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Coopetition with Frenemies: Towards Modeling of Simultaneous Cooperation and Competition Among Enterprises

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Abstract. Enterprise modeling frameworks are concerned with the representation of social phenomena and researchers have proposed a number of notations and techniques for depicting social behaviors. However, coopetition, which is a specific type of social interaction, has not been explored in the enterprise modeling literature. Coopetition, which refers to simultaneous cooperation and competition, has been studied extensively in the social sciences where conceptual theorizing and empirical fieldwork have established it as a prominent field of research. It is regularly observed in dealings between many kinds of enterprises, such as businesses and governments, where it has been analyzed at both inter- as well as intra-organizational levels. Coopetition is especially relevant for enterprise modeling because goal alignment/convergence can yield cooperation among actors while goal conflict/divergence can lead to competition among actors. In this paper we (a) present an overview of academic research into coopetition, (b) discuss the requirements for representing coopetition, and (c) propose future work that will be relevant for the modeling and analysis of cooperation, competition, and coopetition between enterprises.

Keywords: Enterprise Modeling. Coopetition. Strategy. Design. Review.

1 Introduction

A number of researchers have proposed modeling notations and techniques for expressing and evaluating organizational strategy [1][2] and a variety of modeling approaches have been developed to describe different aspects of enterprises (e.g., goal, actor, value, process, etc.) [3]. Additionally, requirements engineering (RE) researchers have applied many goal- and actor-oriented approaches to model and analyze business strategy [4][5]. However, none of these approaches have focused directly on this phenomenon of simultaneous cooperation and competition. This is a gap in the RE literature because strategic coopetition impacts many entities (such as actors, goals, tasks, resources, boundaries, value, etc.) that are relevant for these approaches.

Coopetition, which refers to simultaneous cooperation and competition, has become "increasingly popular in recent years" [6] and is "an integral part of many companies' daily agenda" [7]. While some research papers in the RE literature have discussed competition and cooperation between enterprises [8][9] — there are many characteristics of these strategic behaviors that are unexplored in the Enterprise Modeling (EM) literature. It can be argued that these gaps "make it difficult for requirements engineers to validate low-level requirements against the more abstract high-level requirements representing the business strategy" [10]. Therefore, the ability to articulate cooperation, competition, and coopetition represents advancement in the state-of-the-art in EM.

In the introductory section of this paper, we discussed the relevance of coopetition for EM. In the next section, we describe the development of coopetition research within the field of Strategic Management. In the third section, we discuss key characteristics of coopetition that are relevant for EM. In the final section, we summarize our current research into coopetition modeling and propose next steps for future research.

2 Enterprise Cooperation, Competition, and Coopetition

Strategic Management (SM), which is a branch of Organizational Theory (OT), is an academic discipline that is concerned with the structure, behavior, and performance of organizations [11]. It emerged in the 1950s as an explanation of the strategic dynamics between firms in competitive industries [12]. It was closely related to Bain's SCP (structure, conduct, performance) paradigm according to which the performance of a firm was determined by its conduct, which, in turn, was impacted by various industry factors [13]. Starting in the late 1970s, Porter popularized this view through his advancement of economic theories of "competitive advantage" [14][15]. A number of economists, including Porter, helped to establish this competitive view of strategy as the dominant paradigm during the first three decades of SM research.

This "militaristic" view in SM was challenged throughout the 1980s and 1990s by researchers who argued in favor of "cooperative advantage" and "collaborative advantage" [16][17]. This stream of research posited that firms could improve their performance and increase their profits by partnering with other firms. Dyer and Singh promoted the notion of "relational rents" as profits that were generated through relationship-specific idiosyncratic assets and resources [18]. Many rationales and justifications were offered for inter-firm relationships such as strategic alliances. These included the ability for partner firms to acquire knowledge [19], share risks [20], access markets [21], spread costs [22], pool resources [23], and achieve strategic objectives [24].

By the mid-1990s, the field of SM was divided into two camps that offered incompatible and divergent explanations of inter-firm behaviors. The competitive camp argued that cooperation among rivals led to collusion/cartelization while the coopera-

tive/collaborative camp asserted that competition between allies led to mutually destructive outcomes. An esemplastic theory was needed to resolve this creative tension.

Coopetition theory was proposed as a syncretistic means for reconciling the competitive and cooperative perspectives [25]. It was introduced in 1995 by two economists who adopted a game-theoretic lens for interpreting inter-firm behaviors [26]. In the two decades since its introduction, coopetition theory has become a prominent field of scholarly inquiry. A number of literature reviews have noted the increase in research interest in this field [27][28][29] and eminent scholarly publications have devoted special issues to this topic [30][31]. Empirical fieldwork has also been used to explore "coopetition along the antecedents-process-outcomes trail" [17][28]. Additionally, coopetition research has progressed beyond SM into other disciplines including political science [32], diplomacy [33], and civics [34].

3 Emerging Requirements for Modeling Enterprise Coopetition

OT researchers have identified various characteristics that define coopetitive relationships [6][35]. These include, but are not limited to, complementarity [36], interdependence [37], trustworthiness [38], and reciprocity [39]. It should be noted that cooperation and competition are germane to coopetition because coopetition represents the coaction of these phenomena. Therefore, a RE framework for coopetition ought to support the depiction of cooperation and competition separately as well as simultaneously (i.e., coopetition). This section discusses the key characteristics of coopetition between enterprises that are essential for modeling it.

3.1 Key features of coopetitive relationships

Table 1 presents a partial list of requirements that are relevant for modeling coopetition phenomenon. Table 2 presents a preliminary assessment of various techniques in terms of requirements for representing coopetition. We acknowledge that each of these entries merit debate and critique and are offering them to stimulate discussion and more in-depth analysis. Please note that this assessment does not consider the syntax and semantics of extensions, derivatives, or combinations of the reviewed techniques. The column titled 'Key' from Table 1 should be used to interpret the coded column headings in Table 2.

Prominent goal- and/or actor-modeling approaches such as NFR framework, KAOS, and i* are able to support the representation of some, but not all, of these requirements. Similarly, practitioner tools such as Business Model Canvas and Value Network Analysis are also deficient with respect to some of these requirements. Nonetheless, these approaches can be extended and combined in creative ways to overcome their respective limitations for modeling coopetition. This is appropriate because according to [40], "depending on the needs, several languages can also be used together in a complementary way".

Characteristics	Features	Key	Description for Modeling Support
Actor	2 Actors or Dyad	A1	Two actors with links between them.
	>2 Actors or Network	A2	More than two actors with links between them.
	Actor Intention	A3	Internal intentional structure of actor(s).
Complementarity	Resource/Asset/Object	C1	Entity associated with some value, benefit, or utility.
	Value Added	C2	Incremental addition of some value, benefit, or utility.
	Added Value	C3	Worth of an actor in terms of value, benefit, or utility.
Interdependence	Positive Dependency	I1	Existence of dependency(ies) between actors.
	Negative Dependency	I2	Non-existence of any dependency between actors.
	Strength of Dependency	I3	Magnitude of dependency (however measured).
Trustworthiness	Goal Convergence	T1	Agreements between goals within and across actors.
	Goal Divergence	T2	Conflict between goals within and across actors.
	Compliance	T3	Evaluation of abidance with terms and conditions.
Reciprocity	Activity or Task	R1	Individual (step) or collection (process) of actions.
	Sequence	R2	Transition from predecessor to successor action.
	Condition	R3	Constraints or restrictions on actions.

Tab. 1. Partial list of requirements for modeling enterprise coopetition.

Technique	A1	A2	A3	C1	C2	C3	I1	I2	I3	T1	T2	T3	R1	R2	R3
NFR Frame-work	✗	✗	✗	✗	✗	✗	✗	✗	✗	✓	✓	✗	✓	✗	✗
i* Strategic Rationale	✓	✓	✓	✓	✗	✗	✓	✗	✗	✓	✓	✗	✓	✗	✗
KAOS	✓	✓	✗	✓	✗	✗	✗	✗	✗	✗	✓	✗	✓	✓	✓
e3Value	✓	✓	✗	✓	✓	✗	✗	✗	✗	✗	✗	✗	✓	✓	✗
Business Model Canvas	✗	✗	✗	✓	✓	✗	✗	✗	✗	✗	✗	✗	✓	✗	✗
Value Network Analysis	✓	✓	✗	✓	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗
Game Tree	✓	✗	✗	✗	✓	✗	✗	✗	✗	✗	✗	✗	✓	✓	✗
Payoff Table	✓	✗	✗	✗	✓	✗	✗	✗	✗	✗	✗	✗	✓	✗	✗
Change Matrix	✓	✗	✗	✗	✓	✗	✗	✗	✗	✗	✗	✗	✓	✗	✗

Tab. 2. Preliminary assessment of modeling support for requirements from Table 1.

3.2 Strategic Competition between Enterprises

A number of theories have been proposed to explain the nature and characteristics of strategic competition between enterprises. These include Industrial Organization, Chamberlinian, and Schumpeterian explanations that refer to different core concepts and units of analysis [41]. For example, [42] claims that “there is no reason to think of business competitive systems as different in any fundamental way from other biological competition”. This view posits that much like biological competition (between

organisms) economic competition (between enterprises) occurs due to resource conflicts [43]. Indeed, this view is in line with a functional definition of economics as the "study of the allocation of 'scarce' resources among competing ends" [44]. This means that actors (enterprises), goals (ends), and resources (means) are pertinent for the modeling of strategic competition between enterprises.

Figure 1 presents an i* SR (Strategic Rationale) diagram of competition between enterprises caused by typical resource conflicts. Two firms, A and B, are in the same industry such that their products/services are substitutes which serve similar customer needs. These firms require similar resources (capital and employees) and consume similar raw materials (ingredients and supplies). They interact in two arenas which are factor and output markets wherein a factor market is comprised of investors, suppliers, and job agencies while an output market is comprised of customers, and an intellectual property office (i.e., patent issuer). We have chosen i* SR modeling because it supports the depiction of resource dependencies across actors as well as means-ends decomposition and softgoal contributions within actors.

Each firm depends on these stakeholders for different reasons. An investor offers funds to firms (shown) in return for principal + interest and/or profits (not shown). A supplier sells raw materials to firms (shown) in return for principal + interest and/or profits (not shown). A job agency helps a firm to recruit employees (shown) in return for a charge (not shown). The Intellectual Property Office issues patents (not shown) after a firm attempt to register its design (shown). A customer offers its business to firms via orders (shown) and in return pays the firm for its products (not shown). We have excluded certain details from the Figure 1 in order to simplify the diagram.

There are two main types of interactions that can take place between two enterprises such as firms A and B. These are depicted in Figure 2 which is an i* SR diagram of abstract resource conflicts between enterprises (i.e., it represents a strategic pattern). In the first type of interaction, an enterprise (e.g., Firm A) depends on a resource (i.e., Resource X) while another enterprise (e.g., Firm B) depends on a different resource (i.e, Resource Z). In this case, there is no conflict between these enterprises as they depend on, and are interested in, different resources. In the second type of interaction, two enterprises (e.g., Firm A and Firm B) depend on the same resource (i.e., Resource Y). In this case, there is a conflict between these enterprises as they depend on, and are interested in, the same resource. This scenario is likely to lead to strategic competition if only one of these firms is able to satisfy its resource dependency (means) that is necessary for achieving its goal (ends).

The ability to represent the heterogeneous facets of resources are also relevant for the modeling of strategic competition between enterprises. This is because [45] argues that a resource that is valuable, rare, inimitable, and non-substitutable serves as a source of competitive advantage for its owner/controller. A resource is considered to be valuable if rivals cannot: obtain/access it, mimic/copy it, or generate comparable value from alternative/replacement resources [46].

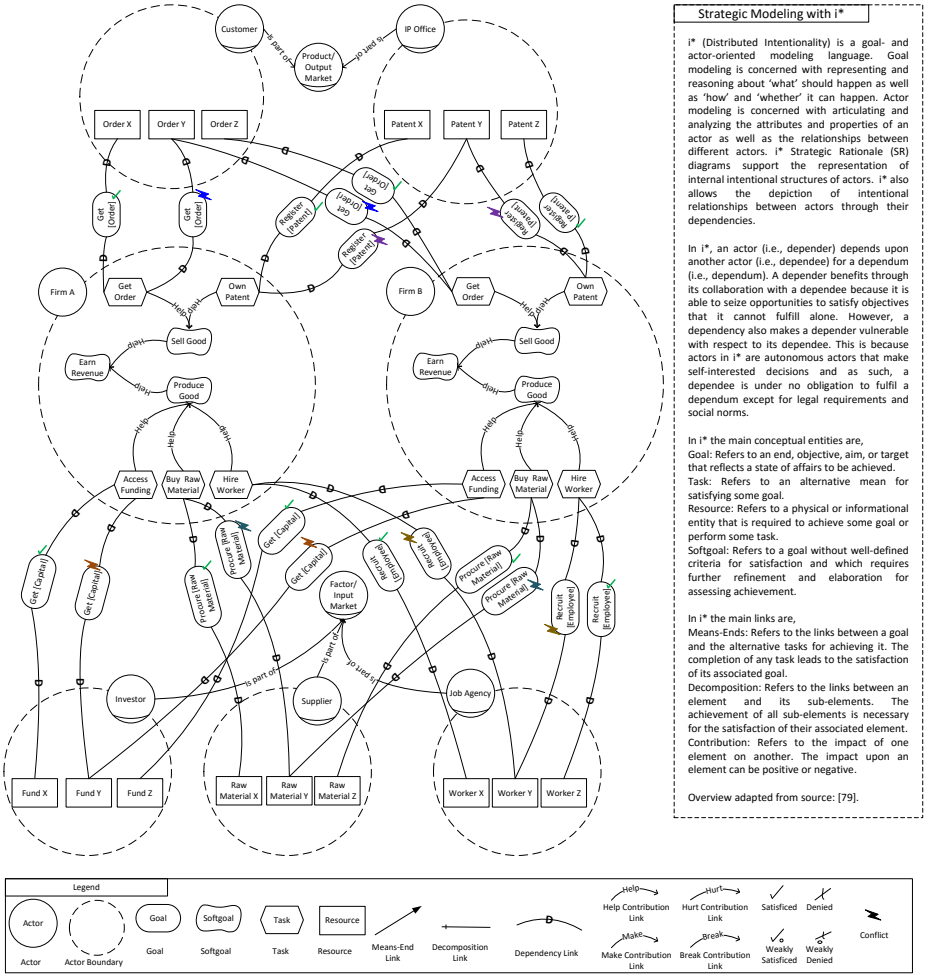

Fig. 1. i* SR diagram of competition from typical resource conflicts among enterprises.

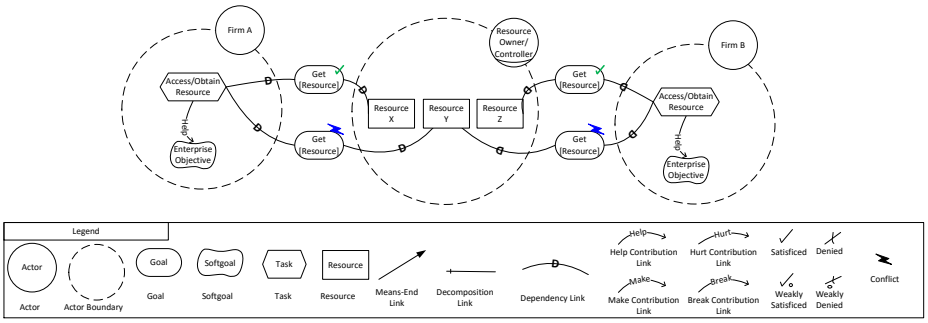

Fig. 2. i* SR diagram of competition depicting abstract resource conflict among enterprises.

3.3 Tensions in Paradoxical Relationships

Competition and cooperation are diametric social behaviors that are undergirded by opposite logics and assumptions [47]. Their co-occurrence in any relationship represents a paradox that creates tensions between the coopeting actors [48]. Different degrees of cooperation and competition can co-exist [47] within vertical (i.e., buyer-supplier) as well as horizontal (i.e., firm-to-firm) relationships [49]. Moreover, coopetition can occur within a dyad (i.e., between two actors) or in a network. Dyadic coopetition necessitates direct coopetition between two actors but network coopetition enables direct as well as indirect coopetition (i.e., via an intermediary). Dyadic coopetition can be regarded as procedural coopetition [50] where activity is an appropriate unit of analysis while network coopetition can be regarded as contextual coopetition [51] where actor is a suitable unit of analysis. Coopetition is also a multi-level phenomenon wherein an actor may exhibit different behaviors at different levels (i.e., within a dyad or network) [52].

3.4 Complementarity, Interdependence, Trustworthiness, and Reciprocity

Complementarity: According to [53],"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." It is informally referred to as synergy wherein: ‘the whole is greater than the sum of its parts’. Complementarity motivates cooperation within competitive relationships and competition within cooperative relationships. Researchers have identified various ways through which firms can develop complementarities with their partners. These include overlap avoidance, knowledge protection, and development of common objectives. [54] note that multi-faceted dealings between Sony and Samsung illustrate a coopetitive relationship that is based on complementary R&D and manufacturing skills.

Interdependence: According to [55], "strategic interdependence is concerned with the extent to which work processes that have strategic implications are interrelated." Firms are typically incentivized to become mutually reliant when they have “partially congruent interest structures” [56]. Interdependence fosters coopetition because it ensures that “each competitor will have a specific individual interest in carrying out an agreement” [57]. Researchers have identified various ways through which firms can become more interdependent with each other. These include investing in relationship-specific assets, interconnecting resources, and knowledge sharing. [47] observed such coopetitive interactions between a number of European firms in the rack and pinion as well as lining industries.

Trustworthiness: According to [58], “trust refers to the expectation that another business can be relied on to fulfill its obligations.” It “is expected to reduce the level of potential and actual opportunism” [59] through “(a) impartiality in negotiations, (b) trustworthiness, and (c) keeping of promises” [38]. Moreover, “while trust is an attribute of a relationship between exchange partners, trustworthiness is an attribute of

individual exchange partners" [60]. Trustworthiness is an important consideration in coopetition because trust and contracts serve as governance mechanisms in cooperative relationships. Researchers have identified various techniques through which firms can grow their trustworthiness. These include increasing communication, avoiding coercion, and increasing linkages. [61] identified trust as a "key factor for success of co-opetitive strategies" through an empirical study of the telecommunications satellite industry in Europe.

Reciprocity: According to [62],"reciprocity is defined as rewarding kindness with kindness and punishing unkindness with unkindness." [63] note that a social actor should "expect this behavior from others" because "reciprocity is a rather stable behavioral response by a nonnegligible fraction of the people" [64]. [65] point out "reciprocity has been studied in depth in economics and game theory as a means to enforce cooperative behavior". This is why it is commonly used in game theory to explain social behavior in sequential move games such as ultimatum game and gift-exchange game [66]. In fact, such behavior is not limited to games and has been observed in the industry by [67].

3.5 Example: Inter-partner learning & knowledge-sharing among enterprises

An important justification for strategic alliances is the transfer and exchange of organizational knowledge between partners [19][22]. However, knowledge sharing can also expose partners to risks and vulnerabilities. This is because partners can engage in 'learning races' [68][69] where each firm tries to 'learn faster' than its partners [70][71]. This might be motivated by opportunism such as a firm's desire for 'knowledge expropriation' [72][73][74]. Such strategic interactions between enterprises can be described using models that depict factors such as complementarity, interdependence, trustworthiness, and reciprocity.

Figure 3 shows the strategic dynamics between two enterprises (i.e., Firm A and Firm B) that possess complementary knowledge. This means that each possesses a stock of information that is of use to the other and hence these firms are interdependent on each other. Information stock is a resource that allows each firm to make decisions regarding a number of business activities. These decisions include, but are not limited to, those about entering new markets, designing new products, developing new business processes, building new organizational structures, and creating new business relationships.

In such inter-partner learning arrangements, each firm must disclose its information stock to its partner in order to access the information stock of its partner in return. Each firm identifies learning opportunities from its partner by evaluating the usefulness of the information stock of its partner for its own business requirements. After identifying learning opportunities, a firm tries to access information from the information stock of its partner so as to add it to its own information stock. However, in order to access information from its partner a firm also has to disclose information

from its own information stock. This is necessary because for information exchange to be mutually beneficial both firms must act on reciprocal learning opportunities.

A firm can exchange information with its partner through two main methods which are accessing and disclosing information. Accessing and disclosing information are two components of the same process because accessing information depends on the ability of a firm to get information from a dependee (i.e., someone that is depended upon) as well as the ability of the dependee to give information to the depender (i.e., someone that depends). Likewise, disclosing information depends on the ability of a firm to give information to a depender as well as the ability of the depender to get information from the dependee.

Learning ability is a socio-technical resource that enables activities related to the acquisition, assimilation, absorption, and application of organizational knowledge. This resource allows a firm to learn from its partners and also makes it possible for a firm to learn faster than its partner (i.e., allows it to get more information than it gives). The ability to learn faster than a partner is advantageous for a firm because it allows that firm to achieve a higher return from the sharing of its knowledge. Indeed, [75] argues that superior organizational learning leads to improved organizational performance and that "the only source of sustainable competitive advantage for a company may lie in its ability to learn faster than its competitors" [76].

A superior learning ability also functions as de facto insurance policy because it precludes a firm from being shut out from the information stock of its partner before it has had a chance to access all the information that it is seeking from that partner. Conversely, a firm that can learn faster than its partner can access all of the relevant information from the information stock of its partner first and then terminate the knowledge sharing arrangement before that partner has had an opportunity to learn all of the relevant information from its information stock. This is why firms evaluate the trustworthiness of partners in order to minimize the risk of exploitation through opportunism (e.g., knowledge expropriation) in knowledge-sharing scenarios.

There are three main types of interactions that can take place between two enterprises (such as firms A and B) in inter-partner learning arrangements. The top diagram in figure 3 depicts a situation in which both firms perceive the knowledge exchange to be equitable as well as fair and therefore they will continue to cooperate by sharing knowledge. This might happen if both partners have foregone opportunism in their dealings and have built up a reservoir of goodwill and understanding. In contrast, the bottom diagram in figure 3 depicts a situation in which any/all firm(s) perceive the knowledge exchange to be harmful as well as malicious and therefore they will conflict and compete with each other. For example, this might happen if any firm detects its partner(s) of engaging in opportunistic behavior because such behavior will create distrust/mistrust in the partnership.

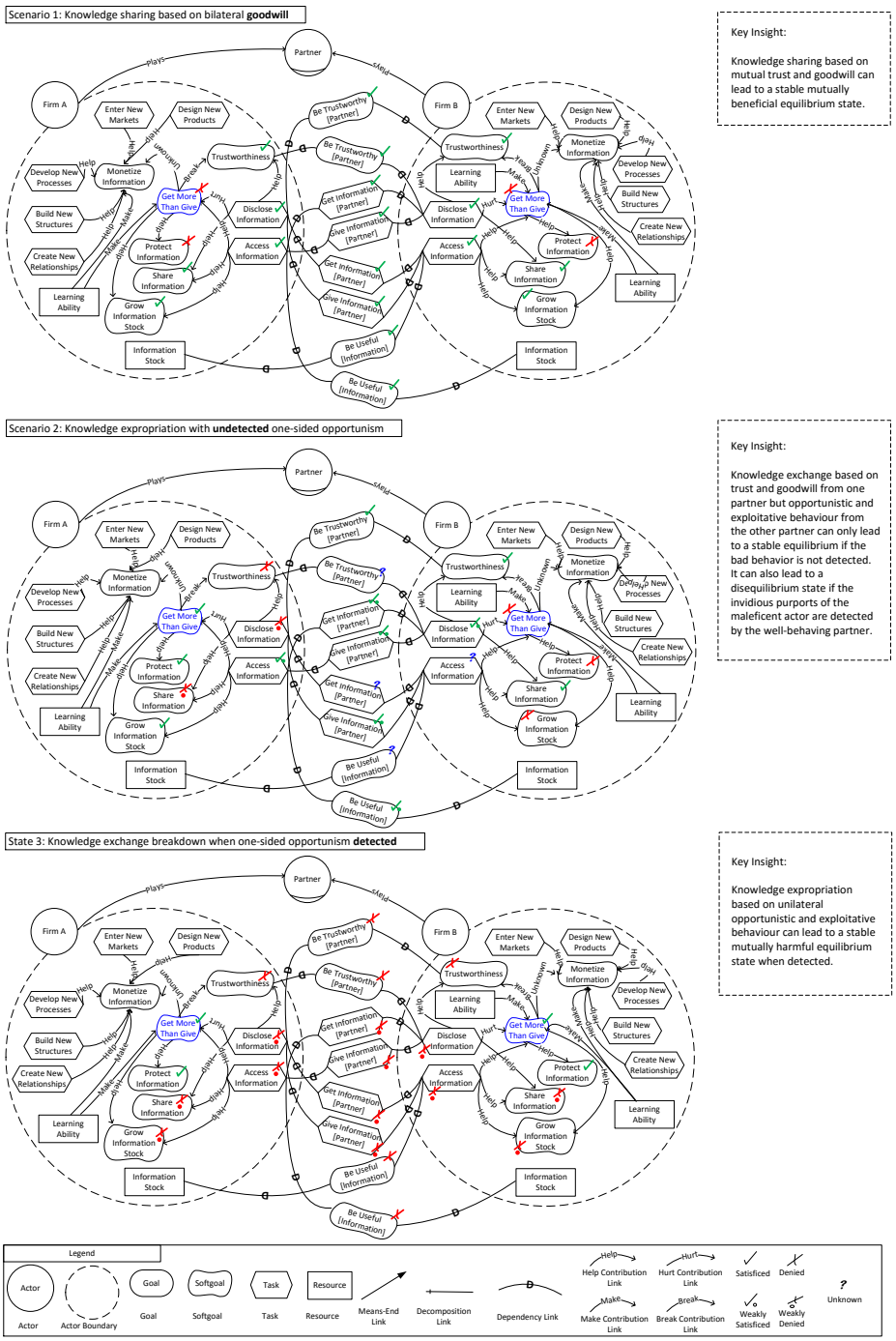

Fig. 3. i* Strategic Rationale diagrams of inter-partner learning and knowledge sharing between enterprises.

The middle diagram in figure 3 depicts a situation in which one firm is cooperating fully (i.e., Firm B) while the other firm (i.e., Firm A) is cooperating partially. This is because while Firm A is sharing its information with Firm B it is also attempting to learn faster than Firm B (i.e., it is competing). In such a situation the stability of the partnership depends on whether or not Firm B detects the opportunistic behavior of Firm A. If Firm B does not detect the opportunistic behavior of Firm A then Firm B will continue to grant unrestricted access to its information stock to Firm A while Firm A will only grant partial access to its information stock to Firm B. However, if Firm B detects the opportunistic behaviour of Firm A, as shown in the bottom diagram in figure 3, then the knowledge sharing will break down on account of Firm B feeling exploited by Firm A. This example shows simultaneous competition and cooperation between the actors because competitive behaviour is present within a cooperative relationship.

4 Conclusions and Future Work

This paper provided an overview of the phenomenon of coopetition as well as some of its key facets and characteristics that are relevant for EM. In addition to being an eminent research area, coopetition is also widely observed in practice. [77] claim that "coopetition is common in several industries" and [78] note that roughly 50% of strategic alliances are between competitors. Nonetheless, in spite of its prominence, coopetition has not been explored in the EM literature. We intend to address this shortcoming by developing a modeling framework that is suitable for representing cooperation, competition, and coopetition.

The next logical step in our research is to identify and catalog the requirements for modeling these phenomena. Table 1 presents a partial list of these requirements however it needs further elaboration and refinement. After identifying the requirements for modeling coopetition, our next step will be to assess the adequacy of extant modeling languages for satisfying those requirements. Table 2 presents preliminary findings however they merit improvement through more rigorous and detailed assay. Moreover, any revisions to Table 1 will necessarily require Tables 2 to be revised as well. We are also interested in exploring alternate approaches for representing the information that is depicted in Figure 3.

After evaluating individual modeling languages for satisfying the requirements from our catalog, our next step will be to address their shortcomings. We will do this by developing a conceptual modeling framework that extends and combines extant notations and techniques. To verify this framework, our goal will be to share it with management practitioners and industry specialists. Additionally, our intention is to validate this framework in the field by collaborating with industry partners. This framework will allow the modeling of opportunities and alternatives for strategic coopetition in a structured and systematic manner. As a result, it is our expectation that, this framework will advance the state-of-the-art for the practice of EM.

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