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The LOCI-method: Collaboration Building in Complex Endeavors Based on Analysis of Interdependencies

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The LOCI-method

Collaboration Building in Complex Endeavors Based on Analysis of Interdependencies

Abstract

In complex endeavors, characterized by multiple interdependent participants with different functions and objectives, it is difficult for an entity to determine how to cooperate with other entities. Simply striving to cooperate at the highest level possible comes at high costs. But how should an entity determine what cooperation approach is appropriate? The present paper describes the newly developed LOCI-method (Levels of Chosen Interdependence) that can be used to determine ones position in the field of other participants, to map out existing dependencies, and to make choices about potential cooperation partners and cooperation approaches. It focuses on interdependence as the most important determinant and consequence of choices for cooperation partners and approaches. The method centers around the Interdependence Space, a three dimensional space with axes that correspond to three properties of interdependence: degree of dependence, mutuality of dependence, and degree of correspondence. An entity that employs the method fills the interdependence space with relevant parties according to their positions on the axes, by means of a questionnaire. Subsequently, the entity is guided in 'reading' the Interdependence Space to better understand the field of interdependencies. Finally, a set of generic principles facilitates in choosing the appropriate cooperation partners and cooperation approaches.

Introduction

The complexity and comprehensiveness of missions in the 21st century requires the creation of coalitions. No single entity can manage the challenges these missions pose alone. Only when different entities combine their capabilities, they are able to reach their goals. Because these goals do not only pertain to the military domain, but also to the political, social, and economic domain, the coalitions should be composed of both military and civilian entities (e.g., Alberts, Huber, & Moffat, 2010; Williams, 2010).

This so-called *comprehensive approach* to missions poses new challenges to the entities contributing to the collective. These challenges include: different approaches to organization and management, conflicting values and norms, irreconcilable political perspectives, mistrust between entities, language problems, technical interoperability issues, and security concerns (e.g., Alberts, Huber, & Moffat, 2010; Friis & Jarmyr, 2008; Essens, Febrarro, Thompson, Baranski, Vogelaar, 2011). In addition, the comprehensive approach does not imply that all entities cooperate with one another at the same level of cooperation. Consequently, one of the most important challenges for an entity may be resolving the question: With whom to cooperate and in what way? Simply

striving to cooperate at the highest level possible with all contributing entities comes at high costs and almost certainly will not be the most efficient solution. But how should an entity determine what cooperation partners and what approaches are appropriate?

In the present paper we present a theoretical-based approach to identifying cooperation requirements and opportunities. In doing so, we aim to extend the way of thinking outlined in the recently developed NATO NEC Command and Control Maturity Model (N2C2M2; Alberts, Huber, & Moffat, 2010). In the network enabled capability (NEC) approach, developed around the year 2000, a capability is established (or emerges) by dynamically linking military and civil elements (sensors, decision makers, effectors) through an information infrastructure. The Maturity concept addresses the level of development of technique, doctrine, personnel, organization, training, and leadership lines, required to be able to interact at various levels of intensity. The N2C2M2 model has been developed to facilitate the exploration of network-enabled command and control approaches in a coalition context. The focus in this work is on being able to operate at higher levels of C2 maturity so that different C2 approaches can be selected for different situations (so-called 'C2 Agility'). However, it does not detail *how* an entity should select the appropriate cooperation partners in a coalition. In addition, the focus on maturity may carry the risk of always wanting to use the more 'capable' C2 approaches, whether this is appropriate or not. This will come at high costs and may limit the potential for cooperation.

Therefore, the present paper focuses on the process of finding the appropriate levels of interaction and commitment between (potential) partners, given their diversity of competencies, capabilities, and interests. In this sense, the presented method may expand the N2C2M2 model with respect to determining with whom to cooperate in what way. We introduce a newly developed method, the LOCI-method (Levels Of Chosen Interdependence-method). The method focuses on *interdependence* as the most important determinant and consequence of choices for cooperation approaches.

Interdependence Theory

According to Kurt Lewin (1948), the essence of a group is the interdependence among its members. Interdependence basically means that the outcomes for individual group members are affected by the actions of other group members (e.g., Johnson & Johnson, 1989). Many researchers in the past decades have underscored the importance of interdependence in work teams, showing that interdependence is related to important team aspects such as within-group collaboration (e.g., Saavedra, Early, & Vandyne., 1993), trust (Alge, Wiethoff, & Klein, 2003), conflict-management (e.g., Jehn, 1995), affective reactions (e.g., Van der Vegt, Emans, & Van de Vliert, 2000), and team effectiveness (e.g., Wageman, 1995). In this line of research, two basic forms of interdependence have been identified: task and outcome interdependence. Members of a team are said to be task interdependent when they must share materials, information, or expertise

to achieve desired outcomes (e.g., Cummings, 1978). When these desired outcomes are contingent on collective performance of the task, team members are said to be outcome interdependent (e.g., Van der Vegt, Emans, & Van de Vliert, 2005).

In coalitions, interdependence not only exists *within* entities, but also *across* entities. As such, coalitions resemble so-called multi team systems (MTSs): new collective forms of organizations that have emerged to deal with highly complex and turbulent environments wherein two or more teams interface directly and interdependently toward the accomplishment of collective goals (Mathieu, Marks, & Zaccaro, 2001). Mathieu et al. defined interdependence in these collectives as: "a state by which entities have mutual reliance, determination, influence, and shared vested interest in processes they use to accomplish work activities" (p. 293). According to Mathieu et al., three forms of interdependence characterize the actions of entities in such collectives: input, process, and outcome interdependence. *Input interdependence* refers to the degree to which entities are required to share human, informational, technological, material, and financial resources to reach individual or collective goals (cf. resource interdependence, Wageman, 1995). *Process interdependence* pertains to the degree of interteam interaction required during task performance to reach individual or collective goals. Interteam interaction consists of processes such as boundary spanning, communication, timing and coordination of actions, and the monitoring and back-up of collective actions. Finally, *Outcome interdependence* refers to the degree to which significant consequences of work for one entity are dependent upon the consequences for another entity.

Besides this distinction between different interdependence forms, interdependence can also be analyzed in terms of different properties (cf. Interdependence Theory, Kelley & Thibaut, 1978; Thibaut & Kelley, 1959). In the context of coalitions, three critical properties of interdependence are relevant: the degree, mutuality, and correspondence of dependence. Although originally Thibaut and Kelley (1959) applied these properties to outcome interdependence only, we propose that all three forms of interdependence (input, process, and outcome) can be analyzed in terms of these properties, resulting in a new framework for analyzing interdependencies. Applying these properties to the three different forms of interdependence, the *degree of dependence* should be understood as the extent to which an entity is required to share resources or interact with another entity, or is dependent upon this entity for attaining good outcomes. The *mutuality of dependence* is the degree to which two (or more) entities are mutually or unilaterally dependent on each other for making use of resources, performing their task, or attaining good outcomes. When one entity is more dependent than the other entity, asymmetry in dependence is said to exist. And finally the *correspondence of dependence* refers to the degree to which the use of inputs, the performance of tasks, or the preferred outcomes correspond versus conflict.

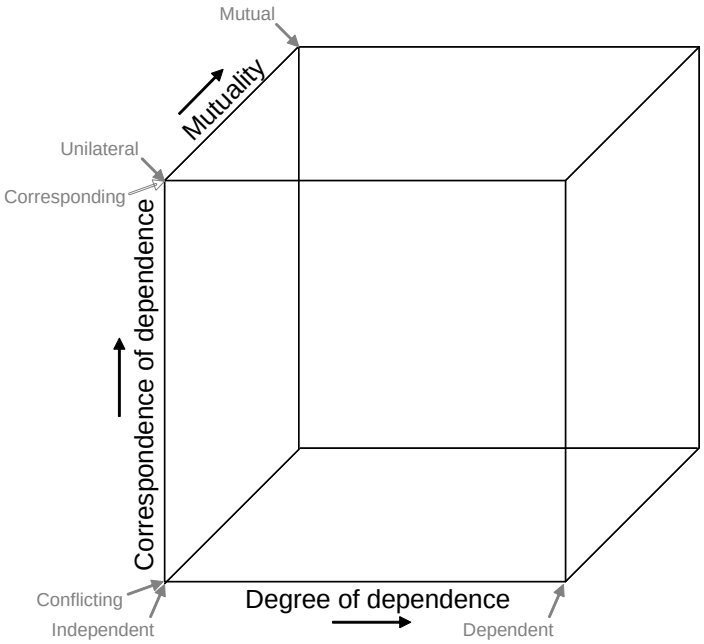

Figure 1. The Interdependence Space

The Interdependence Space

The three properties of interdependence can be visualized in a three-dimensional Interdependence Space (see Figure 1) with axes that correspond to degree, mutuality, and correspondence of dependence. In this space, input, process, and outcome interdependence may vary freely on all three axes. This space can be filled from the viewpoint of one single entity (say entity A). Other entities (e.g., potential cooperation partners in a coalition) occupy certain positions in this Space relative to entity A with regard to input, process, and outcome dependencies. Representing these dependencies in the Interdependence Space helps an entity to gain insight in its position in the field of other entities. As we will describe later on in this paper, with help of a number of generic principles that incorporate the position of the dependencies on the axis, the position of different entities relative to each other, and the combination input, process, and outcome dependencies for each entity, the Interdependence Space can be used to determine with whom to cooperate in what manner

In its simplest form, the Interdependence Space describes the interdependence between two entities, given a specific, well-described task. Consider, for example, a situation where two different nations (A and B) participate in a NATO mission. The efforts of both nations are necessary to attain stability in the country (*outcome interdependence*). A commander of Nation A has to conduct a rescue operation and needs close air support. However, his nation does not have

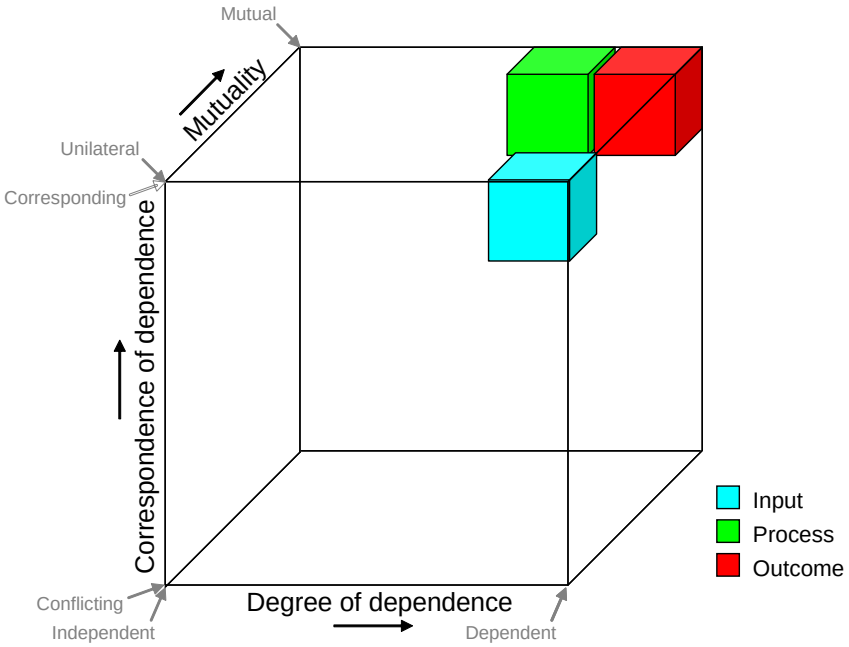

Figure 2. Interdependence Space for the collaboration between Nation A and Nation B

aircrafts (*input dependence*). Nation B, however, does have aircrafts and these are not in use at that moment. When the commander of Nation B is willing to assist in the operation, the pilots of Nation B's aircrafts will have to maintain close communication with the Forward Air Controller of Nation A to coordinate their activities (*process dependence*). The Interdependence Space for the collaboration between Nation A and B in this rescue operation is depicted in Figure 2. In this Space, dependencies are represented by small blocks. Different colors represent the different forms of dependence (i.e., input, process, and outcome dependence).

A quick glance at the Interdependence Space shows that at all levels, there is correspondence between Nation A and Nation B (all blocks are positioned in the top of the Space). Hence, there should be no obstacles to collaboration. In addition, the Interdependence Space shows that, for this specific task, there is asymmetry in dependence: Nation A depends more on Nation B (one of the blocks is positioned in the front half of the cube). However, there is correspondence in the outcomes (see the red block), because the goal of rescuing the soldiers of Nation A eventually contributes to the higher level goal of all nations to attain stability in the country. And because there is no conflict in input interdependence (Nation B does not need the aircrafts themselves at that specific moment, see the blue block) Nation B will likely be prepared to assist Nation A with close air support and assume process interdependence during the operation (see the green block). In Table 1, the different (most extreme) positions that a single entity (entity B) may occupy relative to entity A are detailed.

Table 1. Examples of combinations of form and property of interdependence (using entity A as reference point)

	Degree	Mutuality	Correspondence
Input interdependence	Independent: A does not need resources of B Dependent: A needs resources of B	Asymmetric: A needs B for resources, but B does not need A Symmetric: A and B both need each other for resources	Conflicting: A needs resources of B which can not be missed by B Corresponding: A needs resources of B which can be missed by B
Process interdependence	Independent: A and B do not need to interact to accomplish their goals Dependent: A and B need to interact to accomplish their goals	Asymmetric: A depends on B for input, but B does not depend on A (one-way workflow) Symmetric: A and B depend to a similar degree on each other for input (independent, two-way, or complex workflow)	Conflicting: A and B cannot cooperate with each other well Corresponding: A and B can cooperate with each other well
Outcome interdependence	Independent: A is not dependent on B for outcomes Dependent: A is dependent on B for outcomes	Asymmetric: A's outcomes depend on B, but B's outcomes do not depend on A Symmetric: A and B depend to a similar degree on each other for attaining desired outcomes	Conflicting: When A attains desired outcomes, B attains undesired outcomes Corresponding: When A attains desired outcomes, B also attains desired outcomes

Description of LOCI-method

In the classical conceptualization of interdependence, entities were 'condemned' to each other: they could only reach their goals in cooperation with the other entity (see the above example of Nation A needing the aircrafts of Nation B to be able to successfully conduct a rescue operation). In coalitions, however, entities may be able to choose between multiple parties to realize their own goals. For example, multiple entities could have the inputs one needs to realize a goal. Similarly, different entities could be appropriate as cooperation partner to perform some kind of task. So, in a sense, entities can choose with which other entities they want to become interdependent and in what manner. This is the foundation for the method we developed: the LOCI-Method (Levels Of Chosen Interdependence-Method).

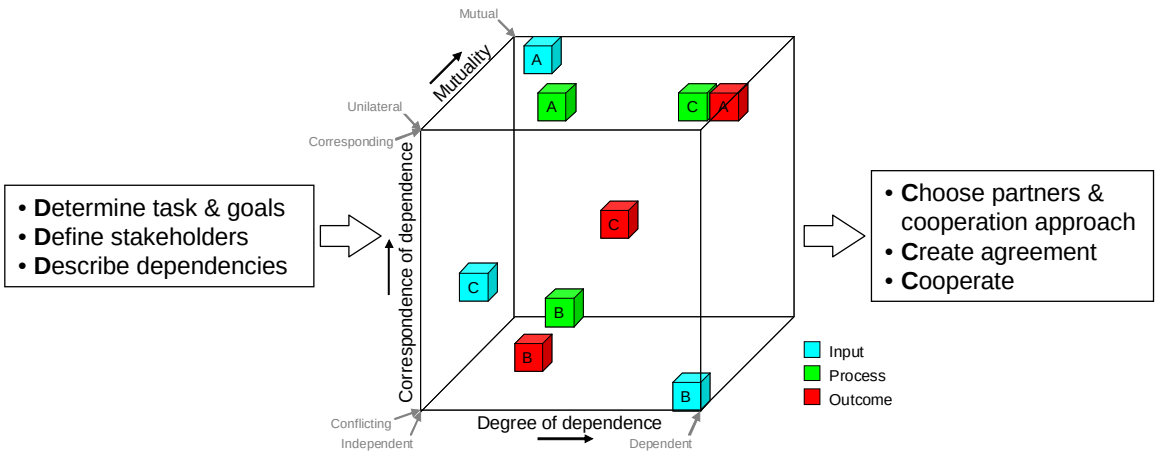

Figure 3. The Interdependence Process Approach

The idea of this method is that entities first determine their position in the field of other entities by determining their own task and goals, defining their environment and the stakeholders positioned in this environment, and mapping out potential dependencies. The results of this positioning phase are represented in the Interdependence Space. This Interdependence Space can then be used to choose potential cooperation partners and cooperation approaches. These choices form the basis for a cooperation agreement and the actual cooperation. As such, the LOCI-method advocates that strategic considerations to cooperation are not solely confined to the capabilities of the different entities or the requirements of the specific mission to be undertaken, but take a broader perspective, incorporating situation specific dependencies, political considerations, and deliberate choice. Schematically, the method is depicted in Figure 3. Below, we describe the different steps of the method. Not all steps have been worked out in detail. The focus in this paper is on the steps in which the dependencies are articulated, represented in the Interdependence Space, and used to choose partners and cooperation approaches (steps 3, 4, and 5). The other steps have been based on research concerning stakeholder analysis (e.g., Bryson, 2003; Mitchell, Agle, & Wood, 1997) interorganizational relationship building (e.g., Ring & Van de Ven, 1994) and systems design (e.g., van den Broek, van der Vecht, van Oosterhout, van Dongen, Bouquet, 2011). Because many useful approaches have already been developed for these steps, we do not elaborate on these steps in this paper, but we refer to the available literature.

1. Entity determines task and goals

To be able to make well-grounded choices for cooperation partners and cooperation approaches, entities first have to look inward: they have to formulate what they want to accomplish, and how they want to do this. Without this step, it is impossible to identify relevant stakeholders, to describe dependencies and, ultimately, to determine which entities one could collaborate with in what manner. Therefore, in the first step of the method, a series of questions guides an entity (e.g. a staff) to describe the ultimate goal it wants to reach (*Why?*) and the nature of the task it wants to undertake (*What?*). In addition, the entity is invited to describe the specifics of the environment in

which the task has to be performed (*Where?*) and the moment and expected duration of the task (*When?*). Finally, the entity has to describe the approach to the task and the resources needed to accomplish the task (*How?*). In answering these questions, an entity formulates the role it wants to play in the mission environment. This forms the basis for defining what other entities come into play and how one relates to these entities.

2. Entity defines stakeholders

After having formulated goals and tasks, entities are in the position to define what other entities could be of relevance in accomplishing their tasks, the stakeholders. An important consideration in this step is who should be involved in the identification of stakeholders. This choice can be approached as a sequence of choices, in which the planning section of the staff begins the effort and other staff officers (and possibly additional advisors, operational analysts, and representatives) are added later as the desirability of doing so becomes clear (e.g., Finn, 1995). Different techniques are available for the identification of stakeholders. In essence, these techniques come down to answering a series of questions that seek to identify who will be influenced (positive or negative) by the task performance, who can influence (positive or negative) the task performance, who will benefit or suffer form the results, and who strives to attain corresponding or conflicting goals (see, for example, Bryson, 2003; Ramirez, 1999). By answering these questions, stakeholders in the task environment can be identified. Subsequently, one has to describe how these entities relate to the home organization. This can be done in the third step of the positioning phase: the description of dependencies.

3. Entity describes dependencies

The previous steps lead to a list of stakeholders. In the present step, for each of the identified stakeholders it has to be determined how they relate to the home organization in terms of potential dependencies. A social network analysis type of instrument can be used to score potential dependencies for each of the identified stakeholders. The Appendix shows an example of what such an instrument could look like. The questions seek to identify potential input, process, and outcome dependencies, each varying on the dimensions of degree, mutuality and correspondence. The questions have to be filled out for each of the identified stakeholders. This instrument can be applied in different ways. When all staff officers participating in the previous step have adequate knowledge of all the identified stakeholders, each officer can fill out the instrument for all identified stakeholders, after which the results can be averaged. On the other hand, when knowledge of the identified stakeholders is distributed across staff officers, each staff officer should only fill out the instrument for the stakeholders of his or her knowledge. When it becomes apparent that none of the officers (nor the advisors, analysts, and representatives) does have adequate knowledge about an identified stakeholder to be able to fill out the instrument, this should be taken as an incentive to gather additional information about this stakeholder, to be able to fill out the instrument with help of this new information.

4. Representation of results: The Interdependence Space

Finalizing the positioning phase, the results of the first three steps can be represented in the

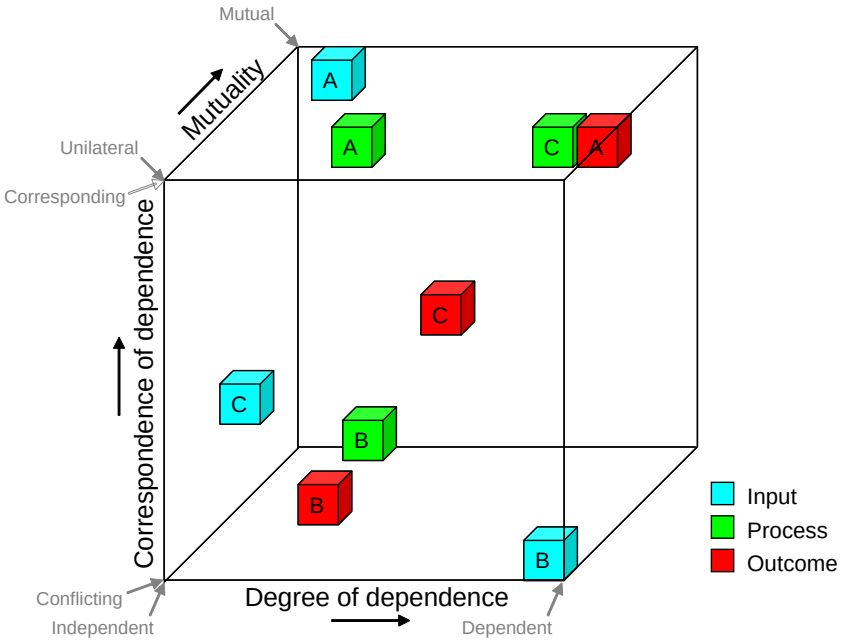

Figure 4. The Interdependence Space in multi-party environments

Interdependence Space, with help of a visualization tool that translates the scores of the social network analysis into blocks in the Interdependence Space (see the footnote in the Appendix for the translation rules). In this space, different stakeholders are represented by different letters in the blocks and the different colors represent the different forms of interdependence (i.e., input, process, and outcome interdependence). The Interdependence Space gives an entity insight into the field of dependencies it is positioned in. With some guidance, an entity can use this Interdependence space as the basis for choosing cooperation partners and cooperation approaches.

Consider, for example, the interdependence space in Figure 4. In this Interdependence space, three stakeholders are represented by the letters A, B, and C. The Interdependence Space can be read in different ways. For example, in the lower part of the Space, dependencies can be found that could potentially cause conflicts (i.e., input, process, and outcome dependencies with entity B). In the right part of the Space, very strong dependencies can be found (i.e., input dependency with entity B, process dependency with entity C, and outcome dependency with entity A) and in the front part of the Space, unilateral dependencies can be found (i.e., input dependency with entity B). Looking at the combined axes leads to the identification of structural dependencies, attractive cooperation partners, etc. Because the Interdependence Space becomes more difficult to interpret when more stakeholders are involved, it is worthwhile to let the researcher comment on the results represented in the Interdependence Space. The researcher may then help make sense of the constellation of different entities in the Interdependence Space, by pointing out a number of distinctive blocks and explaining the meaning of the position of different dependencies.

5. Entity Chooses partners and cooperation approach

The previous steps have provided an entity with insight in its position in the field of other entities. The entity has determined what other entities are relevant in light of the goals it pursues and it has gained insight into the dependencies that might arise when cooperating with these entities. Now it is time for the most important step: the entity has to choose its cooperation partners and the accompanying cooperation approaches. These choices can be based on the representation of the positions of the other entities in the Interdependence Space. In choosing cooperation partners and cooperation approaches with help of this space, the entity is led by situation specific dependencies. It can use a number of generic principles to determine what cooperation partners may be interesting and which approaches could be fit for cooperation with these partners. However, this does not mean that there is no room for deliberate choice. Political and other considerations may lead an entity to deviate from the generic principles and choose other partners and approaches. As such, the method is not deterministic: the entity is not solely confined to the requirements of the specific mission to be undertaken.

In this step, an entity has to make two types of choices. First, the entity has to determine with what other entities it wants to become interdependent. Remember that, so far, the entity has mapped out *potential* dependencies with other entities. That is, it has described to what extent the other entity has resources it *could* use, and to what extent it *would* need to interact with the other entity when it should choose to cooperate with this entity. Only when the entity chooses to become interdependent with another entity, this potential dependency becomes a real dependency. Second, the entity has to determine what approach to cooperation it wants to choose for each cooperation partner. When a cooperation partner has been chosen, the accompanying interdependencies give guidance for the level of the cooperation. Additional considerations may lead an entity to deviate from the recommended level of cooperation.

5.1 Principles for choosing cooperation partners

Two of the three forms of dependence require cooperation: input and process dependence. If an entity lacks certain resources to be able to realize its goals (input dependence), it needs to find another entity which can provide these resources. Hence, in this case some kind of cooperation is necessary. In addition, if an entity needs to interact with another entity to reach its goals, evidently cooperation is necessary as well. Only in the case of outcome dependence (when important results of your work depend on the results another entity achieves), there is no explicit need for cooperation. However, when this outcome dependence is strong and corresponding (i.e. when one entity achieves good results, the other entity also achieves good results), cooperation might be advisable.

If an entity has input or process dependence, and if the positioning phase has revealed that multiple other entities could provide in this dependence, then the entity has to choose between these potential cooperation partners. This choice has to be based on three generic principles, which have a hierarchical ordering:

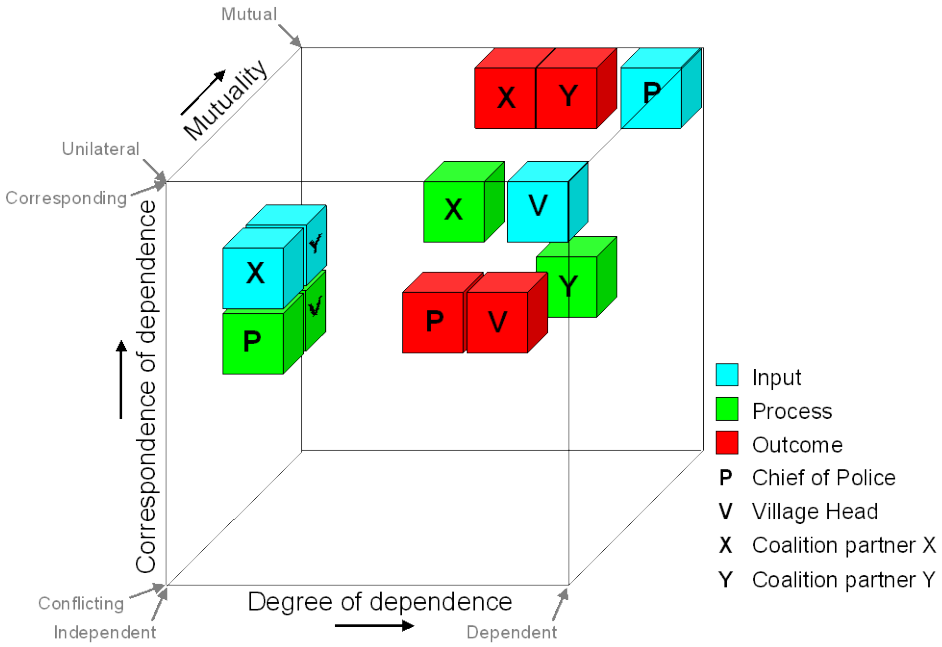

Figure 5. Interdependence Space for example 1 and 2

1. The more corresponding the outcome dependency, the more preferred the potential cooperation partner.
2. The more corresponding the input or process dependency, the more preferred the potential cooperation partner.
3. The more dependent the potential cooperation partner is on the home entity, the more preferred.

An example may show how this works out for input and process dependence. Suppose you are planning an operation and you need security information about the area in which the operation is to take place. You cannot generate this intel yourself, nor can you change the degree to which you need this information. So you have input dependence upon a party who can provide this intel. In this case, there are two parties who could provide you with this information: the local village head and the local chief of police. How do you choose the party you are going to ask for this information? First, on the basis of the Interdependence Space (see Figure 5), you determine which party has the most corresponding outcome dependency with you (generic principle 1). In this case, both the village head and the chief of police have some goals that correspond with your goals, but also some goals that contradict yours. Both parties occupy a position somewhere in the middle between corresponding and conflicting outcome dependency. Therefore, on the basis of the first generic principle, no choice can be made between both parties. Thus, you have to move on to the second generic principle, and determine which party has the most corresponding input dependency. In this case, both parties can provide the information you are looking for and are

willing to share it with you; both their input interdependencies are corresponding with yours. So, on the basis of generic principle 2, no choice between the two parties can be made either. Moving on the generic principle 3, you have to establish which party is more depending on you, the village head, or the chief of police. This is represented on the mutuality axis. Here, a difference emerges between both parties: the local village head does not depend on you for any specific matter (as can be seen by the position of the input dependency on the mutuality-axis: it is unilateral). The chief of police, however, wants its personnel to be trained and is looking for a party who can provide the training he is looking for. You are the only party he can turn to. So the chief of police depends on you for certain inputs (the position on the mutuality-axis is mutual), whereas the local village head does not depend on you. Therefore, the chief of police is the preferred cooperation partner. The fact that he depends on you for certain inputs as well, makes him a more reliable partner to cooperate with; between him and you there is *inter*dependence, whereas between you and the local village head there would only have been dependence.

In the same operation as described above, two coalition partners are taking part (X and Y). The nature of the operation requires that at some point you closely collaborate with one of the coalition partners to realize more firepower. Hence, you have process dependence. Again, the question is: How to choose between X and Y? On the basis of the Interdependence Space for this operation (see Figure5), you first determine which partner has the most corresponding outcome dependency (generic principle 1). In this case, both coalition partners try to achieve the same goals as you do, and the degree to which you depend on each other for achieving your goals is similar for each of the partners. So both partners occupy a position at the high end of the degree of correspondence scale with regard to the outcomes. Therefore, on the basis of the first generic principle, no choice can be made between both partners, and you have to look at the second generic principle: the correspondence of the process dependencies. Here, a difference emerges between both coalition partners as can be seen in the Interdependence Space: partner X has a strongly corresponding process interdependence, whereas partner Y's position is less corresponding, because you know from your experience that working together with partner X always goes smoothly, while working together with partner Y can be troublesome. Therefore, on the basis of these principles, partner X would be the preferred cooperation partner. Partner Y is more dependent on you than partner X (third principle); however, because the principles are hierarchically ordered, the preferred choice in this case is based on principle 2 and not on principle 3.

5.2 Principles for choosing cooperation approach

Above, the principles for choosing the partners have been outlined. When cooperation partners have been chosen, the accompanying dependencies provide guidance for the cooperation strategy that might be used. After all, a comprehensive approach does not necessitate that all entities use the same cooperation approach. One has to define an approach to cooperation for each chosen cooperation partner.

5.2.1 Cooperation approaches

Researchers in this area agree that cooperation approaches can be ordered on a scale running from low intensity cooperation to high intensity cooperation (e.g. Alberts & Hayes, 2006; Konrad, 1996; Williams, 2010). In the present method, five cooperation approaches of increasing intensity are defined: no cooperation, de-confliction, coordination, collaboration, and integration[1]. Cooperation intensity is reflected in processes such as information sharing, communication, and decision making, and characteristics like organizational structure, authority and accountability, and culture and values (Williams, 2010). Similar terminology is being used in the NATO NEC C2 Maturity Model (N2C2M2: Conflicted C2, De-conflicted C2, Coordinated C2, Collaborative C2, and Edge C2; Alberts, Huber, & Moffat, 2010). The N2C2M2 focuses on the governance of the entire endeavor of parties, defined by levels of decision rights, distribution of information, and breath of interactions between the parties. While the underlying concepts may be the same, our operationalisation differs in several ways. First, we see the cooperation approaches as processes to implement or realize the identified interdependencies, rather than structures for governance. Second, there is not a natural ordering of cooperation approaches from less to more effective or capable. Even de-confliction is an active process to define the boundaries of interaction and procedures to realize that. Below, each of the five approaches is briefly characterized.

No cooperation. When there is no cooperation, entities do not use resources or engage in common processes. There is no information sharing, no communication, and no shared decision making. Both entities function entirely independently and separately.

De-confliction. When entities use de-confliction, they engage in the lowest level of cooperation, mostly aimed at avoiding harm and conflicts, such as the potential incompatible use of resources and/ or execution of conflicting activities. This is captured formally in protocols, or informally in personal commitments. At this level, entities may use resources of each other, but do not engage in common processes. Information exchange and communication is directed at maintaining the agreements. Organizational characteristics are hardly affected by this cooperation approach.

Coordination. When entities use coordination as cooperation approach, they aim to align plans and processes according to some common intent. At this level, entities may share resources and engage in common processes. Information sharing, communication, and shared decision making may be quite frequent, depending on the activities that have to be aligned. While entities will maintain relative independence, organizational characteristics may be affected by the need for coordination, for example by institutionalizing boundary spanning structures.

Collaboration. When entities engage in collaboration, they aim to create synergy by developing shared plans and jointly engaging in activities. At this level, entities share resources and engage

[1] Of course, in reality, cooperation takes place on a continuum, and dividing cooperation into five different approaches is somewhat artificial. However, in case of this method, a division in different approaches is more practical than a continuum of increasingly encompassing cooperation structures and processes.

in common processes. There is rich information sharing, communication, and shared decision making. Organizational characteristics reflect the high level of cooperation, by, for example, the formation of cross-organizational entities with delegated authority and control over shared resources.

Integration. When entities cooperate at the highest level possible, they engage in integration. Integration is aimed at being able to think and act as one in order to reach collective goals more effective and efficient. At this level, resources can be shared unlimitedly and processes can be fully merged. There is extensive sharing of information, continuous communications, and fully shared decision making. Organizations can no longer be seen as separate entities, because organizational boundaries are blurred and one common culture and set of values starts to emerge.

5.2.2 Determining the preferred cooperation approach

As we stated before: simply striving to cooperate at the highest level possible with all cooperation partners comes at high costs and almost certainly will not be the most efficient solution. Efficiency however, has not only been the major criterion underlying standard models of economic exchange (e.g., Plott, 1986), it has also been pointed out as one of the most important criteria for assessing interorganizational relationships such as alliances, partnerships, and coalitions (e.g., Ring & Van de Ven, 1994). Therefore, the first principle for choosing a cooperation approach is: *Choose the least intensive cooperation approach necessary to reach your goals*. The rationale behind this principle is that this will bring along the least amount of costs. Obviously however, considerations other than efficiency could lead to the choice for a more intensive cooperation approach. With this generic principle in mind, we define for each form of dependence the preferred cooperation approach.

Input dependence. When there is only input dependence, the preferred cooperation approach is *de-confliction*. The reason for this is that the only dependence that has to be managed has to do with resources. There is no need for aligning plans or processes, so a higher level of cooperation is not necessary. Entities only have to make sure that no conflicts arise in the use of the needed resource. When both entities have corresponding outcome dependencies, or when there are other reasons for a more intensive cooperation approach, entities could choose the next higher cooperation approach: *coordination*.

Process dependence. In case of process dependence, a more intensive cooperation approach is needed than in the case of input dependence. With process dependence, the preferred cooperation approach depends on the degree of dependence: with a low to medium dependence, the preferred approach is *coordination*. Using coordination, entities will be able to align plans and processes, to ensure that activities of both entities can take place and goals can be reached. When both entities have corresponding outcome dependencies, or when there are other reasons for a more intensive cooperation approach, entities could choose *collaboration* instead of coordination. However, because the property of correspondence in the case of process dependence pertains to the expected nature of the cooperation (conflicting versus harmonious), it is not advised to choose

this more intensive cooperation approach when the process dependence scores low on the correspondence dimension. Collaboration may also be the preferred choice when there is a strong process dependence. Using collaboration, entities will be better able to manage strong dependencies, because plans can be developed together and activities undertaken jointly. In this manner process dependencies can be addressed in an early stage and resolved adequately. Again, in the case of corresponding outcome dependencies, or in case of other reasons for more intensive cooperation, entities could choose a higher approach to cooperation: *integration*. Once more, however, this more intensive approach is not recommended in case of a highly conflicting process dependence.

Outcome dependence. As was stated above, in case of outcome dependence, there is no explicit need for cooperation: whether another entity achieves its goals or not, will or will not have consequences for the achievement of your own goals. Cooperation with such an entity does not automatically influence this. Hence in the case of outcome dependence *no cooperation* is required. However, entities with corresponding outcome dependencies make excellent cooperation partners, because they try to achieve similar outcomes as you do. Therefore, although there is no explicit need for cooperation, it is anyhow recommended to seek cooperation at the *coordination* level with entities that have medium strong corresponding outcome dependencies, and at the *collaboration* level with entities that have strong corresponding outcome dependencies. Similarly, it is recommended to try to *de-conflict* with entities that have medium strong outcome dependencies with undetermined influence (neither corresponding nor conflicting), and to try to *coordinate* with entities that have strong outcome dependencies with undetermined influence.

6. Entities create agreement

After an entity has chosen its cooperation partners and determined what cooperation approach it wants to employ for each of the partners, it has to negotiate with these partners concerning the way they want to work together. In this *negotiations stage*, the parties discuss their dependencies, develop joint expectations about their motivations and investments, and determine whether and to what extent they want to become interdependent on each other. When parties decide to create mutual interdependence, they reach an agreement on the approach to cooperation (the level of interdependence) and the rules for future action in the *commitments stage*. This agreement may be laid down in a formal relational contract, or it may be informally understood in a psychological contract among parties (cf. Commons, 1950; Ring & Van de Ven, 1994).

7. Entities Cooperate

Finally, in the *executions stage*, parties implement the cooperation approach they have agreed upon. Here, the chosen interdependence takes effect, through sharing of resources and engaging in joint processes.

Discussion

The present paper introduced the LOCI-method, a method that entities in a comprehensive approach can use to analyze their position in the field of other entities and to choose cooperation partners and cooperation approaches. The method focuses on interdependence as the most important determinant and consequence of choices for cooperation partners and approaches. It centers around the Interdependence Space, a three dimensional space in which all forms of interdependence can be represented according to their position on three axes, corresponding to the three properties of interdependence: degree of dependence, mutuality of dependence, and degree of correspondence.

The LOCI-method has been designed for entities taking part in complex endeavors to guide them in choosing appropriate cooperation partners and cooperation approaches. As such, it complements the existing body of work concerning the NATO NEC C2 Maturity Levels (e.g., Alberts et al., 2010). This work mainly focuses on the C2 approach of the collective, and does not explicitly address the issue of choosing the right cooperation partners and cooperation approaches. Moreover, the focus in this work is on being able to operate at higher levels of C2 maturity so that different C2 approaches can be selected for different situations (so-called 'C2 Agility'). The assumption is that with increasing C2 maturity, automatically the ability to determine the appropriate C2 response for any given situation increases (Alberts et al., 2010; p. 81). However, being able to select different C2 approaches is not the same as being able to recognize which C2 approach is appropriate in a given situation. In the Maturity Model, the only determinants for adopting a particular approach are the complexity of the situation and the C2 approaches the other entities are capable of. The present approach aims to extend the current way of thinking by taking a less deterministic stance; it does so by leaving room for deliberate choice for cooperation partners and cooperation approaches and by focusing on (inter)dependencies as the most important consideration in making this choice.

Although we believe that the proposed method can significantly add to improving collaboration in complex endeavors, we should note that up to this point its contribution has been purely theoretical. So far, we have not been able to test and apply it in exercises or operational settings. However, the German/ Netherlands Corps has shown interest in the method and has planned to apply it in a large-scale comprehensive approach exercise by the end of 2011.

Future developments of the LOCI-method might include:
- The inclusion of power as an important attribute of potential cooperation partners. Power is the ability of one entity to influence activities and the realization of goals of other entities. Power of entities could be represented in the Interdependence Space by the size of the blocks representing the potential dependencies that could exist in relation to this entity.
- Automated advice about ideal cooperation partners and cooperation approaches on the basis of the questionnaire data. The current approach aims to create awareness of the field of dependencies and to leave room for deliberate choice. However, in situations of time pressure, of

extreme complexity, automated support might be the preferred option. The generic principles can be easily translated into rules which can be used to automatically detect optimal solutions.

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Appendix

Example of an instrument to quantify dependencies[2]

Degree and mutuality	Not	To some extent	Strongly
Input			
1. To what extent does entity X have resources (materiel, financial, personal, informational, technological, etc.) that you could use to reach your goal?	☐	☐	☐
2. To what extent do you have resources (materiel, financial, personal, informational, technological, etc.) that entity X could use to reach its goal?	☐	☐	☐
Process			
3. To what extent would you need to interact with entity X if you would cooperate with X to reach your goals?	☐	☐	☐
4. To what extent would entity X need to interact with you to reach its goals?	☐	☐	☐
Outcome			
5. To what extent do important results from your work (e.g. achieving goals) depend on the results entity X achieves?	☐	☐	☐
6. To what extent do important results from entity X's work (e.g. achieving goals) depend on the results you achieve?	☐	☐	☐

Correspondence	Yes	No	Don't know
Input			
7. Does entity X itself need the resources you could use?	☐	☐	☐
8. Does entity X have benefit from sharing these resources?	☐	☐	☐
Process			
9. Do you expect problems when cooperating with entity X?	☐	☐	☐
10. Do you expect a good cooperation with entity X?	☐	☐	☐
Outcome			
11. Do your goals and the goals of entity X conflict?	☐	☐	☐
12. Do your goals and the goals of entity X correspond?	☐	☐	☐

[2] This is an example of how an instrument for quantifying dependencies could be designed. For specific applications, more fine-grained scales could be used, or questions could be framed differently. To translate the scores on this instrument to positions in the Interdependence Space, the following rules should be applied:

→ For the position on the *degree-axis*: Scores on questions 1, 3, and 5
'Not' = independent, 'Some' = middle, 'Strongly' = dependent

→ For the position on the *mutuality-axis*: Combination of the scores on resp. questions 1 & 2; 3 & 4; 5 & 6
'Not' + 'Strongly' = unilateral, 'Not' + 'Some' = middle, 'Not' + 'Not' = mutual, 'Some' + 'Not' = unilateral, 'Some' + 'Some' = mutual, 'Some' + 'Strong' = middle, 'Strong' + 'Not' = unilateral, 'Strong' + 'Some' = middle, 'Strong' + 'Strong' = mutual

→ For the position on the *correspondence-axis*: Combination of the scores on resp. questions 7 & 8; 9 & 10; 11 & 12
'Yes' +'Yes' = middle, 'Yes' + 'No' = conflicting, 'Yes' + 'Don't know' = conflicting, 'No' + 'Yes' = corresponding, 'No' + 'No' = middle, 'No + 'Don't know' = middle, 'Don't know' + 'Yes' = middle, 'Don't know' + 'No' = conflicting, 'Don't know' + 'Don't know' = conflicting (note that in case of lacking knowledge, a conservative position is chosen on the correspondence dimension)