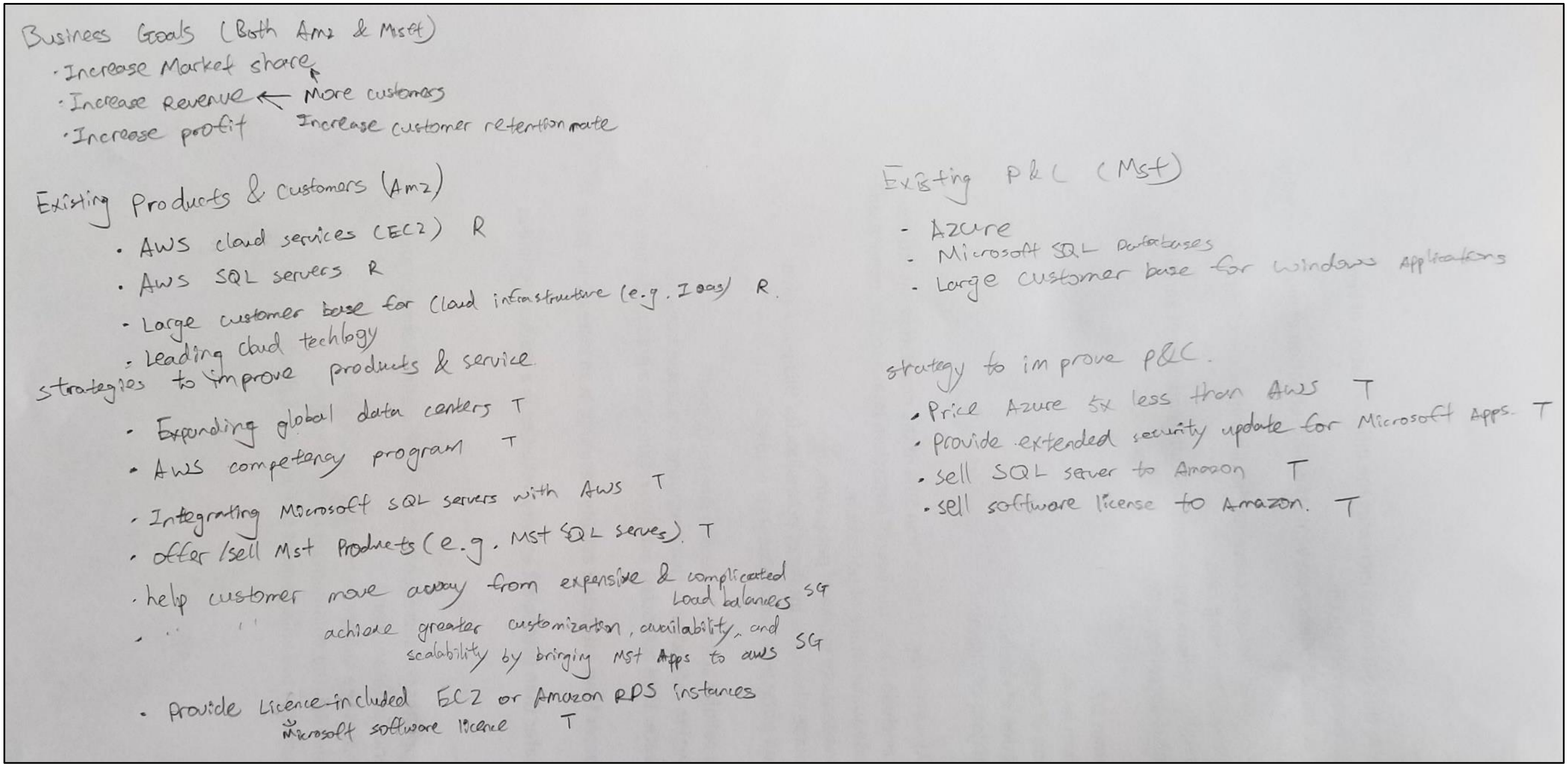


Figure A4-9. Final e3value model developed by Subject 2 during their participation in our research



Business Goals (Both Amz & Msft)
- Increase Market share
- Increase Revenue ← More customers
- Increase profit Increase customer retention rate

Existing Products & customers (Amz)
- AWS cloud services (EC2) R
- AWS SQL servers R
- Large customer base for cloud infrastructure (e.g. IaaS) R.
- Leading cloud techlogy

strategies to improve products & service.
- Expanding global data centers T
- AWS competency program T
- Integrating Microsoft SQL servers with AWS T
- offer /sell Mst Products (e.g. Mst SQL serves). T
- help customer move away from expensive & complicated Load balances SG
- " " achieve greater customization, availability, and scalability by bringing Mst Apps to aws SG
- Provide Licence-included EC2 or Amazon RDS instances Microsoft software licence T

Existing P&C (Mst)
- Azure
- Microsoft SQL Databases
- Large customer base for Windows Applications

strategy to improve P&C.
- Price Azure 5x less than AWS T
- provide extended security update for Microsoft Apps. T
- sell SQL server to Amazon T
- sell software license to Amazon. T

Figure A4-10. Sample of hand-written draft notes with comments and feedback written by the Subject 2 during their participation in our research. These notes contain details regarding their application of our conceptual modeling framework to the Microsoft and Amazon case.

V8:

- SD between different levels in different goal hierarchies doesn't make sense
- A mix of goal hierarchies(Different types of decision making) might be better to be represented by breaking down actors into more subtle roles
- **(New Information)** Using Case study of Capital One in attempts to understand how has AWS exactly helped Capital One achieve their technical goals through cloud computing and why they choose to use AWS.
  https://aws.amazon.com/solutions/case-studies/innovators/capital-one/
- **(New Information)** Contrasting between Economical choices doesn't make sense with additional sources that suggest current public cloud service providers do not have much of a difference when doing a price comparison.
- **(New Information)**Hybrid cloud infrastructure seems to be a focus with Azure, steps ahead of AWS. (http://blog.pragmaticworks.com/why-choose-azure-over-aws)
- **(New Information)**While AWS is much more mature and contains much more solutions than Azure, The focus on SaaS such as AI
- Thoughts on breaking down larger actors into different layer of agents, with different goals and soft goals at each level, example below
  - For Profit Business
    - Financial Industry
      - Bank
        - Product Focus
        - Executive teams
      - Credit Card Company
      - Insurance
    - Healthcare Industry
    - Tech
    - Education
    - Retail
  - Non-Profit Business
- Modeling uncertainty is a struggle.
  - In the process of modeling the Coopetition case between AWS and Azure, there are an overwhelming amount of information, differences in opinion and the need to analyze the importance of these information for each actor.
- Throughout the process of Modeling this case, it is difficult to provide any sense of accurate analysis without diving into the different actors and roles. However, doing so has shifted the focus from discovering limitations with modeling into trying to more accurately depict information such that reasoning with the model is more accurate.
- Thoughts on the Goal(and Softgoal) hierarchy
  - Like the fact that it is more structured, a great structure to begin with
  - Reduces some free form that is needed in the models, especially when dealing with partial information.
- How to represent Actor hierarchies and map goal dependencies between actors at different hierarchies if mapping different levels in different goal hierarchies doesn't make sense?
  - For example, when an actor at a higher level of the hierarchy depended on an actor (more specialized at a lower level) to make a certain type of decision, then the top level of the goal hierarchy would be such a decision. However, the paren "Task" may not be a top level task, thus dependencies between the goal and the task will not be at the same level
- Should guidelines exist for adding new information onto the model?
  - Often we find new sources of information that may require additional information to be considered at different levels of the goal hierarchy. It seems trivial to add new pieces of information between hierarchie, however, sometimes leaving partial information seem to violate "best modeling practices". For example, V9 attempts to breakup the structure of a large corporations into smaller actor components that are related in the process of adopting cloud computing technology. Task was added to the "Tech Company" Actor to delegate tasks to subsidiary teams which would provide feedback to deciding on adopting cloud technology as a whole, however such task does not contribute to existing soft goals that focus of the goal hierarchy in "Tech Company".

Figure A4-11. Sample of typed notes with comments and feedback written by the Subject 2 during their participation in our research. These notes contain details regarding their application of our conceptual modeling framework to the Microsoft and Amazon case.

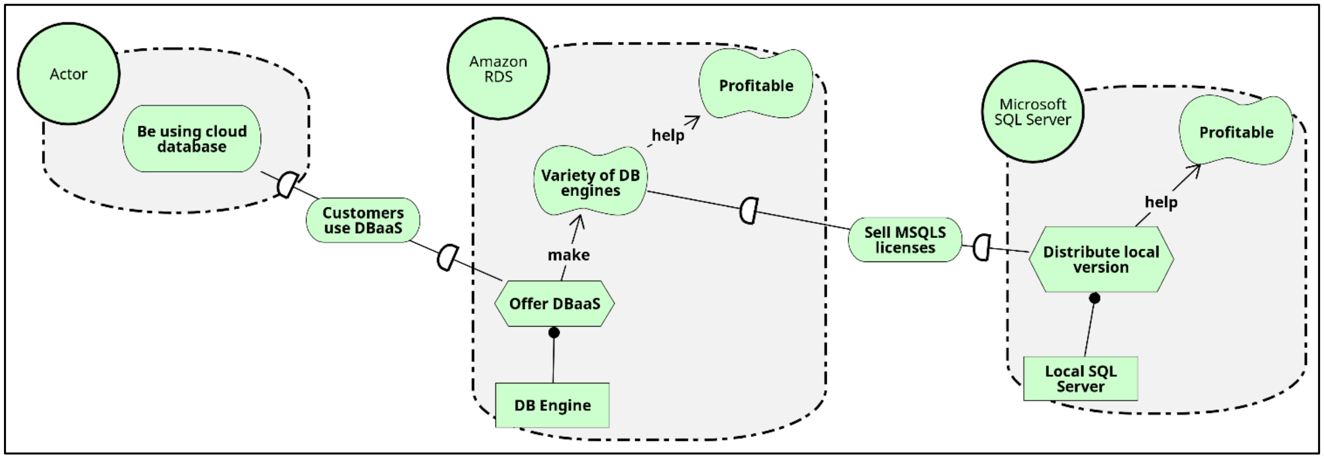


Figure A4-12. Early *i** model of Microsoft and Amazon case developed by Subject 1 using software tool

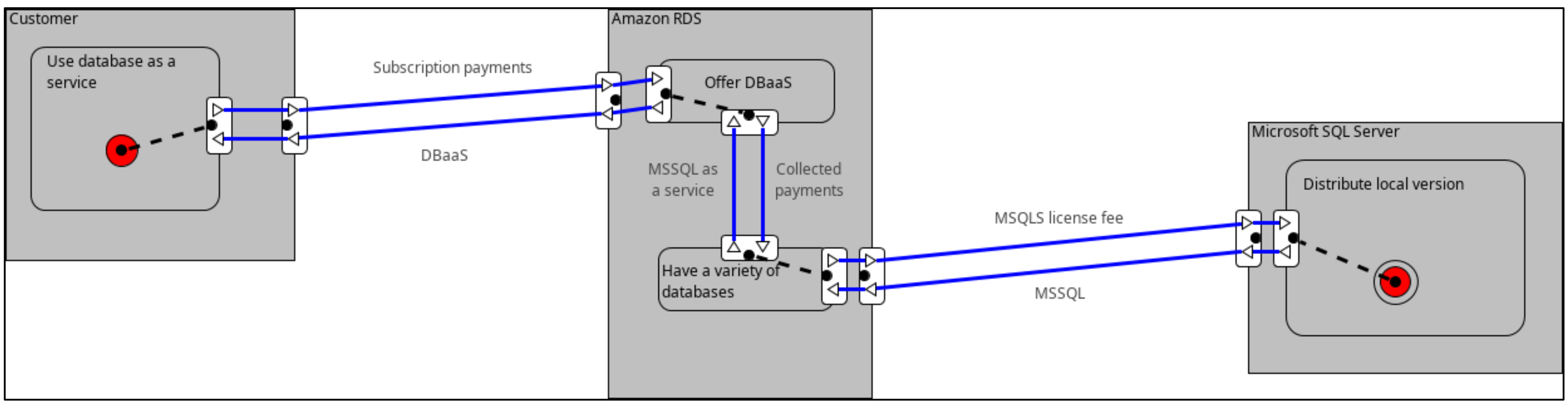


Figure A4-13. e3value model developed by Subject 1 during their participation in our research

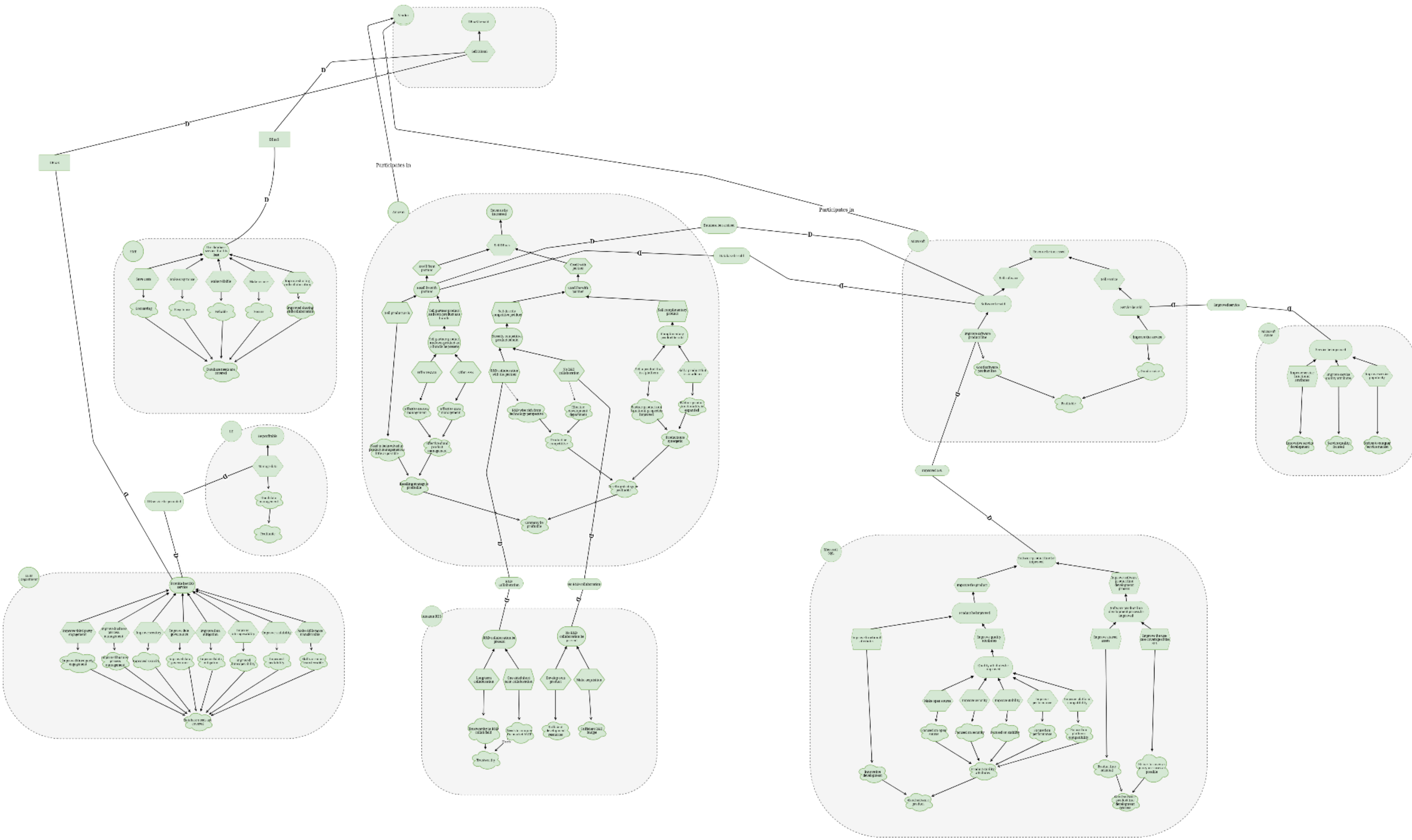


Figure A4-14. More detailed *i** model of Microsoft and Amazon case developed by Subject 1 during their participation in our research

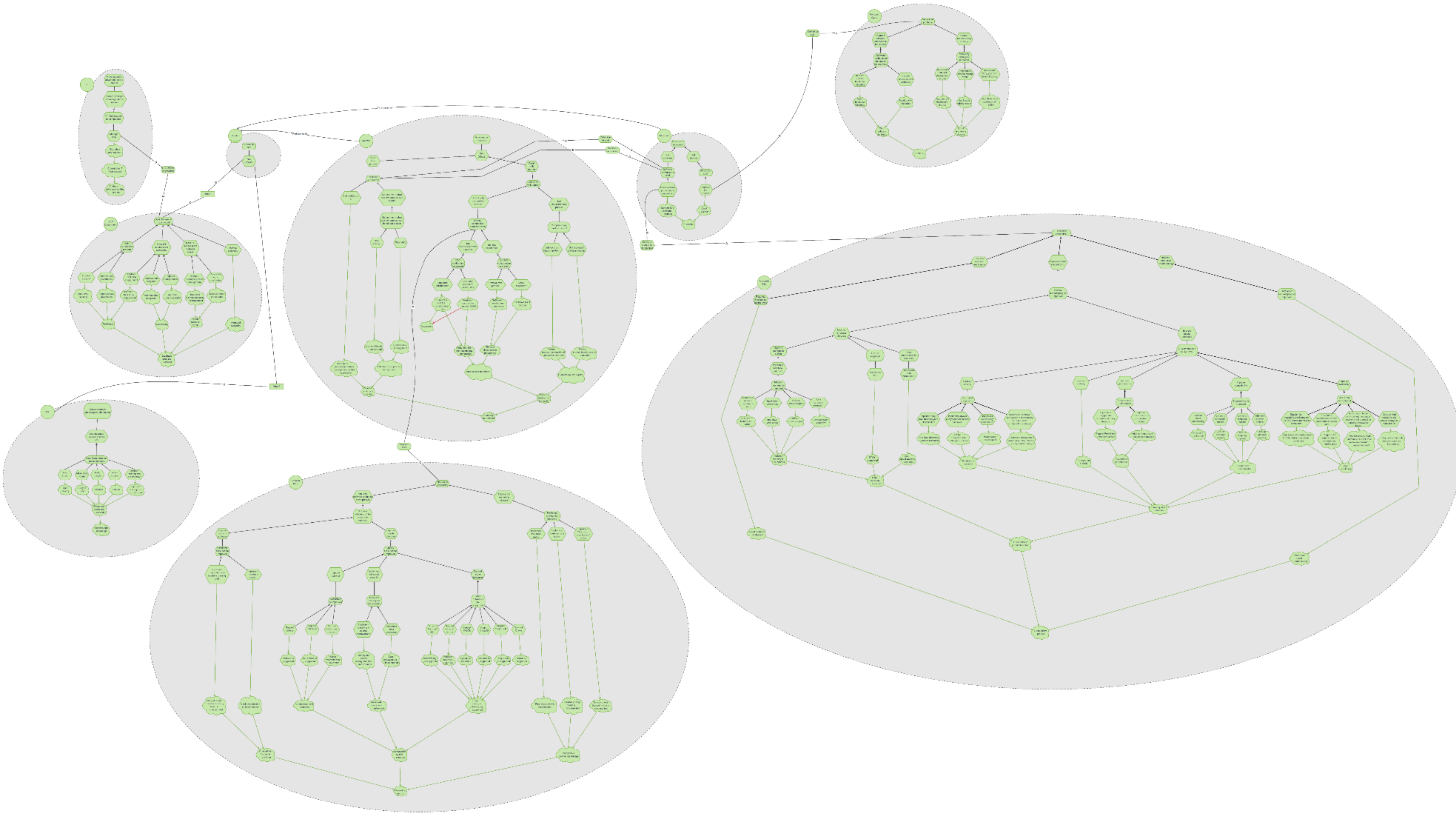


Figure A4-15. More detailed *i** model of Microsoft and Amazon case developed by Subject 1 during their participation in our research

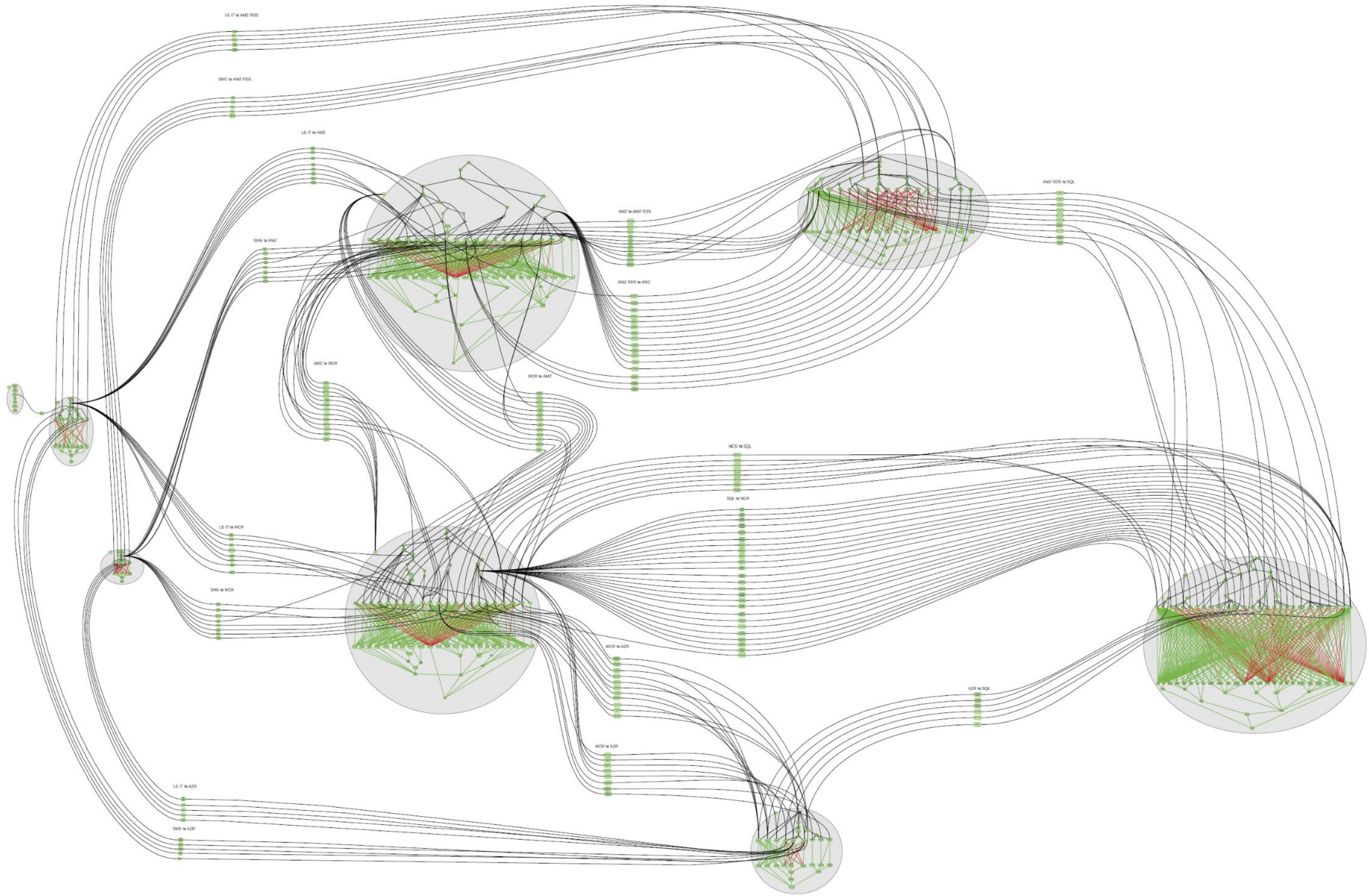


Figure A4-16. Final *i** model of Microsoft and Amazon case developed by Subject 1 during their participation in our research

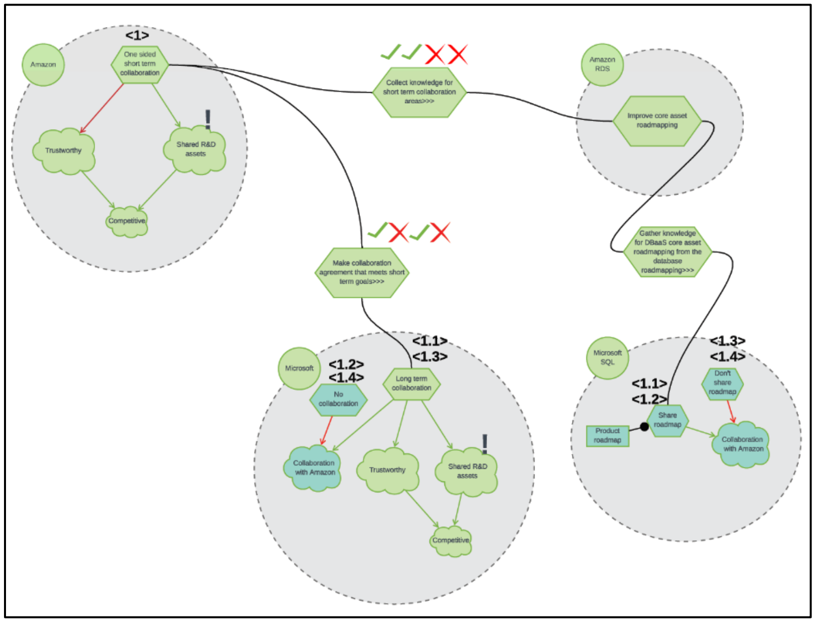


Figure A4-17. Segment of final *i** model showing goal satisfaction and mapping to corresponding Game Tree elements

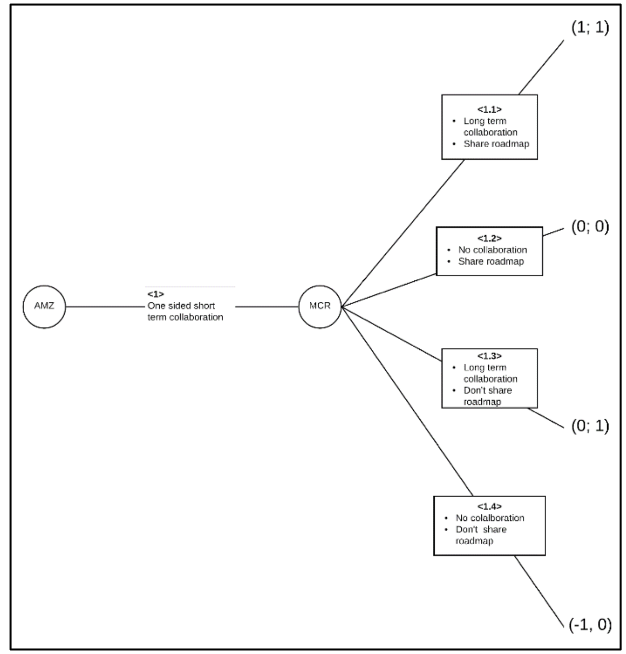


Figure A4-18. Game Tree model developed by Subject 1 during their participation in our research

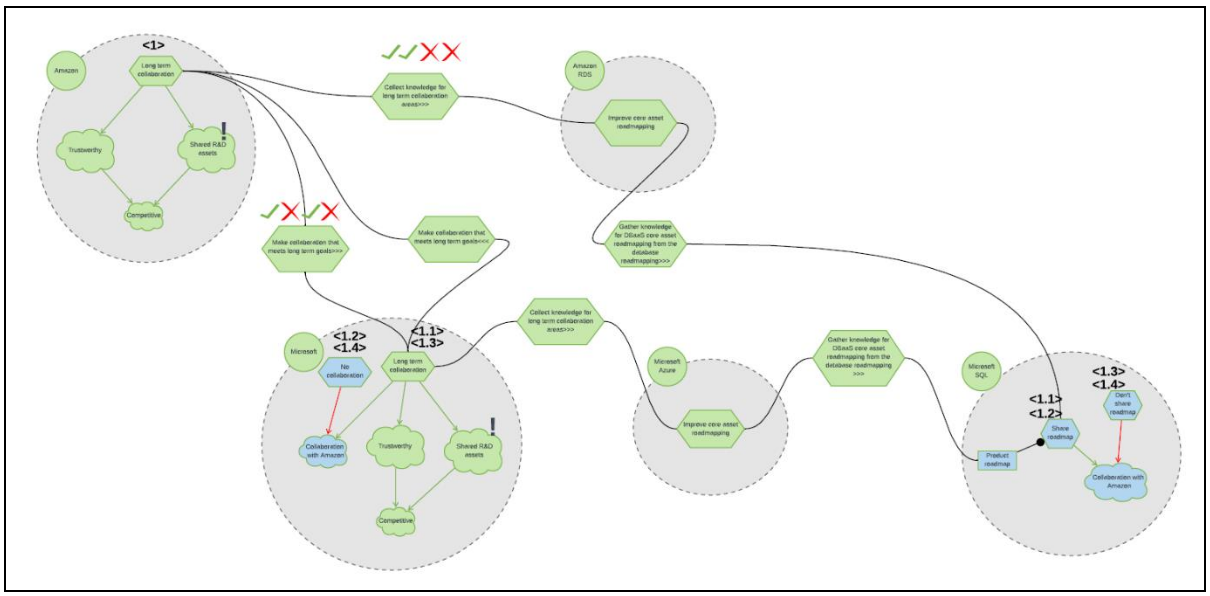


Figure A4-19. More detailed segment of final *i** model showing goal satisfaction and mapping to corresponding Game Tree elements

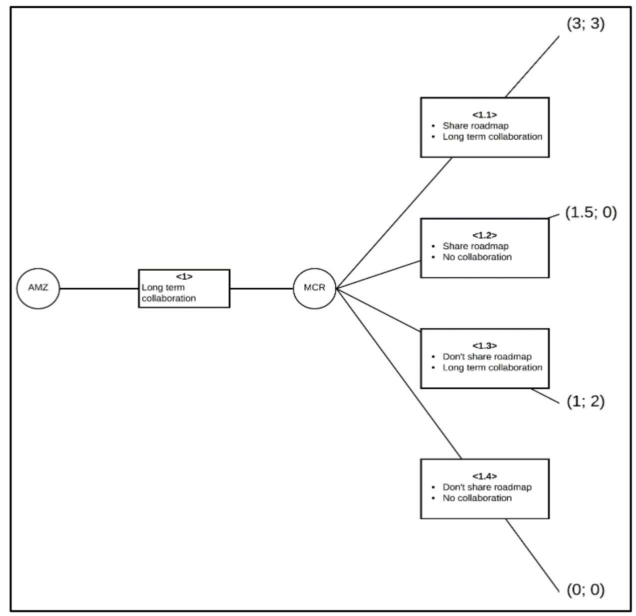


Figure A4-20. Final Game Tree model developed by Subject 1 during their participation in our research

Variables:

- $s_{i...n}$ – set of weights of given softgoals based on the priority of the item in the SR model
- $x_{k...m}$ – set of tasks related to the softgoal

Generalized, the formula for utility can be written as following:

$$Utility = \sum_{i=1}^{n} \left(s_i \frac{1}{m} \sum_{k=1}^{m} f(x_k) \right)$$

Figure A4-21. Formula for calculating utility of a course of action considering the cumulative *importance* of *softgoals* achieved through it

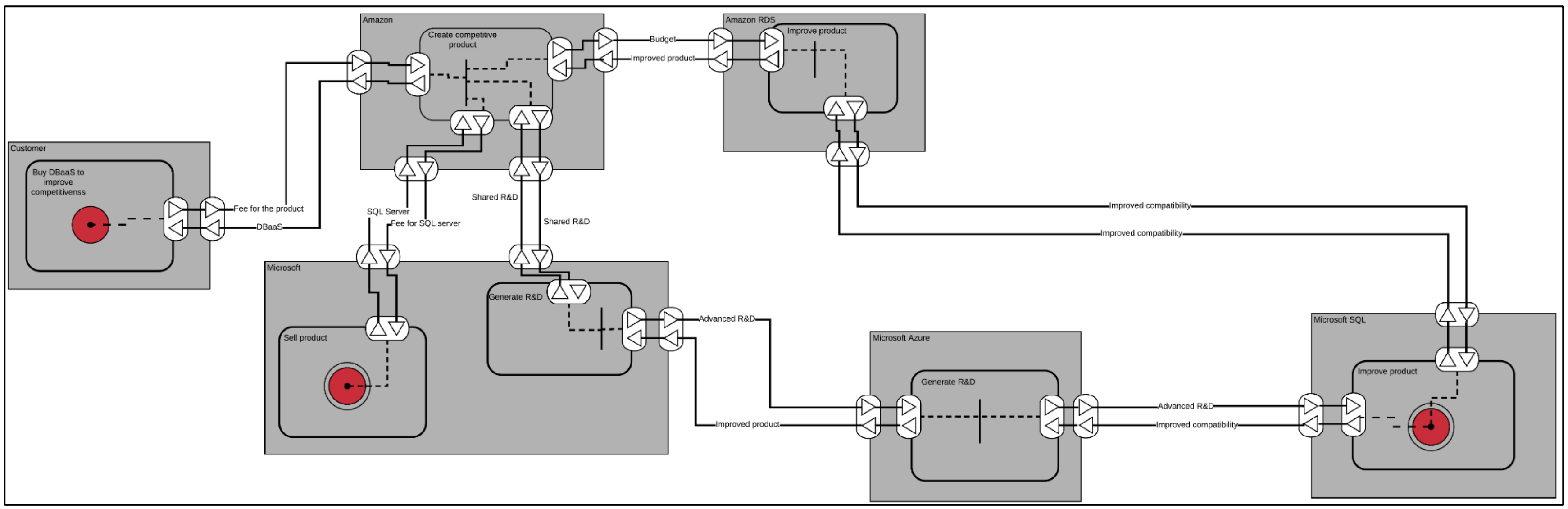


Figure A4-22. Final e3value model developed by Subject 1 during their participation in our research

Glossary

MSSQL -- Microsoft SQL server, local version, if the other is not stated
DBaaS -- Data Base as a Service
DBE -- database engine. Amazon's technology utilized in it's platform in order to offer specific database to the customer.

iStar

Strategic Dependencies

A customer (in most cases a business) depends on a cloud database provider, in this case Amazon. Amazon has a goal related to customers: Amazon's DBaaS needs to be used by the customers.

Amazon needs to have physical copy of the MSSQL and a license to use MSSQL in commercial tasks (host it on it's platform and collect fees from the customers, that use Amazon's platform with MSSQL)

For Microsoft, in order to sell MSSQL to Amazon, it needs to be supported my Amazon's DBE.

Strategic Rationale

Questions:

1. **What to do with a customer having to pick out of several options?**
2. **View Microsoft as solely MSSQL provider or also as an Azure owner?**
3. **Add other qualities, such as popularity?**

A customer has a goal to use a cloud database. In principle, the customer faces a choice between a number of DBaaS.

Amazon has a quality of being profitable. To achieve this quality, it needs it's DBaaS to be used by customers.

This can be achieved by offering a DBaaS with MSSQL or without it. Offering DBaaS with/without MSSQL are tasks that rely on a DB engine with/without MSSQL respectively. DB Engine without MSSQL qualifies for "Lesser variety of DB engines" quality, while DB engine with MSSQL qualifies for "Variety of DB engines" quality.

The task "Offer DBAAS with MSSQL" also helps the Profitable quality. The rationale behind this is that the product offered to the customer is more likely to be picked if it has more features, MSSQL being one of those features. The alternative, "Offer DBaaS without MSSQL" hurts the profitability quality, following the logic described above.

In order to achieve "Variety of DB engines" quality, Amazon needs to complete "Buy MSSQL license" task. The "Offer DBaaS with MSSQL" depends on Microsoft's task "Distribute local version of MSSQL to Amazon. This task depends on Amazon's task "Buy MSSQL license".

Microsoft's quality "Microsoft is profitable" is being contributed to by 2 separate qualities: "MSSQL is profitable" and "Azure is profitable".

Those qualities are contributed to by achieving the goals of "MSSQL be used" and "Aure be used" respectively.

The task "Distribute local version of MSSQL to Amazon" hurts the "Azure is profitable". The rationale behind this is that by allowing other companies to offer a DBaaS with MSSQL, Azure loses a competitive advantage in the form of an exclusive product being offered only on their platform.

Figure A4-23. Sample of typed notes with comments and feedback written by the Subject 1 during their participation in our research. These notes contain details regarding their application of our conceptual modeling framework to the Microsoft and Amazon case.

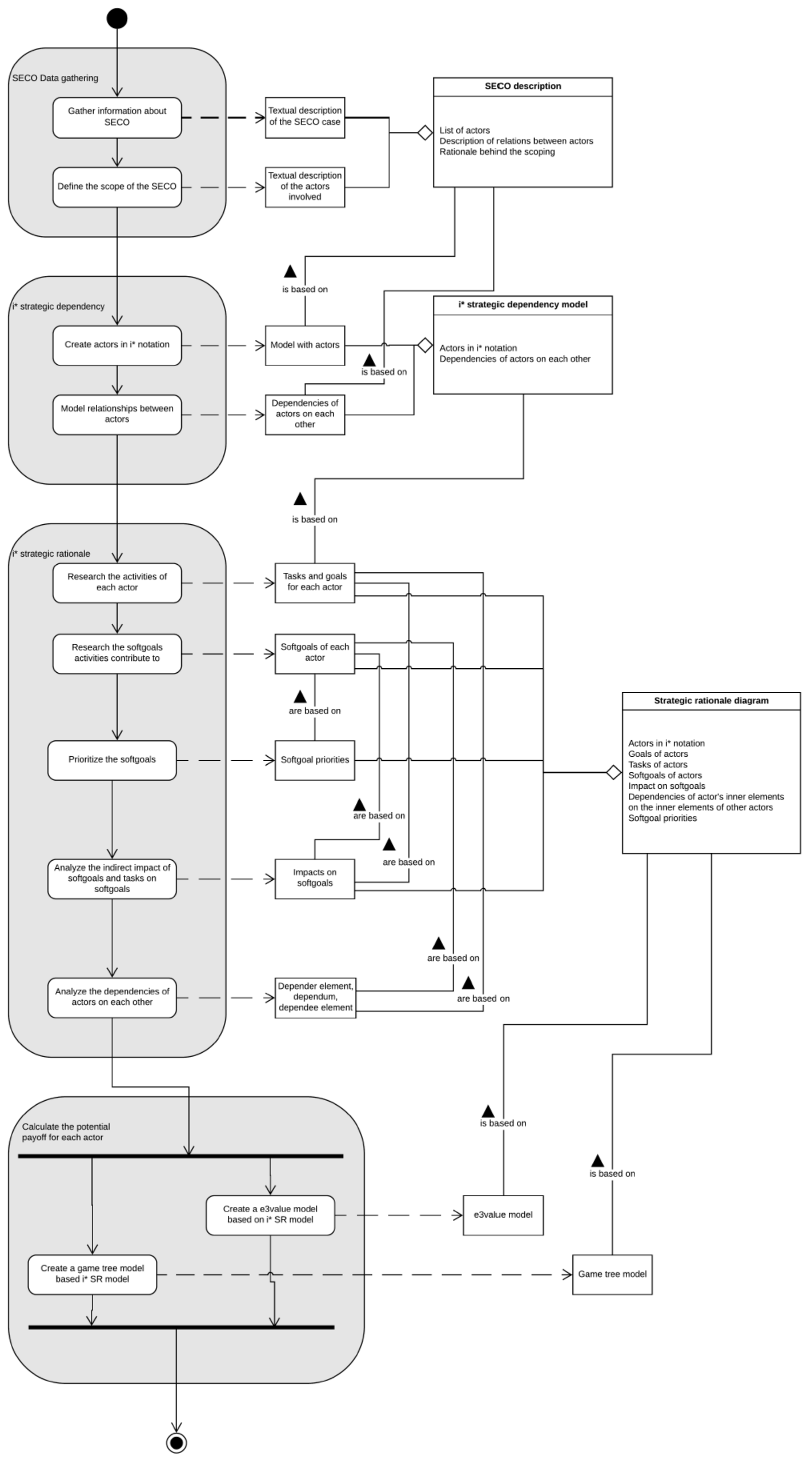


Figure A4-24. Process-data Diagram (PDD) proposed by Subject 1 during our research to supplement methodology depicted in Section 7.3 for co-developing *i** and e3value models

Appendix 5: Models and analysis from testing by the author of the framework as applied to the case study of Microsoft and Amazon

A5.1 As-Is Configuration: Competition between Microsoft and Amazon

A5.1.1 Modeling phase: An *i** model of the As-Is configuration between Microsoft, referred to in the rest of this chapter as MS, and Amazon, referred to in the rest of this chapter as AM, in the cloud-based database-as-a-service (DBaaS) market is presented in Figure A5-1.

MS's primary objective is to increase its market capitalization and this is represented as *softgoal* Valuation be increased. This top-level *softgoal* Valuation be increased is supported by another *softgoal* Revenue be generated.

This *softgoal* Revenue be generated is, in turn, supported by the *softgoal* Software be sold. the *task* Sell MSSQL makes *help contribution* to the *softgoal* Software be sold. Therefore, the *task* Sell MSSQL helps to satisfy the top-level *softgoal* Valuation be increased of MS. MS also has a high-level *goal* Offerings be sold to customers that can be achieved by the *task* Sell directly.

A lower-level *goal* Microsoft DBMS be sold is a subsidiary *goal* of this *task* Sell directly. This MS *goal* Microsoft DBMS be sold is achieve through the *task* Sell MSSQL.

AM's main objective is also to increase its market capitalization *softgoal*: Valuation be increased. This top-level *softgoal* Valuation be increased is supported by another *softgoal* Traction be established.

This *softgoal* Traction be established is, in turn, supported by the *softgoal* Revenue be increased. the *task* Sell DBMS to customers makes *help contribution* to the *softgoal* Revenue be increased. Therefore, the *task* Sell DBMS to customers helps to satisfy the top-level *softgoal* Valuation be increased of AM.

AM also has a high-level *goal* Offerings be sold to customers that can be achieved by the *task* Sell DBMS to customers.

A lower-level *goal* Amazon DBMS be sold is a subsidiary *goal* of this *task* Sell DBMS to customers. This AM *goal* Amazon DBMS be sold can be achieved by any of three *tasks* Sell DynamoDB, Sell RDS, and Sell Aurora[46].

[46] DynamoDB, RDS (Relational Database Service), and Aurora are distinct cloud-based DBaaS offerings from Amazon.

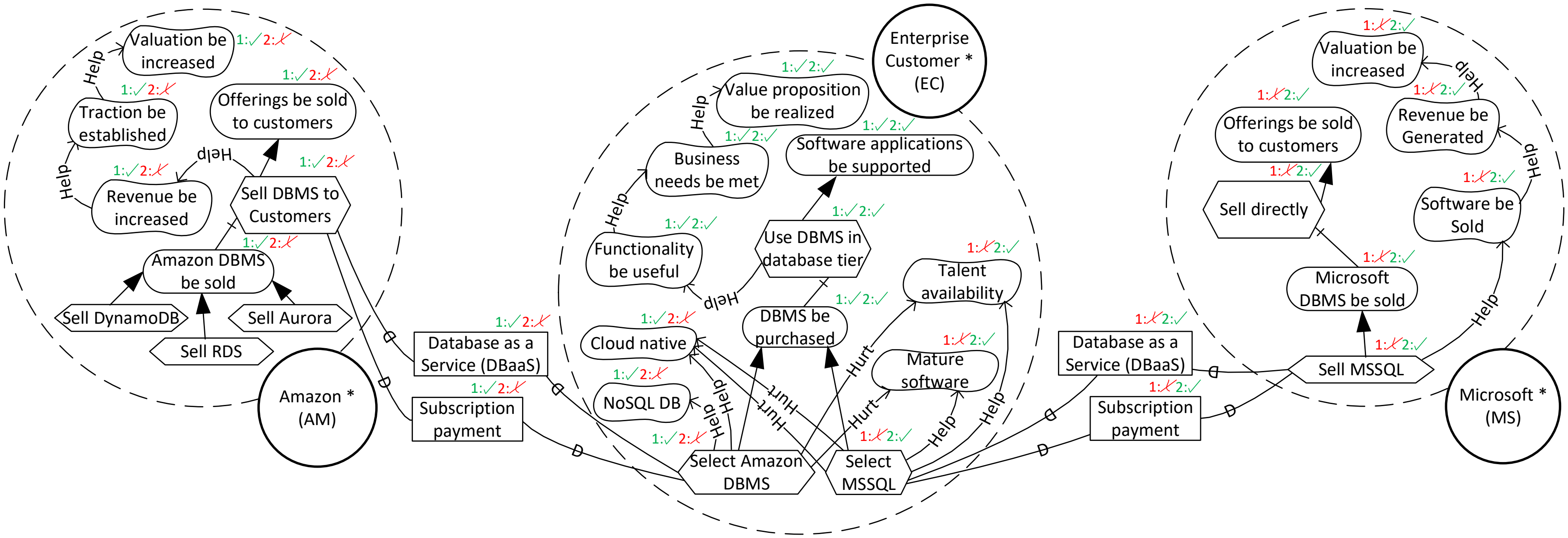


Figure A5-1 *i** model depicting purely competitive relationship between Amazon (AM) and Microsoft (MS) in the past (i.e., As-Is configuration)

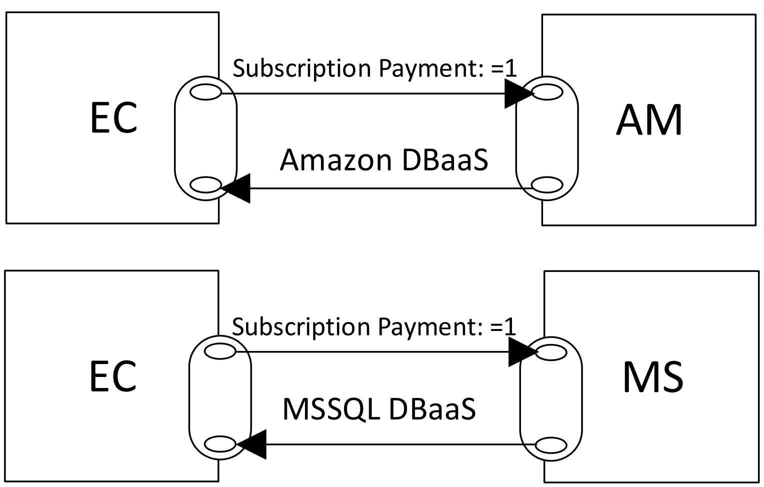


Figure A5-2 e3value model depicting relationship between Amazon (AM) and Microsoft (MS) in the past (i.e., As-Is configuration)

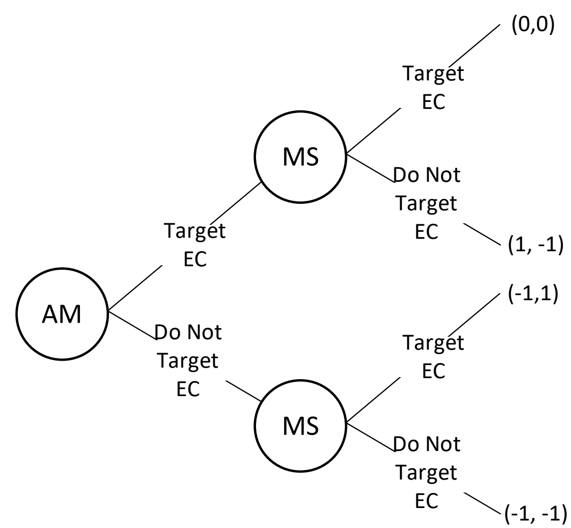


Figure A5-3 Game Tree model depicting purely competitive relationship between Amazon (AM) and Microsoft (MS) in the past (i.e., As-Is configuration)

MS sells its SQL Server product to Enterprise Customer, referred to in the rest of this chapter as EC, and this is depicted as the *resource dependency* Database as a Service (DBaaS), from MS to EC. In return, EC pays MS and this is depicted as a *resource dependency* Subscription payment, from EC to MS. Similarly, AM sells its products (i.e., DynamoDB, RDS, and Aurora) to Enterprise Customer (EC) which is depicted as the *resource dependency* Database as a Service (DBaaS) from AM to EC. As remuneration, EC pays AM and this is depicted as a *resource dependency* Subscription payment from EC to AM.

EC has a top-level *softgoal* Value proposition be realized that is supported by another *softgoal* Business needs be met. This *softgoal* Business needs be met is supported by a *softgoal* Functionality be useful. The top-level *goal* of EC is Software applications be supported and the *task* Use DBMS in database tier serves a means to achieve this *goal*. This *task* Use DBMS in database tier is comprised of a *sub-goal* DBMS be purchased and this sub-*goal* can be achieved by either of the two *tasks* Select MSSQL, and Select Amazon DBMS.

EC compares MSSQL from MS and Amazon DBMS from AM with respect to the four *softgoals* Cloud native[47], Talent availability[48], Mature software[49], and NoSQL DB[50]. Amazon DBMS makes *help contribution* to two *softgoals* (Cloud native, and NoSQL DB) and *hurt contribution* to two other *softgoals* Talent availability, and Mature software. MSSQL makes *help contribution* to two *softgoals* Talent availability, and Mature software and *hurt contribution* to the other two *softgoals* Cloud native, and NoSQL DB.

We developed an e3value model to model the value exchanges among AM, MS, and EC. This e3value model shows the relationship between AM and MS with respect to EC in the past (i.e., As-Is configuration). This e3value model is presented in Figure A5-2 and corresponds to the *i** model that is depicted in Figure A5-1. It portrays three *actors* AM, MS, and EC, where both AM and MS deals with EC independently. Subscription payment amounts for an actor (i.e., payee), in Figure A5-2, are calculated by applying the concepts of willingness-to-pay and opportunity-cost that are outlined in Section 7.4.

Subscription payment: =1 represents a baseline situation in which some but not all intentional elements of the payer are satisfied. Subscription payment: >1 represents an alternate situation in which more intentional

[47] "Cloud native": DBMS was built specifically for the cloud and is not a port of an on-premise software.
[48] "Talent availability": Market of freelance contractors specializing in that DBMS is large.
[49] "Mature software": DBMS has been in industrial use for many years.
[50] "NoSQL DB": DBMS uses a key-value architecture for managing data.

elements of that payer are satisfied in comparison to the baseline. Therefore, the payer has a higher willingness-to-pay in the alternate situation than in the baseline.

Similarly, the Subscription payment is greater in the alternate situation than in the baseline because the payee has to forego satisfaction of more intentional elements in the baseline than in the alternate scenario (i.e., payee has a lower opportunity cost in the baseline). AM provides the *value object* Amazon DBaaS to EC and EC provides the *value object* Subscription payment: =1 to AM.

Similarly, MS provides the *value object* MSSQL DBaaS to EC and EC provides the *value object* Subscription payment: =1 to MS. Here, the quantity 1 is used in an *actor*-specific scope to be able to compare the worth of *value objects* received by a specific *actor* because of different strategies. Therefore, the Subscription payment: >1 for AM is preferable to Subscription payment: =1 for AM. It is not meant to compare the worth of *value objects* received by different actors. Therefore, the Subscription payment: =1 for AM does not equal in monetary terms to Subscription payment: =1 for MS.

A Game Tree model that portrays the purely competitive relationship between AM and MS with respect to EC in the past (i.e., As-Is configuration) is depicted in Figure A5-3. This Game Tree model corresponds to the *i** model that is depicted in Figure A5-1.

It shows that AM moves first and can choose between Target EC and Do Not Target EC. In response, MS can countermove with either Target EC or Do Not Target EC. *Payoffs* associated with each of these strategic scenarios are calculated in the following way:

(i) if both *players* Target EC then they compete with each other to acquire and retain customers. This scenario leads to a status quo *payoff* of zero (0) since each *player* gains some EC from the other *player* but also loses some EC to that other *player*;

(ii) if only one *player* Targets EC then the *player* that acts has a positive *payoff* (+1) because it is able to acquire and retain EC thereby achieving its business objectives while the player that does not act has a negative *payoff* (-1) because it foregoes economic opportunity in spite of incurring fixed and overhead costs to run its business;

(iii) if neither player Targets EC then each earns a negative *payoff* (-1) as each foregoes economic opportunities in spite of incurring fixed as well as overhead costs to run their businesses.

A5.1.2 Evaluation phase: We have labeled Scenarios as 1 and 2 in Figure A5-1 using the scenario labelling technique described in Section 5.2. In Scenario 1, EC conducts business with AM while in Scenario 2 EC conducts business with MS.

If EC picks AM then it is able to satisfy all its *goals* and *softgoals* except for Talent availability and Mature software (Figure A5-1). In this scenario, EC conducts business with AM so its *dependums* with AM are satisfied and as a result AM is able to achieve all of its *goals* and *softgoals*. However, none of the *dependums* between EC and MS are satisfied leading to the denial of all *goals* and *softgoals* of MS.

Conversely, if EC picks MS then it is able to satisfy all its *goals* and *softgoals* except for Cloud native and NoSQL DB. In this scenario, EC conducts business with MS so its *dependums* with MS are satisfied and as a result MS is able to achieve all of its *goals* and *softgoals*. However, none of the *dependums* between EC and AM are satisfied leading to the denial of all *goals* and *softgoals* of AM.

This shows a purely competitive relationship between AM and MS with respect to EC.

Assessment of the *payoffs* reveals that both AM and MS are better off by selecting the option Target EC (i.e., it is the dominant *strategy*) (Figure A5-3). The option Do not target EC leads to a lower *payoff* for the *player* that moves or countermoves irrespective of the move or countermove of the other *player*. However, if both AM and MS select Target EC then they maintain a status quo outcome.

This absence of a win-win *strategy* in the As-Is scenario triggered the Exploration phase in our methodology. The intended outcome of this exploratory phase was a *strategy* that would support the attainment of positive *payoffs* by both MS and AM.

A5.1.3 Exploration phase: According to the methodology in our conceptual modeling framework, in the Exploration phase, a modeler can pursue any of six lines of action iteratively and incrementally. As depicted in Sections 6.4, 7.3 and 8.3, they can add/remove some *actor*, *agent*, or *role*; generate a change in *beliefs* of some *actor*, *agent*, or *role*; generate a change in *goals* of some *actor*, *agent*, or *role;* generate a change in *softgoals* of some *actor*, *agent*, or *role*; generate additional alternatives for achieving *goals* of some *actor*, *agent*, or *role*; or generate a change in relationships among some *actors*, *agents*, or *roles*.

Our conceptual modeling methodology allows AM and MS to create specialized types of *actors* based on generic types of *actors*. This enables AM and MS to contemplate different and specific types of stakeholders.

We followed the *i* actor* specialization and composition technique described by López, Franch, & Marco (2012) to represent specializations of EC and composition of MS using *is-a* and *is-part-of* links respectively.

Application of domain knowledge about the cloud-based DBaaS market to assess the generic *actors* in Figure Figure A5-1. Figure A5-1 reveals that the *actors* MS and EC can be better represented as *agent* and *role* respectively.

Additionally, the generic MS *agent* can be specialized into four *agents*:

(i) Microsoft division (MS);

(ii) MSSQL solutions unit (MU), MSSQL software delivery unit (ML);

(iii) and MSSQL software integration unit (MI).

Similarly, the aggregate EC *role* can be composed from four *roles*:

(i) Enterprise customer (EC);

(ii) MSSQL on AWS customer (QC);

(iii) Amazon DBMS customer (AC);

(iv) MSSQL on Microsoft Azure Customer (ZC).

A5.2 To-Be Configuration: Coopetition between Microsoft and Amazon

A5.2.1 Modeling phase: An *i** model depicting the To-Be scenario that resulted through the interactive and iterative application of our methodology is presented in Figure A5-4.

It shows MS and EC as well as specialized *agents* and composite *roles* that are connected with them using *is-a* and *is-part-of* links respectively. This is used to show relationships between generic and specialized as well as aggregate and composite classes.

Relevant internal intentional elements from EC in Figure A5-1 are copied over to OC and CS in Figure A5-4. Loops in the process depicted in our methodology indicate that any step in the Exploration phase of this modeling approach can trigger other steps. Therefore, additional internal intentional elements are introduced in each of the *agents* and *roles* in Figure A5-4. They enable the inclusion of pertinent details that can be exhibited using differentiated *actors*.

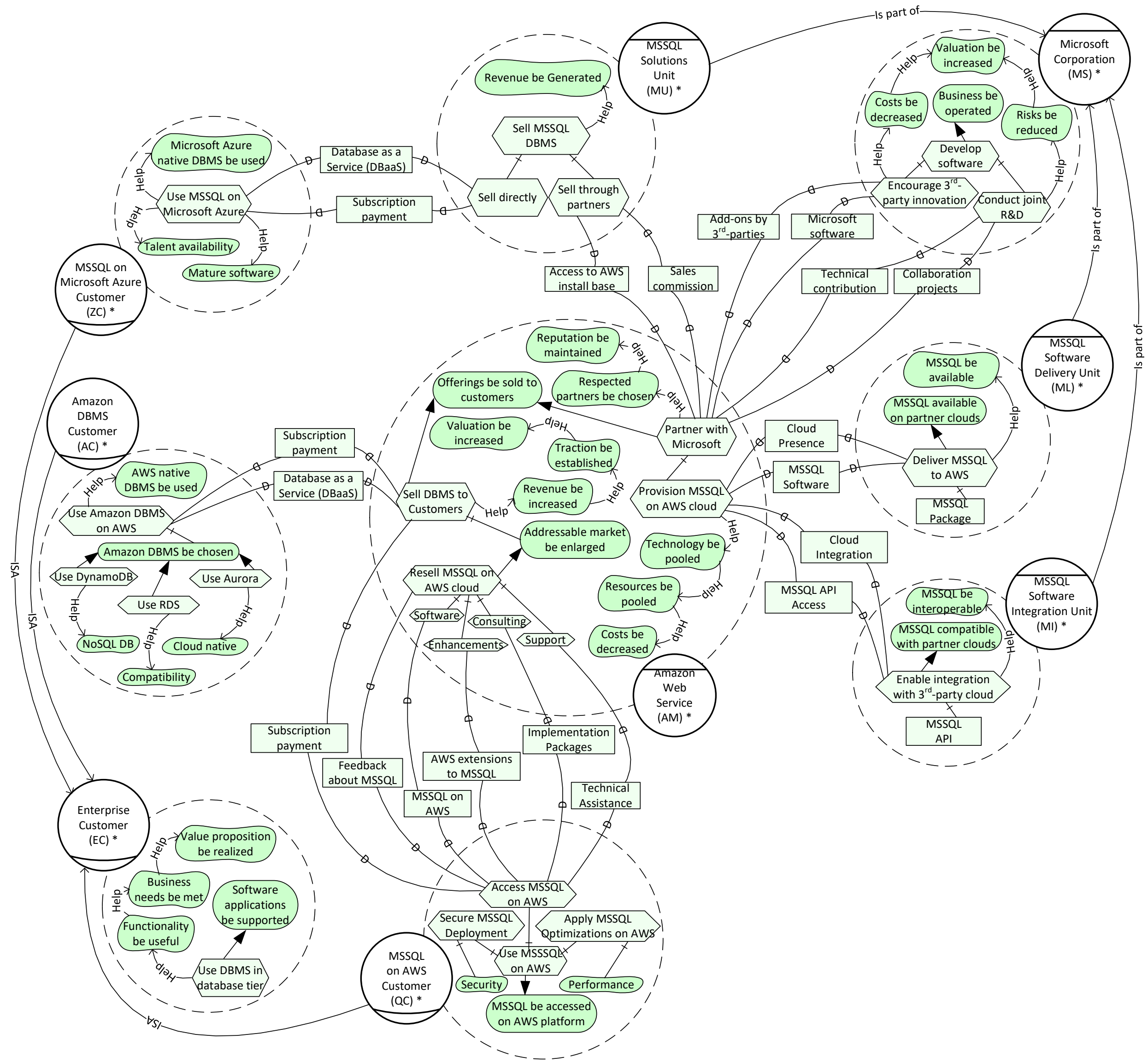


Figure A5-4 *i** model depicting strategic relationship between Amazon (AM) and Microsoft (MS) in the future (i.e., To-Be configuration)

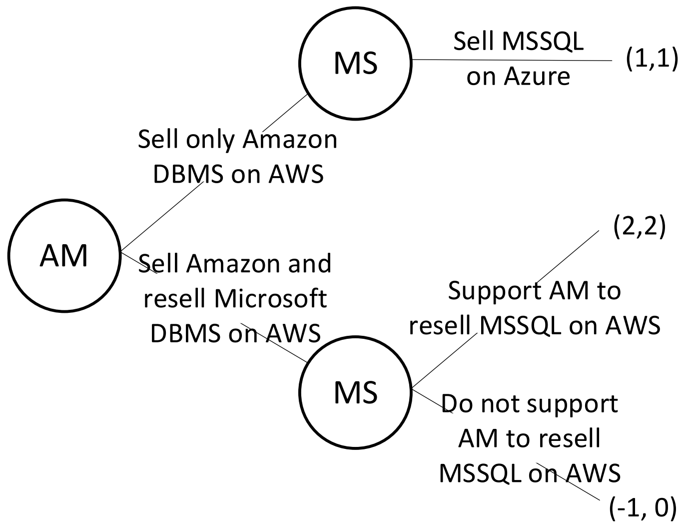


Figure A5-5 Game Tree model depicting strategic relationship between Amazon (AM) and Microsoft (MS) in the future (i.e., To-Be configuration)

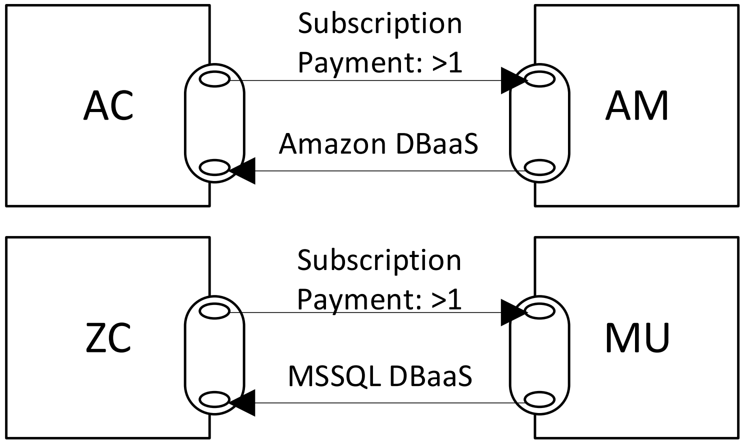


Figure A5-6 e3value model depicting depicting strategic relationship between Amazon (AM) and Microsoft (MS) in the future (i.e., To-Be configuration)

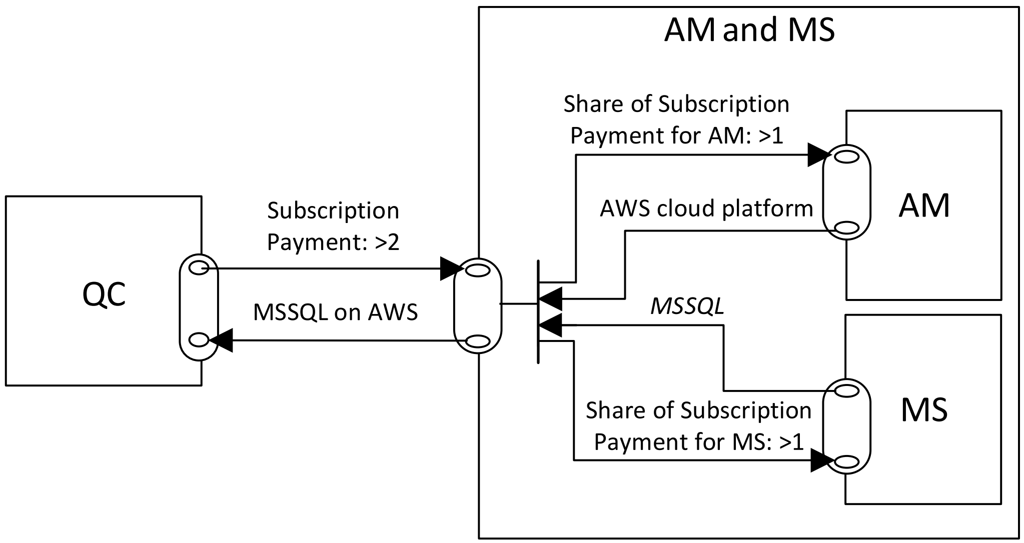


Figure A5-7 e3value model depicting depicting strategic relationship between Amazon (AM) and Microsoft (MS) in the future (i.e., To-Be configuration)

This market has three distinct customer segments with some commonality between each customer segment (Figure A5-4). This commonality is depicted in the internal intentional structure of EC in the form of one *goal* and three *softgoals*. The *task* Use DBMS in database tier is a means to satisfy the *goal* Software applications be supported and this *task* makes *help contribution* to the *softgoal* Functionality be useful. This *softgoal* (Functionality be useful) supports the *softgoal* Business needs be met, which in turn, supports the top-level *softgoal* Value proposition be realized.

Peculiarities in the intentional structure of a specialized *role* (i.e., QC, AC, and ZC) is portrayed only within the scope of that *role*:

- ZC has three *softgoals* Microsoft Azure native DBMS be used, Talent availability, and Mature software. *Task* Use MSSQL on Microsoft Azure makes *help contribution* to each *softgoal* of ZC.
- AC has four *softgoals* AWS native DBMS be used, Cloud native, NoSQL DB, and Compatibility. *Task* Use Amazon DBMS on AWS in AC makes *help contribution* to its *softgoal* AWS native DBMS be used. This *task* comprises a *sub-goal* Amazon DBMS be chosen that can be achieved by any of three *tasks* (Use DynamoDB, Use RDS, and Use Aurora). *Task* Use DynamoDB makes *help contribution* to the *softgoal* NoSQL DB, Use RDS makes *help contribution* to Compatibility, and Use Aurora makes *help contribution* to Cloud native.
- QC has one *goal* MSSQL be accessed on AWS platform and the *task* Use MSSQL on AWS serves a means for achieving this *goal*. This *task* is composed of three *sub-tasks* (Access MSSQL on AWS, Secure MSSQL deployment, and Apply MSSQL optimizations on AWS). The *task* Secure MSSQL deployment has a *sub-softgoal* (Security) and Apply MSSQL optimizations on AWS also has a *sub-softgoal* (Performance).

MS is comprised of three distinct parts as shown in Figure A5-4. The aggregate *agent* MS contains one *goal* and three *softgoals*. The *task* Develop software is a means to satisfy the *goal* Business be operated and this *task* is comprised of two *sub-tasks* (Encourage 3rd-party innovation, and Conduct joint R&D). The *task* Encourage 3rd-party innovation makes *help contribution* to the *softgoal* Costs be decreased while the task Conduct joint R&D makes *help contribution* to the *softgoal* Risks be reduced. These *softgoals* (Costs be decreased, and Risks be reduced) support the *softgoal* Valuation be increased.

Specificities in the intentional structure of a compositional *agent* (i.e., MU, ML, and MI) is portrayed only within the scope of that *agent*:

- MU has a *softgoal* Revenue be generated and its *task* Sell MSSQL DBMS makes *help contribution* to that *softgoal*. This *task* (Sell MSSQL DBMS) contains two *sub-tasks* (i.e., Sell directly, and Sell through partners).
- ML has a *softgoal* MSSQL be available as well as a *goal* MSSQL available on partner clouds. Its *task* Deliver MSSQL to AWS serves as a means to accomplish its *goal* MSSQL be available on partner clouds and makes *help contribution* to its *softgoal* MSSQL be available. The performance of this *task* deliver MSSQL to AWS requires a *resource* MSSQL package.
- MI has a *goal* MSSQL be compatible with partner clouds and a *softgoal* MSSQL be interoperable. Its *task* Enable integration with 3rd-party cloud makes *help contribution* to its *softgoal* MSSQL be interoperable and serves to fulfill its *goal* MSSQL compatible with partner clouds. The performance of this *task* (Enable integration with 3rd-party cloud) requires a *resource* MSSQL API.

AM has three top-level *softgoals,* which are Valuation be increased, Reputation be maintained, and Costs be decreased. Another *softgoal* Revenue be increased makes *help contribution* to the *softgoal* Traction be established, which makes *help contribution* to Valuation be increased. The *task* Sell DBMS to customers makes a *help contribution* to the *softgoal* Revenue be increased and this *task* has a *sub-goal* Addressable market be enlarged. The *task* Resell MSSQL on AWS cloud consists of four *sub-tasks* (i.e., Software, Enhancements, Consulting, and Support) and serves as a means to achieve this *sub-goal* (Addressable market be enlarged). The *task* Partner with Microsoft makes *help contribution* to Respected partners be chosen and is a means for realizing the *goal* Offerings be sold to customers. This *softgoal* (Respected partners be chosen) makes a *help contribution* to the *softgoal* Reputation be maintained. The *task*(Partner with Microsoft is comprised of a *sub-task* Provision MSSQL on AWS cloud that makes *help contribution* to the *softgoal* Technology be pooled. The *softgoal* Technology be pooled makes *help contribution* to the *softgoal* Resources be pooled, which makes *help contribution* to Costs be decreased.

These *agents* and *roles* are connected through many *dependencies* as depicted in Figure A5-4:

- ZC depends on MU for Database as a service (DBaaS) and MU depends on ZC for Subscription payment. Similarly, AC depends on AM for Database as a service (DBaaS) and AM depends on AC for Subscription payment. QC depends on AM for MSSQL on AWS, AWS extensions to MSSQL, Implementation packages, and Technical assistance. In return, AM depends on QC for Subscription payment and Feedback about MSSQL.

- MU depends on AM for Access to AWS install base while AM depends on MU for Sales commission. ML depends on AM for Cloud presence while AM depends on ML for MSSQL software. MI depends on AM for Cloud integration while AM depends on MI for MSSQL API access. MS depends on AM for Add-ons by 3rd-parties and Technical contribution while MS depends on AM for Microsoft software and Collaboration projects.

e3value models that show the relationship between AM and MS with respect to various customer segments in the future (i.e., To-Be configuration) are presented in Figure A5-6 and Figure A5-7. These e3value models correspond to the *i** model that is depicted in Figure A5-4. Four *actors* (AM, MU, AC, and ZC) are shown in Figure A5-6. AM deals with AC and MU deals with ZC independently in this model.

As noted above, Subscription payment amounts for an actor (i.e., payee), in Figure A5-6 and Figure A5-7, are calculated by applying the concepts of willingness-to-pay and opportunity-cost that are outlined in Section 7.4. Subscription payment: =1 represents a baseline situation in which some but not all intentional elements of the payer are satisfied. Subscription payment: >1 represents an alternate situation in which more intentional elements of that payer are satisfied in comparison to the baseline. Therefore, the payer has a higher willingness-to-pay in the alternate situation than in the baseline. Similarly, the Subscription payment is greater in the alternate situation than in the baseline because the payee has to forego satisfaction of more intentional elements in the baseline than in the alternate scenario (i.e., payee has a lower opportunity cost in the baseline).

AM provides the *value object* Amazon DBaaS to AC and EC provides the *value object* Subscription payment: >1 to AM. Similarly, MU provides the *value object* MSSQL DBaaS to EC and EC provides the *value object* Subscription payment: >1 to MU. Three *actors* (AM, MS, and QC) are depicted in Figure A5-7. AM and MS conduct business with QC jointly in this model to benefit from synergy. This is because QC regards the worth of joint value proposition from AM and MS to be more than the sum of their individual value proposition. AM and MS provide the *value object* MSSQL on AWS to QC together and in return QC provides a *value object* Subscription payment: >2 to AM and MS as a whole.

Within the composite *actor* (i.e., AM and MS), the *actor* AM delivers *value object* AWS cloud platform and the *actor* MS provides *value object* MSSQL. In return, the *actor* AM receives Share of subscription payment for AM: >1 and the *actor* MS receives Share of subscription payment for MS: >1. As noted earlier, these amounts of payments (i.e., *value objects*) are nominal and relative but not absolute or universal since they are meant for contrasting of *strategies* in terms their comparative worth for an *actor*.

A Game Tree model that portrays the strategic relationship between AM and MS with respect to various customer segments in the future (i.e., To-Be configuration) is depicted in Figure A5-5. This Game Tree model corresponds to the *i** model that is shown in Figure A5-4.

It shows that AM moves first and can choose between Sell only Amazon DBMS on AWS and Sell Amazon and resell Microsoft DBMS on AWS. If AM chooses to Sell only Amazon DBMS on AWS then, in response, MS can countermove with Sell MSSQL on Azure. However, if AM decides to Sell Amazon and resell Microsoft DBMS on AWS then MS can countermove with Support AM to resell MSSQL on AWS or Do not support AM to resell MSSQL on AWS.

Payoffs associated with each of these strategic scenarios are calculated in the following way:

- If AM chooses to Sell only Amazon DBMS on AWS then MS will countermove with Sell MSSQL on Azure. This will restrict their market access to smaller customer segments and will preclude them from cross-selling and re-selling each other's solutions. This scenario leads to a *payoff* of positive 1 because, while the *players* are not competing in the same customer segments, they are addressing a limited share of the overall market
- If AM decides to Sell Amazon and resell Microsoft DBMS on AWS then MS can countermove with Support AM to resell MSSQL on AWS or Do not support AM to resell MSSQL on AWS. If MS chooses the former *option*, then AM and MS earn *payoffs* of positive 2. This is because they can address those customer segments where each fulfills unique customer requirements individually (i.e., AC for AM and ZC for MU) in addition to jointly addressing a customer segment where both need to collaborate in order to address customer requirements together (i.e., QC). However, if MS chooses the latter option then AM will earn a *payoff* of negative 1 and MS will earn a *payoff* of zero. This is because AM will spend its time and effort to create the opportunity for it to address a new customer segment jointly with MS but if MS does not cooperate then this outlay will be wasted. Similarly, MS will lose an opportunity to grow its business by serving a larger market.

A5.2.2 Evaluation phase: The existence of a win-win strategy between AM and MS can be seen in the *i** (Figure A5-4), e3value (Figure A5-6 and Figure A5-7), and Game Tree (Figure A5-5) models of the To-Be configuration. The *i** model shows that every intentional element of each *actor* is satisfied. This is depicted with green color fills of the intentional elements with *goals* as well as *softgoals* filled using a darker shade of green, and *tasks* as well as *resources* filled using a lighter shade of green. This is done to simplify visual presentation of this *i** model.

The Game Tree model shows that the optimal strategy is for AM to Sell Amazon and resell Microsoft DBMS on AWS and for MS to Support AM to resell MSSQL on AWS. This strategy will lead to the highest individual *payoffs* for AM and MS (positive two for both). The e3value models show that the ideal strategy for AM and MS involves them targeting focused customer segments individually (i.e., AC for AM and ZC for MU) as well as another customer segment jointly (QC for AM and MS). This strategy is ideal for AM and MS because they can address:

- Customer segments where each fulfills unique customer requirements individually (AC for AM and ZC for MU) thereby earning Subscription payment: >1. This is greater than the *value objects* (Subscription payment: =1) that were received by AM and MS in the As-Is scenario. In the As-Is scenario, due to the presence of competition, AM and MS acted as substitutes and this allowed EC to drive down the *value* that they compensated to AM and MS.
- Customer segment where both need to collaborate in order to address customer requirements jointly (i.e., QC). AM resells MSSQL (Software) from MS and includes its own value-adding components such as Enhancements, Consulting, and Support for QC. Therefore, the total value object that is received by AM and MS is Subscription payment: >2 of which the individual value objects received by AM and MS separately are Share of subscription payment: >1.

In the As-Is scenario, AM and MS competed over customers but they do not compete over customers any longer in the To-Be scenario. Instead, AM and MS cooperate in the context of market access and even address a customer segment together. However, in the As-Is scenario, AM and MS compete to maximize their individual share of the combined payment that is received by them jointly from the customers they serve together. This means that AM and MS cooperate as well as compete simultaneously and, hence, they are coopetitors.

A5.3 Summary

We applied the conceptual modeling framework for designing and analyzing coopetition to represent and reason about the strategic relationship between Amazon and Microsoft in the database market. *i** modeling was used the understand goals of Amazon and Microsoft so that competition could be complemented with cooperation to result in a win-win outcome. e3value modeling was used to comprehend the bargaining power and negotiating leverage of Amazon and Microsoft for dividing the surplus from synergy. Game Tree modeling was used to compare outcomes from opportunistic and benevolent conduct. These modeling techniques were used in an integrated manner to generate a coopetitive strategy, for Amazon and Microsoft in the database market, that resulted in a win-win outcome.

Appendix 6: Interview questionnaires for data collection during empirical study

Interview Questionnaire: Data collection regarding As-Is scenario
Objective: Gather information about existing environment and relationships of Participant Organization

- When was [Participant Organization] founded?
- What was the reasoning by the founding team for starting [Participant Organization]?
- Are any, all, or some of the original co-founders of [Participant Organization] still working in [Participant Organization]?
- How many employees does [Participant Organization] employ as on [Current Date]?
- Which industry and sector does [Participant Organization] self-identify with?
- Which geographic areas and regions does [Participant Organization] operate in?
- Which revenue streams and inflows are pursued/targeted by [Participant Organization]?
    - How many customer segments are served by [Participant Organization]?
    - Which customer segments are served by [Participant Organization]?
    - Which services does [Participant Organization] offer to its clients in each customer segment?
    - What is the value proposition of [Participant Organization]'s services for its clients in each customer segment?
    - Which are the Key Channels of [Participant Organization]?
        - What are the contributions of each channel to the revenue of [Participant Organization]?
        - What is the attribution of each channel to the cost of [Participant Organization]?
        - Are channels independent of value propositions or are their couplings between channels and value propositions?
        - Are channels independent of customer segments or are their couplings between channels and segments?
    - Which are the Key Customer Relationships of [Participant Organization]?
        - Does [Participant Organization] quantify/gauge value of a customer numerically?
        - How does [Participant Organization] prioritize/rank customer relationships?
        - Is there a correlation between best/worst customer relationships and customer segments?
        - Is there a correlation between best/worst customer relationships and value propositions?
- What are the causes and drivers of costs and outlays of [Participant Organization]?
    - Which are the Key Activities of [Participant Organization]?
        - Which activities are important for serving/addressing each customer segment?
        - Which activities are essential for offering/delivering each value proposition?
        - Which activities are necessary for provisioning/supplying key channels?
        - Which activities are imperative for obtaining/controlling key resources?
    - Which are the Key Resources of [Participant Organization]?
        - Which resources are important for serving/addressing each customer segment?
        - Which resources are essential for offering/delivering each value proposition?
        - Which resources are necessary for performing/completing key activities?
        - Which resources are imperative for provisioning/supplying key channels?
- Who are the Key Stakeholders of [Participant Organization]?
    - Who are indispensable vendors of [Participant Organization]?
    - Who are primary suppliers of [Participant Organization]?
    - Which crucial activities are performed by stakeholders of [Participant Organization]?
    - Which critical resources are provided by stakeholders of [Participant Organization]?

Interview Questionnaire: Data collection regarding To-Be scenario
Objective: Gather information about future environment and relationships of Participant Organization as currently envisioned (without modeling support)

Reminder about interview question usage: The objective of the participant interviews is to gather a rich dataset about the participant's opinions and perceptions about their organization's strategic relationship with another organization. Therefore, these questions are meant to initiate a comprehensive discussion and stimulate a frank and transparent dialogue. These questions are not meant to direct or force the flow of the conversation. If the participant wishes to direct the flow of the conversation in different directions than pointed to by these questions, then the participant will be able to do so freely.

- How do you define cooperation among organizations?
    - Why do you think [Participant Organization] cooperates with its partners?
    - How do you define competition among organizations?
    - Why do you think [Participant Organization] competes with its rivals?
- Does [Participant Organization] have partners with which it competes? How does the respondent know this?
    - If so, then what is the reason for competing with partners?
    - Also, what is the rationale for partnering with rivals?
- In the industry and market within which [Participant Organization] operates, is it possible to have purely cooperative relationships?
    - Is it possible to have solely competitive relationships?
- Did cooperation and competition in inter-organizational relationships of [Participant Organization] emerge concomitantly?
    - Did competition enter relationships that were originally cooperative?
    - Did cooperation emerge within relationships that were originally competitive?
- Are inter-organizational relationships in which [Participant Organization] cooperates and competes at the same time balanced in terms of the magnitude of competition and cooperation? How does the respondent know this?
    - Are these relationships imbalanced with more competition and less cooperation or more cooperation and less competition?
    - What is the reason for this balance or imbalance?
- How are decisions about competition and cooperation made in [Participant Organization]?
    - Is competition preferred over cooperation? Is cooperation preferred over competition?
    - Why is one preferred over the other? Is one preferred over another in certain situations?
    - Is one preferred over another in all situations?
- What role does the presence or absence of complementarity or synergy in an inter-organizational relationship play in the decision by [Participant Organization] to cooperate or compete?
    - Does the presence of complementarity help or hinder cooperation?
    - Does the absence of complementarity help or hinder cooperation?
    - Does the presence of complementarity help or hinder competition?
    - Does the absence of complementarity help or hinder competition?
- What role does the presence or absence of reciprocity in an inter-organizational relationship play in the decision by [Participant Organization] to cooperate or compete?
    - Does the presence of reciprocity help or hinder cooperation?
    - Does the absence of reciprocity help or hinder cooperation?
    - Does the presence of reciprocity help or hinder competition?
    - Does the absence of reciprocity help or hinder competition?
- Are certain competitive behaviors more prevalent in inter-organizational relationships where competition and cooperation exist concomitantly?
    - Are certain competitive behaviors less prevalent in such inter-organizational relationships?
    - Are certain cooperative behaviors more prevalent in inter-organizational relationships where competition and cooperation exist concomitantly?
    - Are certain cooperative behaviors less prevalent in such inter-organizational relationships?
- In inter-organizational relationships where competition and cooperation coexist concomitantly does?
    - More competition necessarily mean less cooperation?
    - Does more cooperation automatically mean less competition?
    - Or, can competition and cooperation be increased or decreased independently?

Interview Questionnaire: Data collection regarding To-Be scenario
Objective: Gather information about future environment and relationships of Participant Organization as currently envisioned (with modeling support)

Reminder about interview question usage: The objective of the participant interviews is to gather a rich dataset about the participant's opinions and perceptions about their organization's strategic relationship with another organization. Therefore, these questions are meant to initiate a comprehensive discussion and stimulate a frank and transparent dialogue. These questions are not meant to direct or force the flow of the conversation. If the participant wishes to direct the flow of the conversation in different directions than pointed to by these questions, then the participant will be able to do so freely.

- Do win-win strategies exist between [Participant Organization] and its partners?
    - If yes,
        - Why do these win-win strategies exist (i.e., what causes them to exist)?
        - Are the win-win strategies balanced and fair in terms of benefits for each partner?
        - Is benefit from each win-win strategy approximately equal to other win-win strategies?
        - Is the contribution of each actor proportionate with the benefit it receives?
        - Are the contributions of each actor to the relationship similar and equal?
- Can win-win strategies exist between [Participant Organization] and its rivals?
    - If so, what are the requirements of a win-win strategy?
        - Which actors are needed for a win-win strategy to exist?
        - Which resources are needed for a win-win strategy to exist?
        - Which tasks are needed for a win-win strategy to exist?
        - Which softgoals are needed for a win-win strategy to exist?
        - Which dependencies are needed for a win-win strategy to exist?
    - Will the [Participant Organization] and its rivals meet these requirements?
        - Why do these win-win strategies exist (i.e., what causes them to exist)?
        - Are the win-win strategies balanced and fair in terms of benefits for each partner?
        - Is benefit from each win-win strategy approximately equal to other win-win strategies?
    - Can the [Participant Organization] and its rivals meet these requirements?
        - Is the contribution of each actor proportionate with the benefit it receives?
        - Are the contributions of each actor to the relationship similar and equal?
        - For the new win-win strategy to exist, which additional
            - Actors are needed?
            - Resources are needed?
            - Tasks are needed?
            - Softgoals are needed?
            - Dependencies are needed?
- Is a win-win strategy stable and sustainable?
    - What are sources of stability and sustainability of a win-win strategy?
        - Is control over these sources
            - Diffused across all actors in the relationship?
            - Concentrated on few actors in the relationship?
        - Can these sources be depleted or eroded over time (e.g., through obsolescence)?
        - Can these sources be diminished or diluted through use (e.g., non-renewable asset)?
    - What are drivers of risk and uncertainty in a win-win strategy?
        - Can these risks and uncertainties
            - Be predicted?
            - Be avoided?
        - Are partners equally vulnerable and exposed to risks and vulnerabilities?

Interview Questionnaire: Data collection regarding Model evaluation

Objective: Gather information about the utility of the models and their contributions

Note- The same participant that is interviewed in Phase 1 (model building) from an organization will be interviewed in Phase 2 (model evaluation). This is because models in Phase 1 will be developed by the principal investigator and these models will represent the principal investigator's understanding of the opinions and perceptions of that participant vis-à-vis a strategic relationship of their organization with another organization. It is appropriate to request the same participants to assess the expressiveness and analytical power of the models. The key objective of this interview questionnaire is to determine whether the models sufficiently and correctly, (1) depict, and (2) provide means for analyzing, a strategic relationship of the participant's organization from the point-of-view of that participant.

Instruments-

Inventory and explanation of modeling artefacts that are produced in the research project.
Models depicting an inter-organizational strategic relationship of the participant's organization from the point-of-view of that participant.
Interview guide (questions listed below).

Interview Guide-

- What are the key characteristics of a competitive relationship between your organization and another organization?
    - Do the modeling constructs portray these characteristics?
    - Can you detect the existence of competition from the modeling constructs?
- What are the key characteristics of a cooperative relationship between your organization and another organization?
    - Do the modeling constructs portray these characteristics?
    - Can you detect the existence of cooperation from the modeling constructs?
- What are the key characteristics of complementarity between your organization and another organization?
    - Do the modeling constructs portray these characteristics?
    - Can you detect the existence of complementarity from the modeling constructs?
- What are the key characteristics of reciprocality between your organization and another organization?
    - Do the modeling constructs portray these characteristics?
    - Can you detect the existence of reciprocality from the modeling constructs?
- Do you think that this kind of modeling is useful for describing existing aspects of a strategic relationship? Why?
- Do you think that this kind of modeling is useful for generating new aspects of a strategic relationship? Why?
- Do you think this type of modeling can help you in your professional activities at work? Why?
- What are some factors that make it practical and applicable in your job? Why?
- What are factors that will make it challenging for you to use it in your job? Why?

Procedure-

1. Describe and explain modeling constructs to the participant.
2. Describe and explain the process for interpreting and analyzing model structure and content.
3. Ask questions to the participant about their opinion and perception of the expressiveness and analytical power of the models.