Complementing *i** with Game Trees - Getting to Win-Win in Industrial Collaboration

Introduction of a New Actor in a Coopetitive Relationship

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Abstract. Interorganizational coopetition describes a relationship in which two or more organizations cooperate and compete simultaneously. Actors under coopetition cooperate to achieve collective objectives and compete to maximize their individual benefits. Such relationships are based on the logic of win-win strategies that necessitate decision-makers in coopeting organizations to develop relationships that yield favorable outcomes for each actor. This paper illustrates the introduction of a new actor in a coopetitive relationship as one of the pathways to a positive-sum outcome. It uses a strategic modeling approach that combines *i** goal-modeling to explore strategic alternatives of actors with Game Tree decision-modeling to evaluate the actions and responses of actors. This paper demonstrates the activation of one component in this guided approach of systematically searching for alternatives to generate a new win-win strategy. An interpretive adaptation of an industrial scenario that is drawn from practitioner and scholarly literatures is used to explain this approach. This illustration focuses on the Industrial Data Space which is a platform that helps organizations to overcome obstacles to data sharing in a coopetitive ecosystem.

Keywords: Coopetition. Win-Win. Design. Modeling.

1 Introduction

Coopetition refers to concomitant cooperation and competition among actors wherein actors "cooperate to grow the pie and compete to split it up" [1]. Actors under coopetition simultaneously manage interest structures that are partially congruent and partially divergent [2]. Partial congruence emerges from actors sharing in certain common objectives while partial divergence emanates from each actor's pursuit of self-interest. Coopetition has become "increasingly popular in recent years" [3] and is widely observed in various domains including business, politics, and diplomacy [4]. 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. In this paper, we apply a synergistic approach that combines *i** goal-modeling with Game Tree decision-modeling to generate and discriminate win-win strategies in a structured and systematic manner. We use an interpretive adaptation of an industrial scenario [9-11] from practitioner and scholarly literatures to explain this approach.

2 Win-Win Strategies and Positive-Sum Outcomes

Coopetition research originated in the field of economics where researchers applied concepts from game theory to explain the motivations of coopeting actors [5]. According to game theory, three types of results are possible in strategic relationships between actors: positive-sum, zero-sum, and negative-sum [6]. In positive-sum outcomes all actors are better off, in negative-sum outcomes all actors are worse off, and in zero-sum outcomes some actors are better off while other actors are worse off [6]. These outcomes are correlated to distinct types of strategies that are adopted by actors in coopetitive relationships: win-win, win-lose, and lose-lose.

Win-win strategies lead to positive-sum outcomes, lose-lose strategies result in negative-sum outcomes, and win-lose strategies yield zero-sum outcomes. Rational and self-interest seeking actors are likely to seek positive-sum or zero-sum (i.e., only if they are better off) outcomes. Therefore, these actors will only implement win-win or win-lose (i.e., solely if they are advantaged) strategies voluntarily. However, win-lose strategies are unsustainable in coopetitive relationships because some actors (i.e., those that are disadvantaged) will be worse off as a result. These actors are likely to withdraw or abandon a win-lose relationship and therefore, win-win strategies are the only durable options for sustaining coopetitive relationships.

3 Modeling Win-Win Strategies using *i** and Game Trees

Pant and Yu [7] proposed a modeling approach for generating and discriminating win-win strategies using *i** and Game Trees. They note that, "while game trees support the depiction of payoffs they do not explicitly codify the reasons for those payoffs" [7]. 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" [7]. In this approach, *i** SR diagrams are used to represent and reason about internal intentional structures of actors while Game Trees are used to express and evaluate moves and countermoves of actors. Therefore, "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" [7].

Figure 1 presents a process diagram of this approach for developing and analyzing win-win strategies in an incremental and iterative manner. It is comprised of three phases: Modeling, Evaluation, and Exploration. In the Modeling phase, an *i** SR diagram and its corresponding Game Tree are instantiated and populated. In the Evaluation phase, the impacts of the alternatives are calculated to detect the presence of any extant win-win strategies. In the Exploration phase, a systematic search is performed to generate new alternatives that yield positive-sum outcomes. This approach incorporates three practical and reasonable assumptions to ensure its usefulness in real-world applications [7]. Firstly, a model represents a modeler's understanding of the world which may or may not be perfect. Secondly, the information available to a modeler could be incomplete and subjective. Thirdly, each actor in the model could have a distinctive preference profile as well as an idiosyncratic interest structure.

In the modeling phase, the actors (concrete and abstract), goals, tasks, resources, and softgoals are denoted in the *i** SR diagram while the sequence of their moves and countermoves is codified in the Game Tree. Figure 2 depicts related *i** SR diagrams and Game Trees of As-Is and To-Be scenarios of a coopetitive relationship between two business partners in the pharmaceutical industry. Model elements in black color represent the As-Is scenario (with two alternatives) and model elements in blue color depict additional model elements in the To-Be scenario. The model elements in blue color are generated by following the process depicted in Figure 1.

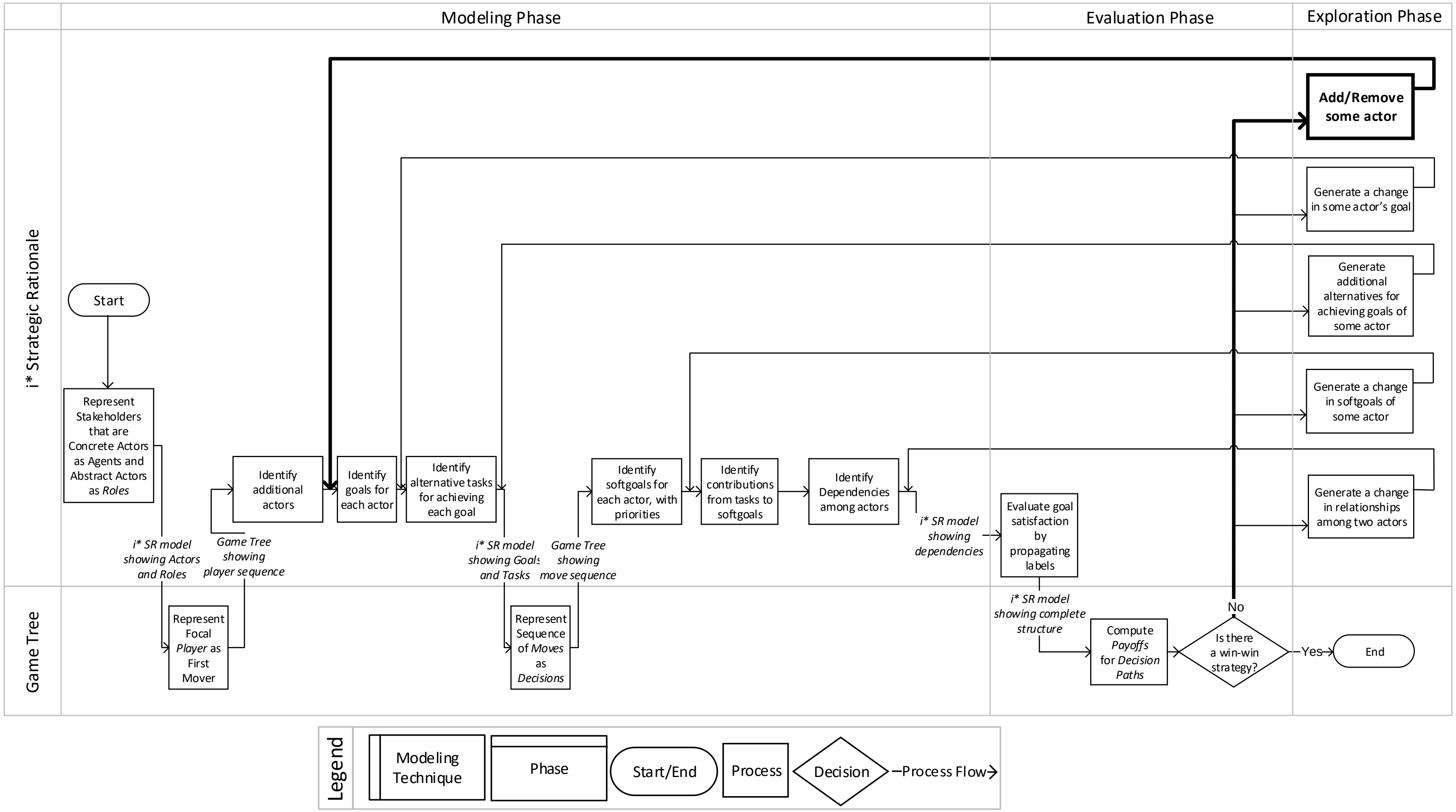
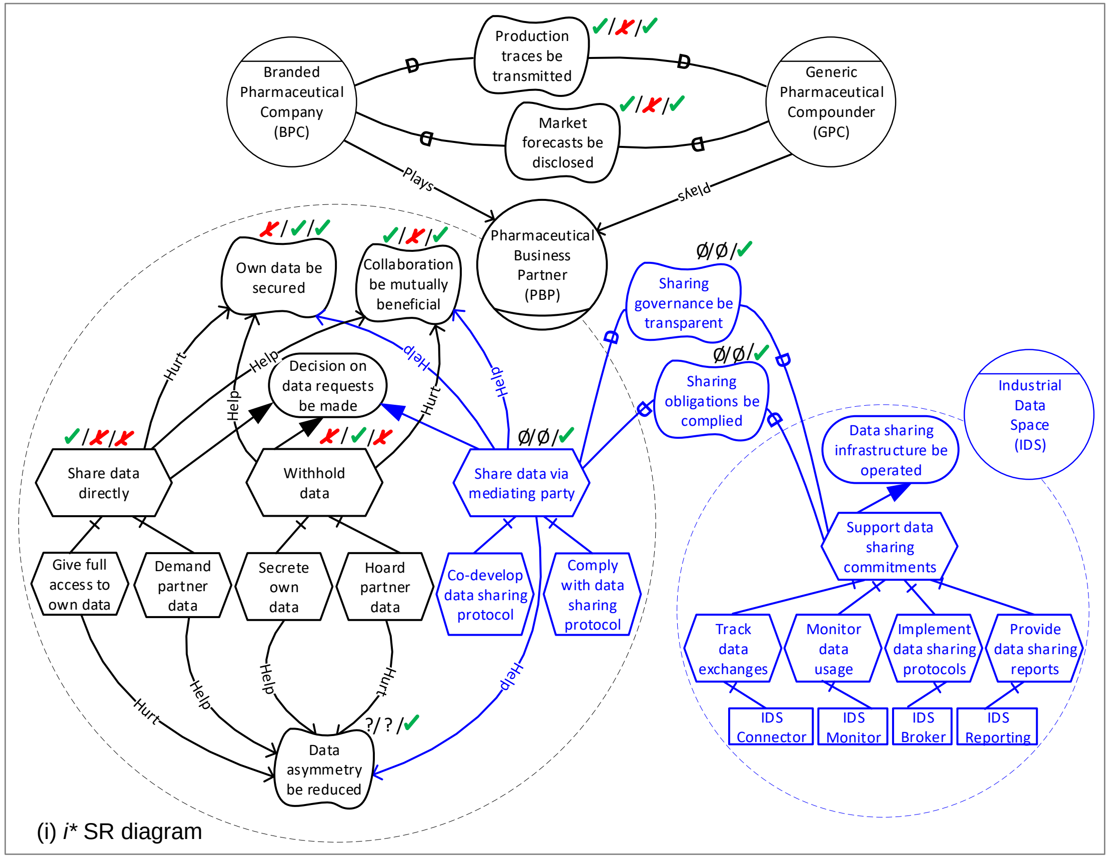


Figure 1. Process to develop *i** SR diagram and its corresponding Game Tree [**emphasis** on introduction of new actor] (source: adapted from [7])



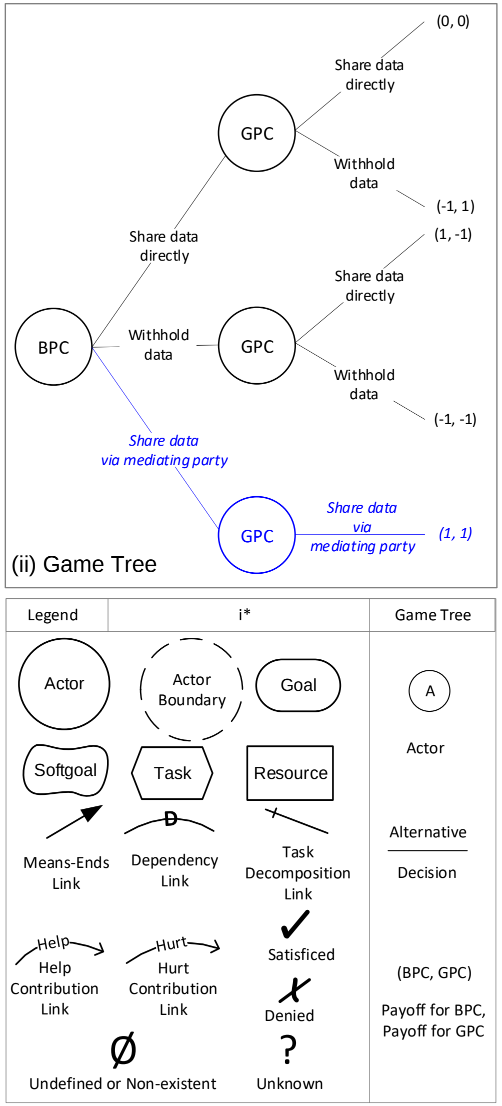


Figure 2. As-Is scenario (in Black) with addition of new elements (in Blue) of To-Be scenario: (i) *i** SR diagram; (ii) Game Tree. (Source: interpretive adaptation from [9-11])

Branded Pharmaceutical Company (*BPC*) and *Generic Pharmaceutical Compounder* (*GPC*) are two actors that play the role of *Pharmaceutical Business Partner* (*PBP*)[1]. *BPC* develops and markets prescription medicines based on its research and development initiatives as well as intellectual property (IP) protections (not shown*). *GPC* manufactures ingredients that are used in *BPC*'s medicines and produces medicines for *BPC* that *BPC* sells to pharmacies and hospitals (not shown*). *GPC* also markets generic medicines that are analogous to the prescription medicines that are sold by *BPC* only if no organizations assert exclusivity on those formulations via their IP protections (not shown*).

GPC depends on *Market Forecasts* of *BPC* (shown) so that *GPC* can approximate the upcoming requirements of *BPC* (not shown*). This helps *GPC* to plan its production runs based on medicines that *BPC* might contract *GPC* to produce (not shown*). *BPC* depends on the *Production Traces* of *GPC* (shown) to verify that *GPC* is only manufacturing those quantities of ingredients of *BPC*'s high margin medicines that are ordered by *BPC* (not shown*). This helps BPC to verify that *GPC* is not manufacturing extra quantities of those ingredients to produce substitute medicines that *GPC* can sell by itself (not shown*). Dependencies among BPC and GPC are shown as softgoals because each is satisficed from the perspective of the depender.

A problem that can occur in such strategic alliances is of 'knowledge expropriation' due to 'learning races' where each organization wishes to 'learn faster' than its partners [4]. Data sharing among partners is crucial for *collaboration to be mutually beneficial*. However, the possibility of *information asymmetry* among partners can motivate each organization to *secure its own data*. For example, access to *GPC*'s confidential *production traces* can endow *BPC* with bargaining leverage over *GPC* while access to *BPC*'s proprietary *market forecasts* can bequeath *GPC* with negotiating advantage over *BPC* (not shown*). Therefore, each actor is likely to demand more data from the other actor than it is willing to give to that other actor. The goal model of the role *PBC* shows that, in the As-Is scenario (represented in black color), *BPC* and *GPC* can *demand partner data* from each other. Upon receiving a demand for data, *BPC*/*GPC* can *share its data directly* with its partner by *giving full access to own data* or it can *withhold its data* from its partner by *secreting its own data* while *hoarding its partner's data*.

In the evaluation phase, payoffs in the Game Tree are estimated by analyzing softgoal satisfaction in the *i** SR diagram. The *i** SR diagram shows that each of PBP's strategies impact its softgoals differently. Labels are placed above softgoals to depict their satisfaction or denial resulting from a certain strategy. Each task has a single checkmark above it at a specific position (i.e., first, second, or third) denoting a unique strategy corresponding with that task. Labels in the first, second, and third positions above a softgoal represent the impact of the strategy corresponding with that position on that softgoal. For example, *Share data directly* (first position) Denies *Own data be secured* but Satisfies *Collaboration be mutually beneficial*.

The strategy of *withholding data* helps the softgoal of *own data be secured* but it hurts the softgoal of *collaboration to be mutually beneficial*. Conversely, the strategy of *sharing data directly* helps the softgoal of *collaboration to be mutually beneficial* but it hurts the softgoal of *own data be secured*. The sub-tasks of the *withholding data* strategy and the *sharing data directly* strategy impact the softgoal *data asymmetry be reduced* differently. In the *withholding data* strategy, *secreting own data* helps *data asymmetry be reduced* but *hoarding partner data* hurts *data asymmetry be reduced*. In the *sharing data directly* strategy, *demanding partner data* helps *data asymmetry be reduced* but *giving full access to own data* hurts *data asymmetry be reduced*. The payoffs in the Game Tree can be used to detect the presence of any positive-sum outcomes. In the As-Is scenario, there are no win-win strategies because neither the *sharing data directly* strategy nor the *withholding data* strategy allow the *PBPs* to satisfice all softgoals. This motivates their systematic search for new alternatives that lead to a positive-sum outcome.

1. Coopetition in the pharmaceutical industry is discussed in [8].

* This aspect of the relationship is <u>not shown</u> to keep the model simple.

In the exploration phase, a subject matter expert (SME) or domain specialist can pursue any of five non-deterministic lines of action incrementally and iteratively. As depicted in figure 1, they can *add/remove some actor*, *generate additional alternatives for achieving goals of some actor*, *generate a change in relationships among two actors*, *generate a change in softgoals of some actor*, or *generate a change in some actor's goal*. Any of these actions can trigger other actions. For example, in the pursuit of a win-win strategy, an SME may choose to generate a new alternative that is an improvement over the best existing option (*share data directly* with payoff of *0,0*). One possible improvement over this alternative is for the *PBPs* to *share data via a mediating party* if that party satisfies certain requirements. For the PBPs, *sharing governance be transparent*, is a crucial requirement and this can be satisfied by *Industrial Data Space* (*IDS*).

The To-Be scenario is depicted in blue color. It shows *IDS*, which is a virtual data space that *supports data-sharing commitments* between partners under the purview of collaborative governance protocols [9-11]. *PBPs* can use *IDS* to *co-develop data sharing protocols* that protect their individual interests while advancing their mutual welfare. Each *PBP* must *comply with data sharing protocols* to which they commit in order to benefit from IDS's capabilities that include *tracking data exchanges*, *monitoring data usage*, *implementing data sharing protocols*, and *providing data sharing reports*. This new alternative (*share data via Industrial Data Space*) in the To-Be scenario satisfices all the softgoals of *PBP* in the *i** SR diagram and thus its payoff score in the Game Tree reflects a higher value than either of the options available in the As-I scenario. This new actor (*IDS*) triggers the creation of a new alternative for *PBP* and changes the interface of *PBP* by creating new dependencies between it and the new actor (*IDS*).

4 Conclusion

We utilized an approach to systematically search for win-win strategies and generate new alternatives for organizations under coopetition. This integrative approach incrementally and iteratively elaborated and refined the *i** SR diagram and its corresponding Game Tree. The resulting model explained the risk of knowledge expropriation in inter-partner learning arrangements if partners shared data directly. No win-win strategies were detected in the As-Is configuration because there existed the possibility for learning races where partners tried to learn faster than each other. In the To-Be scenario, a win-win strategy was generated by using the best-existing option as a starting point and reference. By *sharing data via a mediating party*, PBPs would benefit from collaborative information exchange without the risk of knowledge expropriation.

5 References

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