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Multi-team and multi-organization systems

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Defence R&D Canada – Valcartier
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Abstract

Increasingly common in political, military, and business worlds, inter-organizational partnerships lead to the creation of hybrid structures which are controlled by several organizations. This document presents a typology of such multi-organization systems that emerge from the interaction of several organizations or are deliberately created by them. Multi-organization systems (and multi-team) systems offer a very interesting framework for the analysis of novel forms of cooperation implemented in response to new constraints or new opportunities. It is shown that these systems can be modelled using three features, which are purpose of partnership, control and cooperation structure, and dynamics of membership. The costs and advantages of different multi-organization systems are discussed individually, but also through their representation as a spectrum where movement in either direction implies a trade-off between autonomy and effectiveness. A middle zone is identified where lie the most efficient multi-organization systems.

Résumé

De plus en plus communs dans les sphères politiques, militaires, et des affaires, les partenariats inter-organisationnels donnent lieu à des structures hybrides qui sont contrôlées par plusieurs organisations. Ce document présente une typologie de ces systèmes multi-organisationnels qui soit émergent de l'interaction de plusieurs organisations, soit sont délibérément créés par elles. Les systèmes multi-organisationnels (et multi-équipes) offrent un cadre très intéressant pour l'analyse des nouvelles formes de coopération mises en oeuvre en réponse à de nouvelles contraintes ou de nouvelles possibilités. On montre que ces systèmes peuvent être modélisés grâce à trois attributs qui sont la raison d'être du partenariat, la structure de contrôle et de cooperation et la dynamique de l'adhésion. Les coûts et les avantages de chaque type de système multi-organisationnel sont discutés individuellement, mais aussi à travers leur représentation comme un spectre où le mouvement dans chaque direction se traduit par un compromis entre l'autonomie et l'efficacité. Une zone est identifiée où résident les systèmes multi-organisationnels les plus efficients.

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Executive summary

Multi-team and multi-organization systems

H. Irandoust, A. Benaskeur; DRDC Valcartier TR 2009-198; Defence R&D Canada – Valcartier; November 2009.

Background: Given the nature of current and future conflicts, military units will be increasingly called to cooperate in joint or combined operations, as part of multi-team or multi-organization systems. These systems can be formed at different scales grouping individuals, teams, or task groups from different services, organizations, agencies or nations. Examples of such systems in the military are joint task groups, standing forces or coalitions. But they can also be found in political and business worlds. These hybrid structures, sometimes deliberately created and sometimes emergent, are formed to support novel types of cooperation implemented in response to new constraints or new opportunities.

Principal results: This report proposes a theoretical framework for the analysis of inter-organization cooperation. It presents a typology of multi-organization systems that emerge from the interaction of several organizations or are deliberately created by them. It is shown that multi-organization systems can be characterized in terms of three features, which are: purpose of partnership, control and cooperation structure, and dynamics of membership. The costs and advantages of different multi-organization systems are discussed individually, but also through their representation as a spectrum where movement in either direction implies a trade-off between autonomy and effectiveness. A middle zone is identified where lie the most efficient multi-organization systems.

Significance of results: The proposed model offers a theoretical framework for the analysis of multi-organization systems which are increasingly common in military forces. It is shown in particular that more integrated organizations, such as alliances and unions, display greater effectiveness at the expense of loss of autonomy of the member organizations, while loose organizations such as networks preserve autonomy, but offer limited effectiveness. Somewhere in the middle, coalitions, consortia and coordinating units, allow for more efficiency by enabling partnerships that are not as constraining as alliances and unions, and at the same time, are structured enough to attain well-defined objectives. This is a space where a small number of partners create an organization of its own right to achieve a short-term operational goal.

Future work: Inspired by research on organizations in social sciences and in multi-agent systems, this work can be extended to account for new organizational concepts such as integrated, agile or edge organizations. The theoretical framework proposed in this report will be used to analyze the new and complex forms of cooperation that will hold within future military organizations.

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Multi-team and multi-organization systems

H. Irandoust, A. Benaskeur ; DRDC Valcartier TR 2009-198 ; Recherche et développement pour la défense Canada – Valcartier ; novembre 2009.

Contexte : Étant donné la nature des conflits actuels et futurs, les unités militaires seront de plus en plus appelées à prendre part à des opérations interarmées ou interalliées, en tant que systèmes multi-équipes ou multi-organisationnels. Ces systèmes peuvent être formés à différentes échelles regroupant des individus, équipes, ou groupes opérationnels issus de différents services, organisations, agences ou nations. Des exemples de tels systèmes dans le domaine militaire sont les groupes opérationnels interarmées, les forces permanentes ou les coalitions. Mais on les trouve également dans les sphères politiques et des affaires. Ces structures hybrides, parfois créées délibérément et parfois émergentes, sont formées pour soutenir de nouvelles formes de coopération mises en oeuvre en réponse à de nouvelles contraintes ou de nouvelles opportunités.

Résultats principaux : Ce rapport propose un cadre théorique pour l'analyse de la coopération inter-organisationnelle. Il présente une typologie des systèmes multi-organisationnels qui soit émergent de l'interaction de plusieurs organisations, soit sont délibérément crées par elles. On montre que les systèmes multi-organisationnels peuvent être caractérisés par trois attributs, qui sont : la raison d'être du partenariat, la structure de contrôle et de coopération, et la dynamique de l'adhésion. Les coûts et les avantages de chaque type de système multi-organisationnel sont discutés individuellement, mais aussi à travers leur représentation comme un spectre où le mouvement dans chaque direction se traduit par un compromis entre l'autonomie et l'efficacité. Une zone est identifiée où résident les systèmes multi-organisationnels les plus efficients.

Portée des résultats : Le modèle proposé offre un cadre théorique pour l'analyse des systèmes multi-organisationnels qui sont de plus en plus communs dans les forces militaires. Il est notamment montré que les organisations plus intégrées, telles que les alliances et les unions, offrent une plus grande efficacité au prix d'une perte d'autonomie des organisations membres, tandis que les organisations non-consolidées, telles que les réseaux, préservent l'autonomie mais offrent une efficacité limitée. Quelque part au milieu, les coalitions, consortia et unités coordinnatrices, se révèlent plus efficaces en rendant possible des partenariats qui ne sont pas aussi contraignants que les alliances et les unions, mais qui en même temps, sont assez structurés pour atteindre des objectifs bien définis. On est alors dans une zone où un petit nombre de partenaires créent une organisation à part entière pour atteindre un objectif opérationnel à court terme.

Recherches futures : Inspiré par la recherche sur les organisations dans les sciences sociales et les systèmes multi-agents, ce travail peut s'étendre pour rendre compte de nouveaux concepts organisationnels, tels que les organisations intégrées, agiles, ou *edge*. Le

cadre théorique proposé dans ce rapport sera utilisé pour analyser les formes nouvelles et complexes de coopération qui seront de mise dans les organisations militaires futures.

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1 Introduction

Given the nature of current and future conflicts, military units will be increasingly called to cooperate in joint or combined operations, as part of multi-team or multi-organization systems. Challenges in the new warfare era are such that no single service or organization can deal with them effectively. To overcome these challenges, current thinking in military forces seeks to enable information superiority through the tight collaboration of military entities [1].

Multi-team and multi-organization systems can be formed at different scales grouping individuals, teams, or task groups from different services, organizations, agencies or nations. Examples of such structures in the military are joint task groups, standing forces or coalitions. But they can also be found in political and business worlds. These hybrid structures, sometimes deliberately created and sometimes emergent, are formed to support novel types of cooperation, which are implemented in response to new constraints or new opportunities.

This report proposes a theoretical framework for the analysis of inter-organization cooperation. It presents a typology of multi-organization systems that emerge from the interaction of several organizations or are deliberately created by them. This is illustrated by real-world schemata found in political, military, and business worlds. It is shown that multi-organization systems can be characterized in terms of three features, which are: *purpose of partnership* (what is the rationale for the inter-organizational cooperation?), *control and cooperation structure* (what mechanisms are used to run the multi-organization system and what is the range of the cooperative activities), and *dynamics of membership* (conditions under which organizations can join the multi-organization system). The costs and advantages of different multi-organization systems are discussed individually, but also through their representation as a spectrum where movement in either direction implies a trade-off between autonomy and effectiveness. A middle zone is identified where lie the most efficient multi-organization systems.

This work has been inspired by research on organizations in social sciences and in the field of Multi-Agent Systems (MAS) [2, 3]. Although human organizations have been used as a basis for the analysis, the framework can also be used for the design of software multi-agent systems. Multi-organization systems, we believe, provide a very interesting framework for the study of the cost, advantages, and mechanisms of cooperation, which is a central topic in MAS.

The document is organized as follows. In Chapter 2, we define the context of this study by illustrating multi-team and multi-organization systems through instances in the Canadian Forces. Useful definitions of team, multi-team system, task group/force versus standing group/force are provided. Chapter 3 discusses the factors that lead to organizational partnerships, both in the case of emergent and deliberately created multi-organization systems. Next, a minimal set of features is identified for their characterization, including *purpose of partnership*, *control and cooperation structure*, and *dynamics of membership*, which captures the different and yet related dimensions of multi-organizational partnership. A typology of multi-organization systems is then presented in Chapter 4 and characterized in terms

of these features. The typology includes *networks*, *tacit agreements*, *coordinating units*, *consortia*, *coalitions*, *alliances*, and *unions*. Finally, in Chapter 5, a synthesis allowing comparison of features across the spectrum of multi-organization systems is presented. We conclude by discussing the correlations between the different features and the balance between autonomy and effectiveness in multi-organization systems. The characteristics of the most efficient multi-organization systems are identified and represented against a spectrum of possible multi-organization systems, ranging from emergent to thoughtfully planned.

2 Multi-team and multi-organization systems in the military

Given the challenges of modern conflicts, military units are increasingly called to cooperate in joint or combined operations, as part of multi-team or multi-organization systems. These new trends are the result of a constant reflection in the military domain on the necessity of collaboration between different military partners and the organizational structures that can effectively support it (see [4, 5]).

In military forces, partnerships often take the form of multi-team systems. These are new heterogeneous organizations, the teams of which belong to different:

1. services from the same larger organization, as in *joint* operations, and/or
2. organizations from the same or different nations, as in coalitions.

Practically speaking, multi-team systems are a special case of multi-organization systems. Basically, the particularity of multi-team systems is that inter-organization partnership is realized through the cooperation of teams, which moreover, existed as such before. As we will see, there are other mechanisms for multi-organizational cooperation.

In the following, definitions of team, multi-team and multi-organization systems are provided, and exemplified by instances in the Canadian Forces and the military.

2.1 Team

While multi-team and multi-organization systems are new concepts, there is a substantial literature on teams studied from a cognitive, sociological and artificial intelligence (AI) perspective. While all these studies focus on the central notion of collective effort toward a common goal, each definition emphasizes some specific features.

2.1.1 General characteristics

Salas et al. [6] underline some important characteristics of teams which are interdependence and complementariness of roles:

> a distinguishable set of two or more people who interact dynamically, interdependently, and adaptively towards a common and valued goal/objective/mission, who each have been assigned specific roles or functions to perform, and who have a limited life-span of membership.

Interdependence, performance goals, but also complementarity of members and mutual accountability are important constructs of teamwork. Katzenbach and Smith [7] capture the latter in their definition:

> a small number of people with complementary skills who are committed to a common purpose, set of performance goals, and working approach for which they hold themselves mutually accountable.

To a certain extent, these features distinguish teams from informal groups that can be formed without any well-defined mission, and which typically have no significant performance requirements, and no true interdependency or accountability [8]. In fact, in our opinion, most of the mentioned characteristics are by-products of two essential characteristics of teams which are: (i) they are embedded in an organizational framework; (ii) they engage in a tight collaboration.

2.1.2 Team as an organizational unit

An important property of teams is that they are part of organizations. That is they exist within a context which both sustains and constrains them. As examples, consider a professional sports team which operates within a league or a Special Forces infantry team which exists within a larger military force which has strategies, doctrines, policies, technologies and a control structure. Yet, only a few studies have emphasized this property. Among those, Rousseau, Aubé and Savoie [9] provide the following definition of team:

> a formal and permanent whole of at least two individuals who are collectively in charge of the achievement of one or several tasks defined by the organization.

Also, Devine [10] describes teams as:

> a collection of individuals who share a common goal, whose actions and outcomes are interdependent, who are perceived by themselves and others as a social entity, and who are embedded in an organizational context.

The belonging of teams to organizations is a defining feature that explains many of the others. Because they are constitutive of organizations, teams have performance goals, a fact which already differentiates them from groups or communities. Achievement of these goals calls upon different capacities and this is why team members have to bring distinct and unique expertise to the team, hence the complementariness of skills and roles [8].

Moreover, goal attainment entails the establishment of various control mechanisms. For example, teams typically have a formal leader (or at least a coordinator), whose role is to link individual effort to organizational goals and supervise the team as it attempts to progress towards those goals. In addition to a control structure, teams have also defined work and communication processes that serve efficiency purposes. These communication processes may include formally chosen and supported set of technologies [8].

To distinguish teams from groups, which may also be part of organizations, we must add that the latter are mainly formed on the basis of perceived identity. While team membership is based on the particular expertise or competency that an individual can bring to the team,

group membership is more based on the intrinsic identity and properties of an individual. Thus, while team formation responds to precise organizational objectives, which are short or mid-term operational goals, group creation is more vaguely based on a convergence of interests. One will be part of a group because of a general background, but he will part of team because of a specific know-how [8] that will allow the organization to attain its goals.

Supported and controlled by an organizational framework, teams are organization units and teamwork can be seen as 'joint work toward common performance goals' [11].

2.1.3 Collaborative action

Not only teams are outcome-oriented, but the achievement of the expected results relies on tight collaboration. While groups are often driven by an exchange of ideas and are aimed at fostering common interests, teams, on the other hand, are driven by collaborative action aimed at achieving short-term operational goals.

Generally speaking, Larson and LaFasto [12] distinguish three types of teams:

– Tactical (*e.g.*, surgery or sports team)
– Creative (*e.g.*, teams that develop new products)
– Process (*e.g.*, strategic management teams)

As we can see, all these types of teams are set up in the pursuit of a specific result: to solve a problem, develop a new approach, design a new product, or achieve a mission goal. Moreover, all three require a dynamic interaction. Teams work together on a regular basis, and sometimes intensely for short periods of time. One of the corollaries of such intense collaboration is a limited lifespan. Teams are disbanded once the operational goals for which they have been formed have been achieved [8].

Teams are characterized by their capacity to carry out a tight, and sometimes repeatable collaborative pattern (i.e. carry out an operation, play a match, accomplish a mission objective, etc.) that can result in observable outcomes at the team and the task levels. The intensity of team interactions gives way to cognitive and affective constructs, such as shared mental models (of team or of task), which could not otherwise be achieved [8].

2.1.4 Summary

On the basis of the previous discussion, we define a team as an organizational unit, the members of which engage in a tight collaboration in order to achieve well-defined goals [8].

The features of teams are summarized in Figure 1.

We consider here that the two features, organizational and collaborative, subsume many others discussed in teamwork literature. Teams develop certain behaviours and processes as a result of a tight collaboration in pursuit of operational goals defined by their reporting organization.

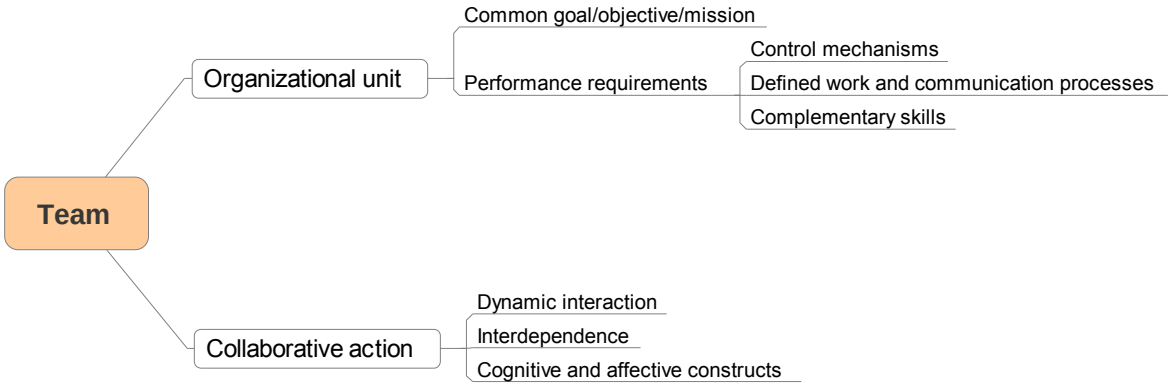

Figure 1: Properties of teams

2.2 Multi-team systems

Multi-team systems are formed when existing teams are called upon to collaborate to meet some emergent situation. Inter-team collaboration can occur between different services of a single organization, as occurs as a matter of course when army, navy and air forces collaborate in joint operations. It also occurs in a multi-organization form when a number of emergency measures organizations, such as various military, police and fire-fighting forces, collaborate to deal with a particular situation. Coalitions are still another form of multi-team system, where each team is attached to a different organization that belongs to a different nation. Thus teamwork is increasingly supported through multi-team and multi-organization systems.

Marks *et al.* [13] have provided a definition of multi-team systems. A summary of their definition is as follows:

> The multi-team systems concept describes the functioning of a tightly coupled network of teams. Multi-team systems are not simply large teams. Their component teams are distinguishable entities capable of independent actions that may pursue different proximal goals. The boundary for inclusion as a multi-team system is defined by the fact that a team shares input, process, and outcome interdependence with at least one other team in the multi-team systems network. The component teams may perform markedly different operations, but their efforts are tied together by a sequential goal hierarchy demanding quality transitions from one to the other, all in pursuit of an ultimate goal.

For their part, Endsley and Jones [14] discuss distributed teams and multiple teams in much the same terms. They point out that "one can think of multiple teams as forming a supra team [where] each team has separate functions and goals but also shares a common overarching goal".

Multi-team systems are very common in the Canadian Forces, with the most prominent example being the joint task force. It must be noted that a task force is different from a standing force or group. A task group/force has a defined goal, and disbands once its objective is reached, while a standing group/force has a lasting purpose with no planned ending [15].

Task forces are generally formed for emergency situations. Examples include strictly military actions, but also interventions against civil unrest and protests (Summit of the Americas, native peoples' protests, Caledonia, Ontario). Natural disasters, such as storms, fires and floods, have required multi-team action as well. Other relevant examples, around the world, would include:

- mass evacuations (e.g., New Orleans and Florida hurricanes of 2005);
- civil defence following terrorist attacks on public places or mass transit, as in New York, London and Madrid;
- crowd control and public safety during major sporting events, such as World Cups or Winter and Summer Olympic Games.

Task forces in CF are made up of maritime, land, air and special operations forces selected and trained specifically for their missions. They are deployed by the 3 Canadian Forces Operational Commands, which are:

1. Canada Command (Canada COM), responsible for all domestic and continental operations.
2. Canadian Expeditionary Force Command (CEFCOM), responsible for all international operations.
3. Canadian Special Operations Forces Command (CANSOFCOM), responsible for all special forces operations.

Standing forces are a concept under development in the Canadian military forces. In a 2005 Defence Policy Statement, the Government of Canada outlined several key changes that, if implemented, will lead to a restructuring and reorientation of the Canadian Forces. Three levels of joint standing forces, comprised of maritime, land, air and special operations forces would be established. These formations include: Special Operations Force (SOF), Standing Contingency Force(SCF), and Mission-Specific Task Force (MSTF).

- The SOF would be a joint military formation capable of operating in both Canada and abroad, and which would include light commando/ranger type units alongside intelligence, aviation, maritime and land and other support capabilities. The Canadian Forces will need to sustain a six-month overseas deployment of the SOF, provide special operations elements to support a SCF or a MSTF in order to enhance their covert surveillance

and other capabilities. This force would be the primary means of participating in high-intensity "intervention operations" with allies, particularly against unconventional and asymmetrical threats such as terrorism.

– The SCF would establish an initial Canadian Forces presence to provide stability or facilitate the deployment of larger, follow-on forces. This high-readiness force would be comprised of maritime, land, and air elements organized under a single integrated command structure. It would be ready to deploy within 10 days' notice. The Canadian Forces will need to sustain a six-month overseas deployment of the command element of the SCF, either land- or sea-based, capable of multinational lead-nation status in peace support operations. This force would provide significant support for SOF and would be designed to deal with the threat posed by failed and failing states and terrorist sanctuaries.
– The MSTF, which seems more to be a task force, would be task-tailored to meet mission-specific requirements and could be deployed as a follow-on force to the SCF or as a stand-alone contribution. They would be drawn from forces at varying states of readiness, configured for longer deployments, and designed to conduct both combat and peace-support operations. There would be a need to sustain indefinitely the national command element of a MSTF overseas. It would also be capable of multinational lead-nation status in peace support operations for more limited periods.

We should add here that multi-team systems are formed to operate at a tactical level, as exemplified by joint task/standing groups. The tactical level is usually defined relatively to the operational or strategic level. Tactics are a short-term plan of action with specific goals executed to achieve objectives set by strategy.

In the military, the tactical level is the level of war at which battles and engagements are planned and executed to accomplish military objectives assigned to tactical units or task forces. Activities at this level focus on the ordered arrangement and maneuver of combat elements in relation to each other and to the enemy to achieve combat objectives. But this term is not reserved to the military, and the definition embraces a diverse set of examples, including sports teams, fire brigades, medical teams, etc.

As we will see in Chapter 4, some multi-organization systems, such as coalitions (Figure 9) and consortia (Figure 10), are also multi-team systems in that participating organizations are represented by teams that engage in a dynamic interaction.

2.3 Multi-organization systems

Organizations can be defined in very abstract terms, as 'a collection of roles, relationships, and authority structures which govern its behaviour' [16]. This MAS definition, however, does not take into account the interests of organizations. We would rather think of organizations as social entities with high-level goals, high-level interests, a governance system, and global strategies, looking for growth and expansion.

Multi-organization systems are organizational structures or arrangements that result from the partnership of two or more organizations. Known also as multi-party organizations or

trans-organizational systems, they can be conceived of as organizations of organizations.

The most prominent instance of a multi-organization system in the military is the coalition, which can also be viewed as a multi-team system, where each team is attached to a different organization from a different nation. The most recent examples of military coalitions are the two wars in Iraq.

Military alliances are still another form of multi-organization systems. Alliances often involve non-military agreements, in addition to their operational purpose, and contrary to coalitions, are not *ad hoc* arrangements initiated in the face of some emergent situation. The North Atlantic Treaty Organization (NATO) is the best known military alliance of our time, which has existed since 1941 and has been undergoing major transformations since the collapse of the Soviet Union. Other military alliances include the Warsaw Pact of the Soviet period and the Axis agreements of the Second World War. The most recent example of a military alliance intervention is the NATO-led action in Afghanistan.

Multi-team actions in military coalitions or alliances offer many of the same challenges as those found in joint operations. Differing organizational cultures, missions, disparate communications technologies, command and control issues, among others, create situations that do not arise when only one agency or force is involved. The fact that each team/organization belongs to a different nation is an aggravating factor in coalitions, which are *ad hoc* structures. Cultural differences complicate the collaborative processes between the different entities in a significant way. In alliances, the cultural heterogeneity is less problematic given that the partner organizations, as long term allies, interoperate on the basis of similar doctrines, procedures, and technologies.

Although they face many challenges [17], coalitions are the most common type of multi-organization system in general and in military organizations in particular. They can be rapidly set up and provide the partners with more power, more impact and influence, increased resources, and enhanced public profile.

In the following, we propose a theoretical model that shows how certain related features shape the dynamics of a multi-organization system and determine its cooperation potential and the effectiveness that can thus be achieved.

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3 Multi-organization systems: a theoretical framework

Defined as organizations of organizations, multi-organization systems are functional social systems that are formed from the partnership of two or more organizations. Although they meet the criteria for organizations, they have many particularities. Of note, they are able to make decisions and perform tasks on behalf of their member organizations, while the member organizations maintain their separate identities and goals [18].

Thomas G. Cummings and Christopher G. Worley [19] in *Organization Development and Change* describe the identical concept of trans-organizational systems as follows:

> In contrast to most organizations, [they] tend to be underorganized; relationships among organizations are loosely coupled; leadership and power are dispersed among autonomous organizations, rather than hierarchically centralized; and commitment and membership are tenuous as member organizations attempt to maintain their autonomy while jointly performing.

Our contention is that multi-organization systems are hybrid structures that must be situated somewhere in the middle of two extremes, which are no organization and one single integrated organization (Figure 2).

Figure 2: Multi-organization systems on the spectrum of organizations

This model accounts for the hybrid nature of multi-organization systems where several organizations try to perform like a single organization given their common objectives, but have to deal with the problem of decentralized control. Multi-organizations systems can 'emerge' from the no organization end, or be 'planned' by individual organizations trying to achieve common objectives. When the latter become too compelling, then the member organizations merge into one single organization, as in the case of unions. The spectrum in Figure 2 will be illustrated by the spectrum in Figure 14. Meanwhile different instances of multi-organization systems will be depicted.

3.1 Emergent and planned multi-organization systems

Multi-organization systems may be formed from the 'no organization' end, in which case they are emergent, or may rise from the 'single organization' end, in which case they are planned at a strategic level.

1. **Emergent** (unsupervised formation): As new objectives are sought and new interests come about, interpersonal (or informal inter-organization) interactions are harnessed, leading to the creation of new organizational structures. This is the process leading to the creation of networks, communities of interest, communities of practice [20] or other sketches of more formal and explicit structures. These emergent multi-organization systems are more defined by information/knowledge sharing than by task, roles and authority/command/control, or coordination structure. Individuals or groups within or across organizations discover commonalities and explore the benefits of networking.
2. **Planned** (supervised formation): In a competitive, challenging, and constrained world, existing organizations may want to increase their resources to achieve short or long-term objectives. This can bring them to collaborate with other organizations, as illustrated by coalitions and alliances. New organizational paradigms are then created to respond to new needs, to satisfy new constraints or to seize new opportunities.

Planned multi-organization systems are designed to be effective, that is achieve certain objectives together. To do so, they require from members a commitment to joint activity [21]. But, sometimes, this comes at the expense of a certain loss of freedom of action and sometimes of autonomy for the member organizations (they have to abide by the rules of the multi-organization system). These multi-organization systems try to behave as a whole, the entities of which are interdependent, at least in certain areas. Furthermore, because of the commitment of members to the partnership, planned multi-organization systems result in more stable systems, the size and behaviour of which remain predictable.

In emergent multi-organization systems, there is no commitment on the part of member organizations, which thus preserve autonomy. Emergent multi-organization systems do not have *performance* goals as such (*i.e.*, do not have to attain well-defined objectives) and in this sense, are less effective, but they allow members to benefit from their mutual contribution. Because of the lack of commitment and absence of common goals, the behaviour of such organizations is unpredictable.

The relationship between these two categories of multi-organization systems and important organizational properties is summarized in Figure 3.

Another important property that we later introduce is that of *efficiency*. In the final discussion, we analyze the set of multi-organization systems analyzed in the report, both in terms of effectiveness and efficiency. Effectiveness must be understood in relation to objectives only. A team is said to be effective if it achieves its goals [22]. The definition also applies to organizations. However, inter-organization cooperation, like any cooperation, implies costs and benefits and the costs must not exceed the benefits for the cooperation to last. Efficiency consists in achieving objectives at the lowest cost.

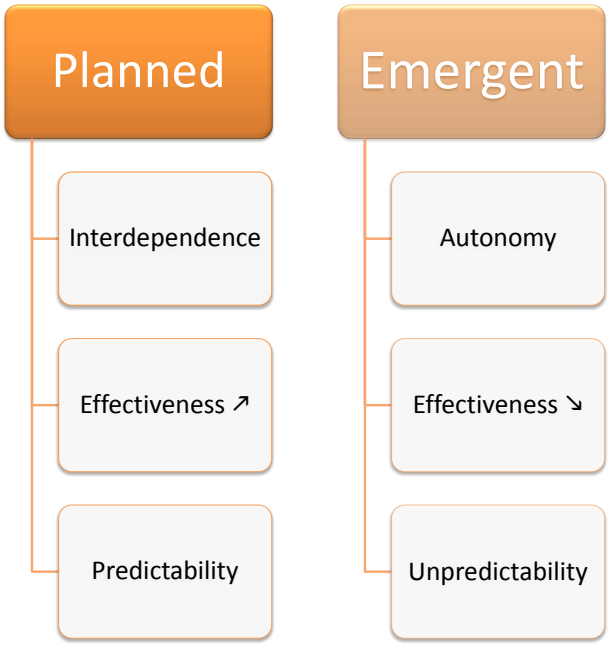

Figure 3: Properties of emergent and planned multi-organization systems

The properties of planned and emergent multi-organization systems will be elaborated in relation with a set of defining features in Section 3.2 and will become more evident when examined, in Chapter 4, across the spectrum of multi-organization systems.

Among the multi-organization systems to be described in this report, *networks* and *tacit agreements* are emergent, while all the others are planned. There are both advantages and risks/costs associated to the diverse forms of partnerships. These will be assessed as we characterize each multi-organization system in terms of our set of features.

3.2 Multi-organization systems defining features

This section presents the three defining features that were identified as the most important ones, along which organizations, and multi-organization systems, in particular, can be modelled. These features, each of which covers several dimensions, are:

– Purpose of Partnership (PP)
– Control and Cooperation Structure (CCS)
– Dynamics of Membership (DM)

A systematic use of this set of features allowed us to distinguish different types of multi-organization systems, but we do not claim that these features are either necessary or sufficient. In fact, the study of taxonomies of teams and groups has shown us that defining features are often determined by the context in which these entities are observed and the research interests of the observers. Our interest in command and control structures and cooperation have led us to consider features that are relevant for these topics.

3.2.1 Purpose of Partnership (PP)

Organizations can be predominantly characterized in terms of purpose. The purpose defines the *raison d'être* of the organization (or the multi-organization system); the reason for which it is designed (in the case of planned organizations) or the reason for which it is formed (in the case of emergent organizations).

In the specific case of multi-organization systems, the purpose refers to the *purpose of partnership*, which defines the set of high-level goals that motivate the deliberative creation of the multi-organization system, or the reasons that induce certain patterns of interaction, leading to the emergence of a multi-organization system. The purpose directly determines the other two features.

In the case of planned multi-organization systems, the purpose of a partnership can be motivated by the maximization of return on investment and/or the minimization of the cost of operations and/or the impact of operational constraints. As Horling and Lesser [16] formulate it (for coalitions), the motivation is that the value of cooperation may be "super-additive" along some dimension, and the costs "sub-additive". Organizations that engage in these partnerships either cannot satisfy a given goal alone or can satisfy it but at a higher cost than if they did it in collaboration with other organizations. Of course, for the collaboration to take place, the costs must not exceed the benefits.

As an example, Figure 4 shows the costs and benefits of coalition building.

With emergent multi-organization systems, goals are not explicitly established. Organizations come together, each for the satisfaction of its own goal. Although they are initially self-interested, in the course of their interaction, they discover commonalities, recognize potential, and possibly define joint goals. The organization can then move from a loose network to a tighter integration where a larger set of cooperative activities can be carried on.

The purpose, and the effectiveness expected from a given cooperation, shape and limit the number of acceptable forms of partnership. Conversely, having a given form of partnership will impose constraints on the performance goals that the multi-organization system can achieve. The level of effectiveness expected from tightly integrated multi-organization systems, will obviously exceed those expected from loosely defined ones. The statement applies to planned versus emergent multi-organization systems. Planned cooperation is always associated with more critical goals and higher performance requirements.

The lifespan of a partnership in the case of planned multi-organization systems is directly related to its purpose. High-level, loosely defined, strategic goals will generally give way to long-term/permanent arrangements, while short/mid-term arrangements will be associated with more concrete, operational goals.

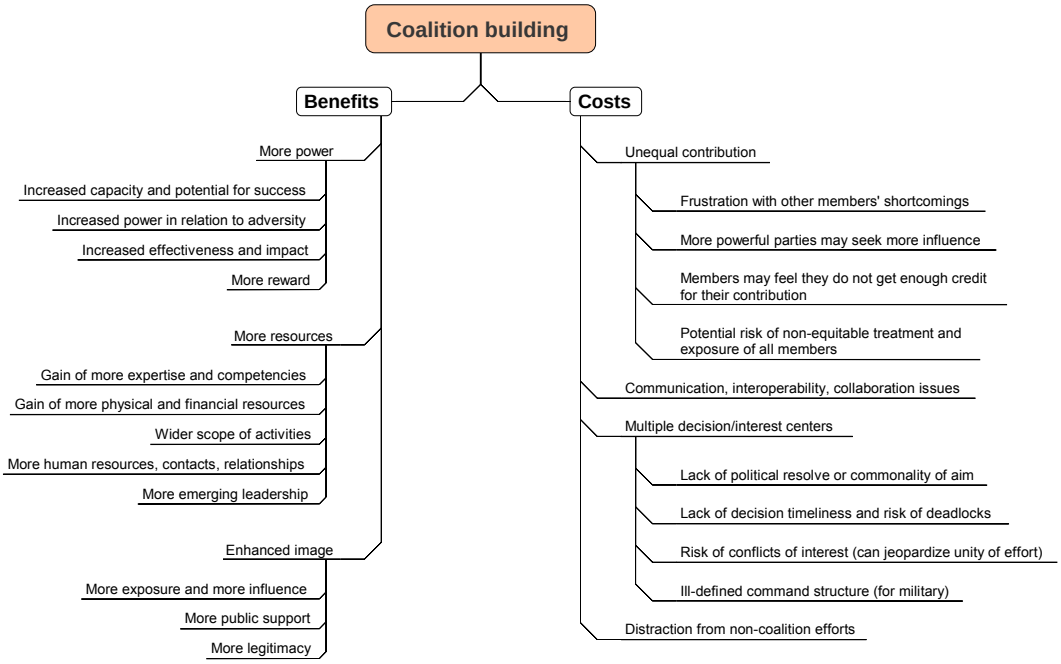

Figure 4: Costs and benefits of coalition building

3.2.2 Control & Cooperation Structure (CCS)

Control architectures aim at regulating control and coordination, and achieving global effectiveness for the overall system in a given situation. The control structure determines the performance of an organization to the extent that it defines its authority structure; it affects task and resource allocation [23]; it indirectly affects effectiveness by influencing cooperative processes; and it defines the external fit of the organization, that is, its adaptability to changing situations [24].

In single organizations, the spectrum of control architectures covers a wide range of possibilities, from hierarchical to holonic to federated to heterarchical/decentralized [25]. Movement in either direction on this spectrum, from centralized to decentralized architectures or vice versa, implies a trade-off between oversight and effectiveness, on the one hand, and local autonomy and operational flexibility, on the other [25].

In multi-organization systems, as we mentioned, there is also a trade-off between effectiveness and autonomy, however, given the multi-party context, the control structure is one that regulates cooperation among the different participating organizations. Moreover, effectiveness, in the context of multi-organization systems, is moderated by the costs of the

cooperative activities.

The CCS feature covers two dimensions, which are control structure and cooperative processes. The control structure defines the mechanisms used for managing the inter-organization cooperative processes.

3.2.2.1 Control Structure (C-Structure)

Control in multi-organization systems covers two tightly coupled aspects. One is relative to the mechanism used by organizations to conduct their common operations. In effect, organizations can create a separate entity for their new conjoint activities, or cooperate/interact directly. Thus, the multi-organization system may give way to an organization of its own right or be an overarching organization resulting from the direct interaction of partner organizations.

The other aspect concerns the oversight or the governance of multi-organization systems. Given that they involve several organizations, multi-organization systems preclude centralized control structures that presume a single chain of command. Multi-organization systems are constituted of autonomous and sovereign organizations that try to exploit a networked environment, and this entails the use of a decentralized architecture, where authority is shared among participating organizations. Thus, oversight can be defined in terms of intensity of control (no control, partial control, or full control) of partner (reporting) organizations.

These two aspects define the C-structure of the multi-organization system in combination:

When a new organizational entity is created to manage the inter-organizational cooperation, the participating organizations may delegate executive authority to that organization. Endowed with a certain autonomy as a new organization, the latter may have a centralized or hierarchical command, although it remains under the supervision of the reporting organizations. This can become problematic if reporting organizations retain too much control over their representative unit in the newly created organization, as is often the case with coalitions.

When organizations cooperate on a direct interaction basis, two cases are possible depending on the nature of the multi-organization system. When the latter is 'emergent', no one has any control on the multi-organization system, and when it is 'planned', organizations have only partial control over it. Shared authority in this case is carried out by means of an administration board, parallel command structure, or turn-taking governance.

3.2.2.2 Cooperative Processes

In the context of multi-organization systems, cooperation is always augmentative [26], that is, the organization engaging in a multi-organization system does so because it cannot do the task alone. This may be because of a lack of capacities, resources, legitimacy, etc.

The type of Cooperative Processes (C-Processes) in each multi-organization system depends on the purpose of partnership, that is the high-level goal (if any) that unites the participating organizations, and their level of commitment. At the inter-organizational level we are interested in here, cooperative processes boil down to: (i) information sharing; (ii) coordination of activities; and (iii) resource sharing. Interestingly, there is an implicit order between these processes.

Sharing information on a network requires less commitment from the participants than coordinating one's activities with other agents or organizations. Altering one's activities can in turn seem less critical than sharing resources. But, there is also a degree within each category that can supersede this *a priori* order. Information can be more or less critical and resources can be more or less vital. Secret or confidential information (intelligence) can be more valuable than weapon resources. Also, one can engage in coordination at different levels [27], which do not imply the same costs or require the same commitments. One can simply avoid negative interference with the other (avoid to do him any harm), coordinate one's own actions as to profit from a favorable circumstance, facilitate the actions of the other, change one's plans as to help the other achieve his goals, or plan one's actions with the other as to create synergy.

Figure 5 summarizes the dimensions covered by the feature control and cooperation structure.

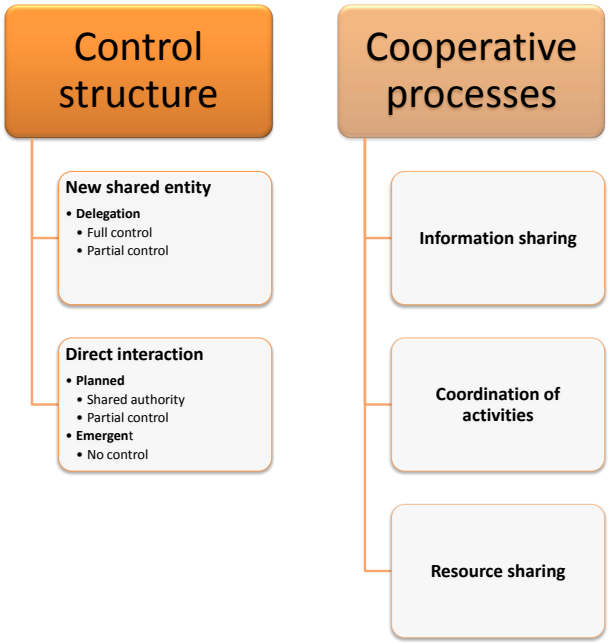

Figure 5: Control and cooperation structure

3.2.3 Dynamics of Membership

Dynamics of Membership (DM) includes the general size, the number of participants and the membership conditions. Membership conditions, expressed in terms of open/closed and

reversible/irreversible, are a measure of the commitment of the participants to the partnership. Open membership means that new members can be admitted, often conditionally in planned multi-organization systems. 'Open' is generally associated to 'reversible', meaning that members can leave the multi-organization system or revise their initial commitments. The general size refers to the elasticity of the multi-organization system, expressed in terms of variable or constant. The number of participating organizations is indicated by (+), (++) and (+++) for small, medium and large.

Figure 6 summarizes the dimensions covered by the feature dynamics of membership.

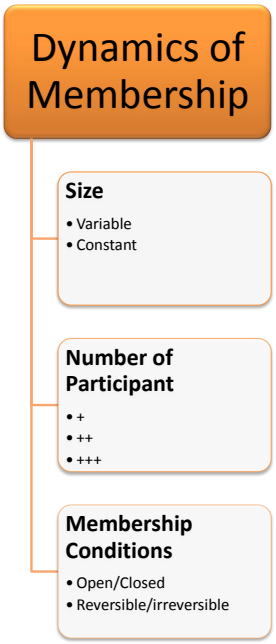

Figure 6: Dynamics of membership

4 Typology of multi-organization systems

In this section, we identify and represent the most common types of multi-organization systems and discuss their characteristics in terms of the features described in Section 3.2. The legend for reading the diagrams is as follows:

– rounded boxes for organizations (greyed when interacting through a shared entity)
– orange ellipses indicating the scope of shared goal
– full black arrows indicating full control of reporting organizations
– dotted black arrows indicating partial control of reporting organizations
– grey boxes for cooperative processes

Grey boxes are dotted when only one type of cooperative process holds. The latter include information sharing (IS), resource sharing (RS), or activity coordination (AC). Boxes are full grey when comprising the full spectrum (FS) of cooperative processes [1].

The last feature, dynamics of membership, is not represented in the diagrams of multi-organization systems except for the number of participants. The latter is indicated by the number of rounded boxes representing the member organizations. This number varies between four for small, six for medium and eight for large. The different dimensions of this feature are however elaborated for each multi-organization system in Table 1.

4.1 Network ($\mathcal{N}_W$)

A network (Figure 7) is an arrangement where several organizations, driven by a common interest, share information for the mutual benefit of all. This is an example of an emergent multi-organization system. Members interact directly and as long as the network serves their interests.

The purpose for a network can be seen as a means to expand one's knowledge while minimizing effort. The knowledge and experience shared through the network is used by each organization for its own individual goal. The participants do not pursue a common goal and therefore one cannot talk of cooperation, but only of its superordinate concept, collective activity, where, in Hoc's words [28], there is interference management (*i.e.*, management of the effects of the actions of other individuals/agents) in real time without necessarily a common goal playing a regulation role. Because of this lack of common goal, the lifespan of the multi-organization system is undefined.

There is no shared control over this type of multi-organization system. The participants have no commitment towards the organization or each other, and therefore preserve full autonomy. Membership is open and reversible. The lack of control and the type of cooperation (IS only) explain the large number of participants and the very variable size of networks.

1. The only dotted grey box can be seen in the *Network*, where the only form of interaction is information sharing. All other multi-organization systems, except in a Tacit Agreement where there is no explicit interaction, conduct the full spectrum of cooperative activities

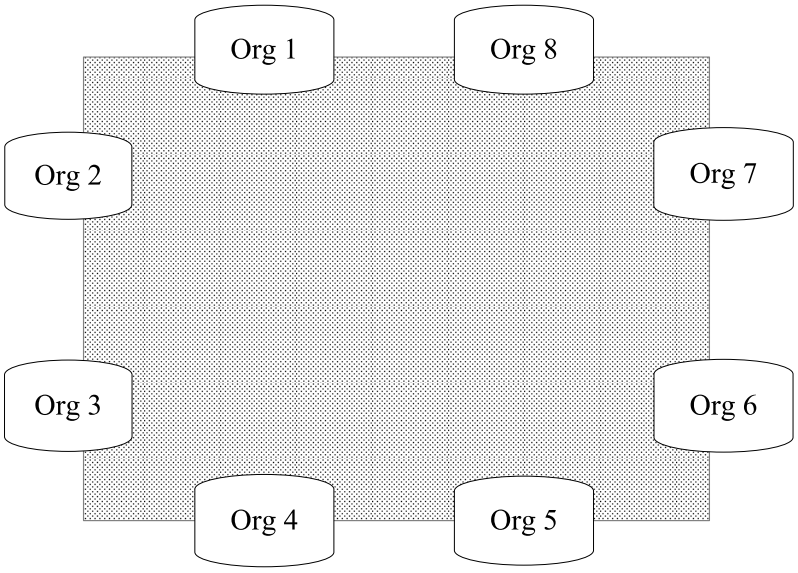

Figure 7: Network

4.2 Tacit Agreement ($\mathcal{T}_A$)

A tacit agreement (Figure 8) is an arrangement where the parties have a common goal and yet perform independent actions. In other words, in a $\mathcal{T}_A$, although the parties do not have a commitment to joint activity, they do have an implicit agreement on the achievement of a punctual goal. This is another instance of an emergent multi-organization system.

Nations, organizations, agencies or private corporations may cooperate in a rather informal manner. They may undertake various independent actions to favor certain shared goals with little or no actual coordination. We may consider the following examples to illustrate the concept:

1. Private corporations may wish to develop a new and emerging market for an innovative product. They may collaborate minimally to define technical standards for the product and will then compete among themselves to secure a share of the developing market. Each makes available a supply of the product and advertises and promotes its own wares, and these independent and competing actions contribute to the common goal of creating a new market.
2. In a parliamentary system, there may be a number of parties in the legislature. Parties in opposition may have very different political and social policy positions and yet share the goal of defeating the party in power. They may have no formal cooperation or coordination, but their cumulative actions and votes may be sufficient to defeat the governing party.
3. In the politico-military domain, nations may find themselves in the position of undertaking independent and uncoordinated military actions that contribute to a common

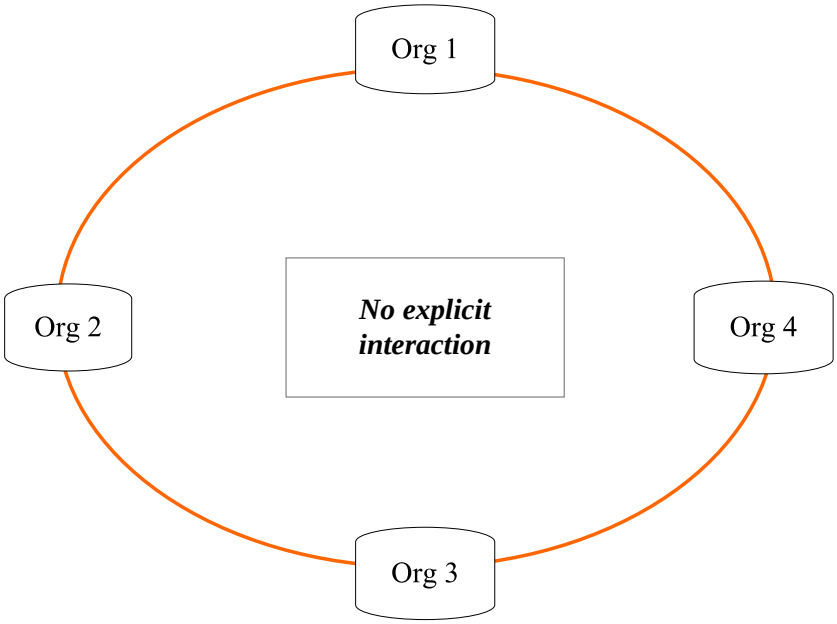

Figure 8: Tacit Agreement

goal although there is no formal understanding or coordination. This was the case at one point during the Second World War when Great Britain and the Soviet Union, who initially had no alliance or treaty between themselves, were both at war with the then fascist nations.

Joint purpose can be related to different dimensions. In the case of a $\mathcal{T}_A$, as Allwood et al. put it [29], one can say that there is mutual awareness of shared purpose, yet the different parties have not entered into an explicit agreement concerning working toward the purpose. In this context, joint reward, if any, would be the product of cumulative behaviours of independent actors and not the product of cooperative interaction in pursuit of common goals. In fact, at different stages, the parties may employ different types of coordination: unilateral (only x is coordinating her own activity with y's activity), bilateral (both are), or mutual (both are aware of their coordination intentions and try to arrive at some agreement) [27]. Mutual coordination would necessarily require some cooperative coordination.

This configuration can involve as many parties as interested. They would interact directly. All parties are self-interested and completely independent and there is no control on the multi-organization system. Membership conditions do not apply, and the whole arrangement is short-lived.

4.3 Coalition ($\mathcal{C}_L$)

A coalition is a temporary alliance or partnering of individuals, groups, organizations, or nations in order to achieve an explicit goal. Forming coalitions with other groups of similar

values, interests, and goals allows members to combine their resources and become more powerful than when they each acted alone [30]. In addition to increasing access to resources, a coalition results in an enhanced profile, presence, and 'leverage' [31]. Participating in a coalition provides an organization with increased capacity and impact, but also with more contacts and relationships, more exposure, more legitimacy, and more support from the outside. But sometimes, coalition building is only a matter of convenience, legitimating actions that cannot be taken unilaterally. Moreover, a coalition can adopt different goals as actions are taken and results are obtained.

Examples of coalitions may be drawn from different social contexts:

1. In a parliamentary system, smaller political parties may form a formal coalition, dividing power among themselves, in order to form a majority in the legislature. None of these parties, however, abandons the objective of eventually being the sole governing party through the electoral process.
2. In floods, forest fires and storms, various public safety and service organizations may be called upon to collaborate in ways that are foreign to their usual practices. Not only police and fire-fighting forces may be involved, but also military and para-military forces, public utility companies and private construction firms can be called upon to quickly agree to find ways to work together.
3. A military coalition is an ad hoc arrangement between two or more nations for common action. These partnerships can occur in both regional and worldwide patterns as nations seek opportunities to promote their mutual national interests or seek mutual security against real or perceived threats. Military coalitions have been frequent throughout history, with the most recent examples being the two wars in Iraq.

A coalition is a dynamic structure that can gain or lose members, and thus vary in size. Yet, the principal actors of a coalition are few and in some cases, the unity of the coalition is based on a mutual perception of membership rather than on a formal structure [32]. The coalition members cooperate in joint action, using the full spectrum of cooperative processes, each in their own self-interest. They have a shared goal or goals, but they retain whatever independence of action that they have in other areas. Within the coalition, the members will retain, to a great degree, their own culture, doctrines and ways of work, making the coalition a heterogeneous entity.

As shown in Figure 9, coalitions are the most complex form of multi-organization configuration, given that participating teams, yet under full control of their reporting organizations, are required to be inter-operable and achieve unity of effort as a single organization.

One of the important challenges of coalitions is their sovereignty issues. Coalition operations may be driven by common agreement among the participating partners or through a mandate provided by some external organization. Either way, the full-control feature remains an important factor because the interests and the influence of reporting organizations often compete with the efficiency of the coalition. Contrary to what is generally perceived, capabilities are not the only factor in assigning missions to participating teams. Equitable treatment and exposure of all members must be ensured. All members must

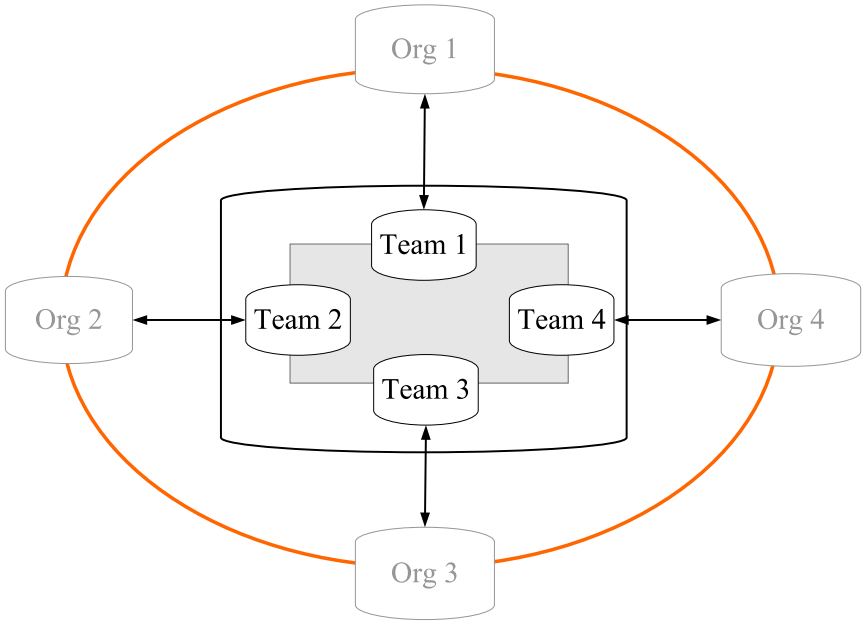

Figure 9: Coalition

have fair representation on planning and decision-making processes and all must perceive missions as appropriate, achievable, and equitable in terms of burden and risk sharing [33].

In military operations, any decision concerning the actions of a coalition requires the consultation of its participant members, and the leader has to accomplish the mission through coordination, communication, and consensus or leadership rather than by traditional command concepts [33]. Several command and control configurations are possible. One is that the nation providing the largest amount of forces for the operation is assigned the lead role, other nations providing appropriate liaison personnel. An alternative to the lead nation concept is the parallel command structure, under which no single coalition commander is named. The coalition leadership must develop a means for coordination among the participants to attain unity of effort. Finally, in a combined structure, two or more nations serve as controlling elements for a mix of international forces, such as the Gulf War coalition [33]. Ill-defined command structure in coalitions can negatively affect timeliness of decision making and decrease overall effectiveness.

The unequal contribution of the participants can also bring about some issues. While some members will be frustrated with the shortcoming of others, others may become irritated by the increasing influence of more powerful parties. The commitment of participants contributing to a coalition may be very different. One participant may see the joint activity as critical to its well being, while another will be represented only symbolically. Also members may change their position and leave the coalition at any time, which can create stability problems. The whole coalition dissolves when its purpose no longer exists or when the coalition ceases to suit its designed purpose [16].

4.4 Consortium ($\mathcal{C}_R$)

A consortium is an entity created by several organizations, usually for the purpose of increased access to resources [31]. Consortia are the business counterpart of coalitions, with which they share many features.

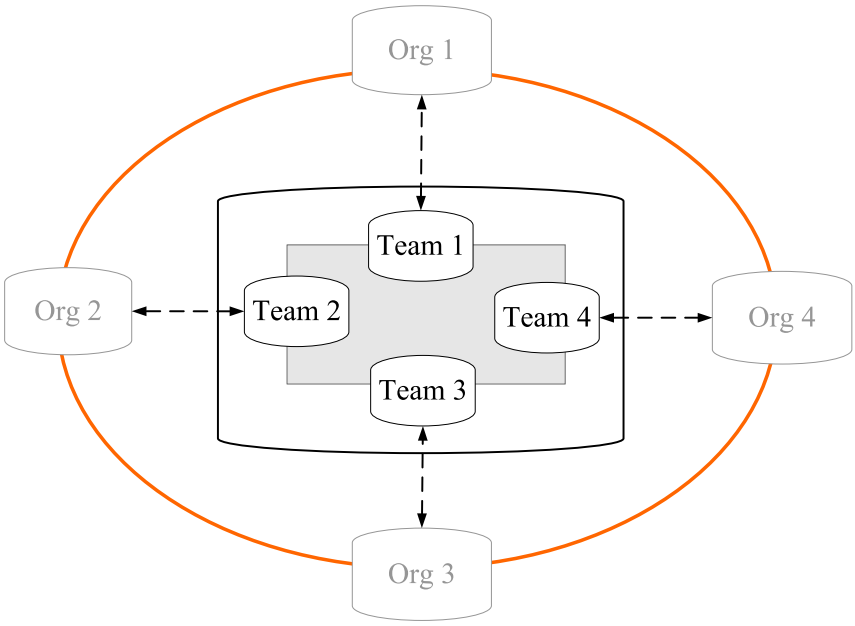

Figure 10: Consortium

Private corporations may form consortia to undertake commercial projects that are beyond the capacity of any single member of the grouping. This is often the case for large construction projects such as hydro-electric generation systems. The firms collaborate closely in the joint project, which defines the scope of their shared goal, but remain in competition in other fields. The heterogeneous character of consortia is less problematic than in coalitions because of the business-oriented nature of the partnership. For the same reason, the membership is more stable and the size is relatively constant. A consortium has an engagement with regard to a third party, who employs the consortium team on the basis of certain capacities or competence that must be preserved until the end of the project. Furthermore, contrary to coalitions, the teams are only partially controlled by their reporting organizations (Figure 10). All these factors contribute to the stability and efficiency of consortia.

4.5 Coordinating Unit ($\mathcal{C}_U$)

A coordinating unit is an arrangement where several organizations agree to have some of their activities coordinated by a separate but shared unit, in order to achieve a common mid-term goal (Figure 11).

For example, several countries have created ‘units’ or ‘centres’ to coordinate efforts related

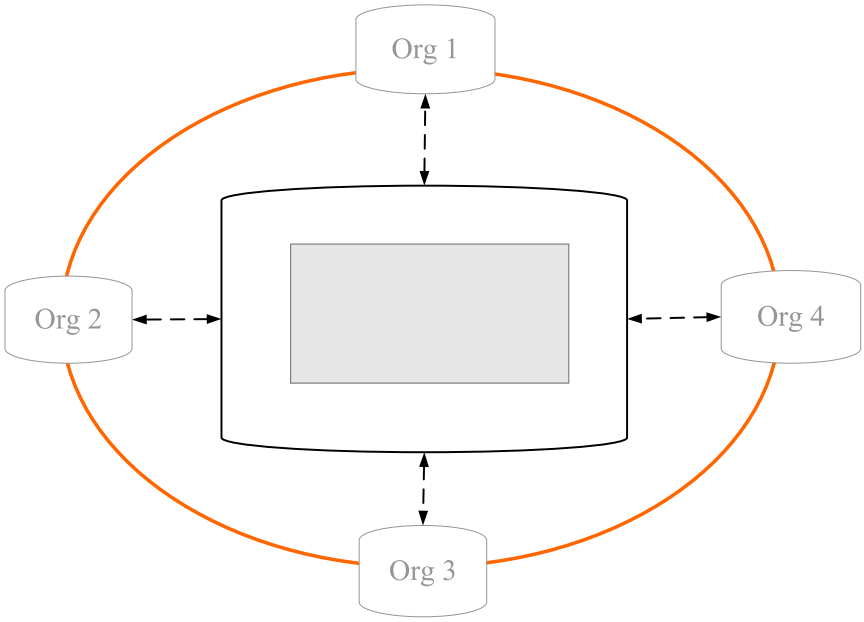

Figure 11: Coordinating Unit

to Essential National Health Research [31]. Other examples are:

1. In military operations, coordination centers are a means of enhancing stability and interaction and improving control within a coalition, especially when operating under a parallel command structure (*i.e.*, no single participant has the lead). The coordination center can be used for Command and Control, as well as the control of a variety of functional areas [33].
2. In business, firms will typically form a separate entity, a *joint venture*, that is partially owned by each of the original firms in some agreed proportion. Governance will be carried out through the establishment of a board of governors and through the assignment of key administrators. Capital will be found and profits divided according to detailed documents agreed to by the participants. Each participant will likely contribute with some significant, and perhaps unique, expertise such as technology, manufacturing or marketing ability. One example of such an alliance is NUMMI a joint venture of Toyota and General Motors. A second example is that of Ericsson and Sony who collaborate in the production of mobile phone handsets.

Aimed at creating synergy around a specific joint activity or product, a coordinating unit or a joint venture functions as a single organization with its own resources. However the resources and the activities are managed at a higher level. The multi-organization system is equally and partially controlled by the participating organizations. As a separate organization, the coordinating unit has its own governance system and enables the full spectrum of cooperative processes. Members are few and membership is closed and irreversible.

4.6 Alliance ($\mathcal{A}_L$)

An alliance is an arrangement where organizations with similar goals intentionally synchronize their activities, and sometimes actually share resources [31] (Figure 12). This is a formal arrangement among as many partners as possible, designed to address a long-term situation.

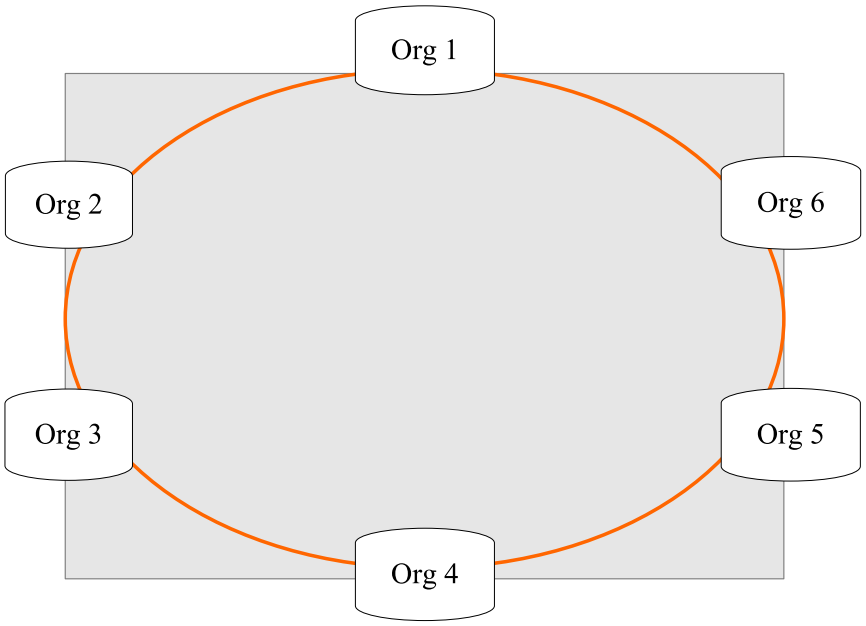

Figure 12: Alliance

Based on direct interaction, the degree of integration in alliances reflects the will of the member organizations. The multi-organization system as a whole is only partially controlled by each of the participants, who by engaging in the alliance accept some delegation of their freedom of action to the alliance. Membership in this multi-organization system is open and reversible, although strict conditions must be met.

A military alliance is a formal agreement between countries related to wartime planning, commitments, and contingencies. Examples of military alliances have been discussed in Section 2.3.

Military alliances often involve non-military agreements, in addition to their primary purpose. The long-term nature of military alliances requires profound political agreements concerning goals and principles and expressing a common view of the future state of world society. One needs only to reread the basic documents that created NATO - the Atlantic Charter of 1941 and the North Atlantic Treaty of 1949 - to see how far-reaching these agreements may be. It is the common vision that allows the subsequent accommodations in culture, doctrine and ways of work, making an alliance an effective organization. Of course, alliances may change as the world changes and it is always possible that the close collaboration of one era may not continue into the next.

4.7 Union ($\mathcal{U}_N$)

A union is the ultimate agreement of collaboration where two or more entities unite. A union is a closed, irreversible and permanent fusion of organizations (Figure 13). This involves the melding of cultures, objectives, doctrines and ways of work in a permanent manner and the establishment of a single means of governance.

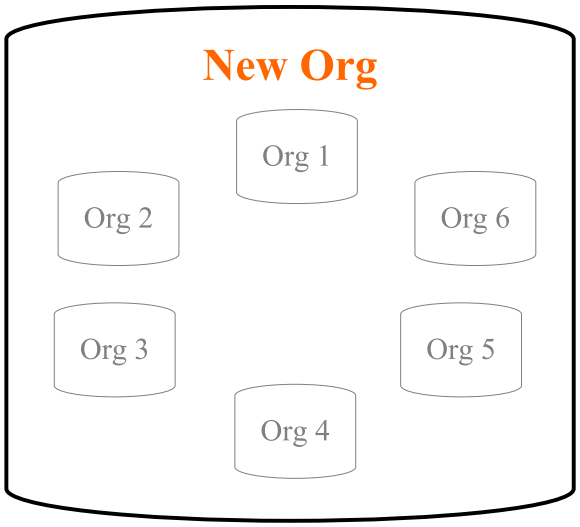

Figure 13: Union

Unions can be formed in different domains:

1. In the business world, mergers and acquisitions are the means of uniting separate firms. Mergers involve the willing union of firms on a more or less equal basis, while, in acquisitions, one firm purchases another in an agreed (friendly takeover) or contested (hostile) situation. A recent example of a merger is the union of the Molson and Coors breweries, while the union of Daimler-Benz and the Chrysler Corporation was essentially a friendly takeover.
2. In the political world, there are few recent examples of outright and complete political union, although the countries of the European Union have taken major steps to create a common political space.
3. A military union must necessarily be preceded by a political union. The formation of the Eurocorps in 1992 was the concrete implementation of a political will that was developed between France and Germany. Since that time, the Eurocorps has followed the evolution of the European Union and now comprises military contributions from Belgium, France, Germany, Luxembourg and Spain. Its headquarters are located in Strasbourg, France. It is not yet clear as to whether the Eurocorps will remain a military alliance or whether it will evolve into a military union.

While engaging in a coalition or an alliance might distract the members from their initial organizational goals, with a union, entire organizations become absorbed by the new common goal, and completely lose their autonomy. A union creates one single organization in which control structure and cooperative processes are no longer an issue.

Table 1 synthesizes the features of different types of multi-organization systems, allowing comparison.

Table 1: Multi-organization systems and features

	PP	**CCS**			**DM**	
		C-Structure		C-Processes	Size	Type
$\mathcal{N}_W$	Mutual benefit (No term)	Direct interaction	No control	IS	Very variable (+++)	Open & reversible
$\mathcal{T}_A$	Punctual goal	Direct interaction	No control	None/AC	Variable (++)	NA
$\mathcal{C}_L$	Short-term operational goal	Shared entity (heterogeneous)	Full control	FS	Variable (+)	Open & reversible
$\mathcal{C}_R$	Short-term operational goal	Shared entity (heterogeneous)	Partial control	FS	Relatively constant (+)	Open (conditional) & reversible
$\mathcal{C}_U$	Mid-term domain-specific goal	Shared entity (homogeneous)	Partial control	FS	Constant (+)	Closed & irreversible
$\mathcal{A}_L$	Long-term strategic goals	Direct interaction	Partial control (adminstration board)	FS	Relatively constant (++)	Open (conditional) & reversible
$\mathcal{U}_N$	Permanent merger	Fusion	NA (centralized)	FS	Constant (++)	Closed & irreversible

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5 Discussion

Situating the multi-organization systems characterized in Table 1 on a spectrum ranging from a network to a union, as in Figure 14, we can identify three zones:

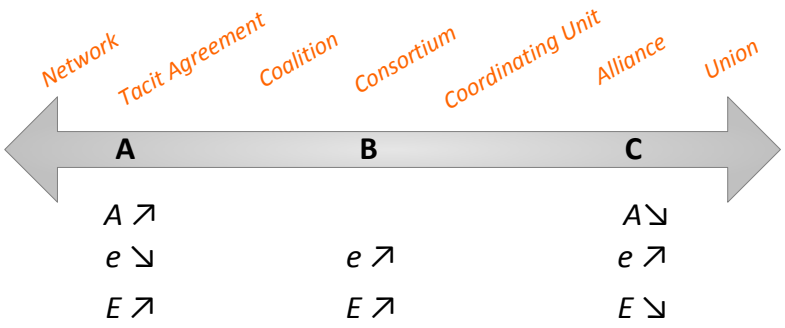

Figure 14: Autonomy (A), effectiveness (e) and efficiency (E) across the spectrum of multi-organization systems

– A covers the $\mathcal{N}_W/\mathcal{T}_A$ end,
– B: includes $\mathcal{C}_L$, $\mathcal{C}_R$, $\mathcal{C}_U$ and similar multi-organization systems, and
– C: covers the $\mathcal{A}_L/\mathcal{U}_N$ end.

When it comes to inter-organizational cooperation, two critical factors are the global effectiveness (e) of the multi-organization systems and the autonomy (A) of participating organizations. One could say that the C-zone provides greater effectiveness obtained from cooperation, at the expense of loss of autonomy of the member organizations, while the A-zone preserves autonomy, but offers limited effectiveness, given the reduced scope of the cooperative activities.

Both of these factors can be balanced out to evaluate the efficiency of an organization or a multi-organization system. While *effectiveness* (e) consists in meeting the objectives and doing the 'right things' to achieve an overall goal [34], *efficiency* (E) consists in achieving the objectives at the lowest possible cost, with a good 'input to output ratio'.

In the A-zone, organizations are not very effective, since they do not establish objectives for the multi-organization systems or the objectives are ill-defined. However, these multi-organization systems are efficient relatively speaking, because, the members' objectives, whatever they may be, are achieved at a very low cost. These multi-organization systems, especially network-type ones, have a large number of participants who, in the worst case, will have no contribution at all. But they cannot have a subadditive value for the organization as a whole. The under-performance of any one member does not affect the others. Moreover, when achieving the purpose becomes too costly, members can simply quit (open and reversible membership). The absence of clear objectives explains the absence of control structure for performance regulation.

In the C-zone, the multi-organization system is driven by clear objectives which have to be achieved unconditionally. These multi-organization systems are still effective, in the sense that they attain objectives by setting mid-term goals and ensuring an important control and cooperation structure. However, they are not efficient, given that a high price must be paid for the achievement of those objectives. One can think of the economic burden of the reunification of East and West Germany. Commitment to such multi-organization systems, puts the member organizations in the obligation of attaining the objectives 'at any price'. Membership is closed and irreversible or conditional (it is possible to seek new members to fill in the gaps) and the costs related to each member have to be assumed by all and compensated in one way or another, which can affect the overall efficiency of the multi-organization system.

Somewhere in the middle of the spectrum (B-zone), coalitions, consortia and coordinating units, allow for more efficiency by enabling partnerships that are not as constraining as alliances and unions, and at the same time, are structured enough to attain well-defined objectives. This is a space where a small number of partners decide to achieve a short-term operational goal by creating a new entity dedicated to their common activity. The new entity ensures effectiveness while controlling the costs.

Paradoxically, short-term goals ($\mathcal{C}_L$, $\mathcal{C}_R$) or goals which concern a particular domain of activity ($\mathcal{C}_U$) imply the creation of a shared separate entity. This is because short-term goals are associated to partnerships with a focus on outcome (*e.g.*, designing new products, launching new concepts, etc.). In this context, the creation of a new entity which would be entirely dedicated to this new activity is not only worthwhile, but necessary for harnessing the collaboration efforts towards the objectives. Multi-organization systems that rely on direct interaction are either lasting partnerships, which pursue long-term strategic goals, or emergent ones with very weak mutual commitment.

The relationship between the number of the participants and the intensity of cooperation is also an interesting one. The multi-organization systems at the two ends of the spectrum can have many members. At one end, partners have loose collective activities that require no commitment. Moreover, new membership does not entail any costs for the multi-organization system. At the other end, strategic cooperations, seek force in the numbers. New membership is sought to bring in new competencies and resources.

In the B-zone, the partners are carefully chosen so as to guarantee efficiency. This automatically restricts the number of participants. As a matter of fact, tight collaborations established in the pursuit of specific results put a limit on the number of participants and the lifespan of the partnership. Collaborations - result-oriented cooperations - take place between a small number of individuals/organizations who bring distinctive if not unique value to the creative process, and are over when the results are reached [35].

The intensity of the cooperation at a given time and the level of commitment of the participants do not have a direct relationship. Commitment is inversely related to autonomy: it increases from the A to the C-zone.

Finally, although we defined control in multi-organization systems in terms of the partial/full dichotomy and shared authority, there is also the issue of the power relationships between the partner organizations. More powerful parties can have more decision making authority and thus more global control over the mission of multi-organization systems.

The study of teams, organizations and multi-organization systems shows that cooperation is often grounded in an organizational context. Individuals rarely cooperate if they do not have performance goals, and expect cooperation to allow them to achieve those goals. Informal networks linked by information sharing or vague coordination disperse and dissolve at some point. Cooperation must be supported by an organizational framework that sets goals at different operational levels and measures the performances relatively to those goals. Organizations and multi-organization systems provide a 'structural objective basis' [27] for cooperation.

Defence relevance

This study concludes a series of research work conducted at DRDC Valcartier to identify different configurations of teams, multi-team systems and multi-organization systems and to analyze their impact on Command and Control mechanisms. More particularly, this set of work, carried out under the project 11bv, provided the authors with a better understanding of teamwork and cooperation in naval national/multinational force-level tactical operations.

The conceptual model presented herein allows the analysis of different organizational structures in the military, explaining their rationale and their potential. It also sets a theoretical framework in which organizational concepts such as integrated, agile, net-centric or edge organizations that form the new realm of military warfare can be explained.

A shorter version of this work was presented at the 7the edition of the COIN (Coordination, Organizations, Institutions, and Norms in Agent Systems) workshop to the AI community, where the authors presented a theoretical framework for the study of multi-organization systems.

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List of Acronyms and Symbology

AC	Activity Coordination
C-Structure	Control Structure
C-Processes	Cooperative Processes
CCS	Control and Cooperation structure
DM	Dynamics of Membership
FS	Full Spectrum (of cooperative processes)
IS	Information Sharing
MOS	Multi-Organization System
MTS	Multi-Team System
PP	Purpose of Partnership
(+)/(++)/(+++)	Small/medium/large number of participants
$\mathcal{A}_L$	Alliance
$\boldsymbol{A}$	Autonomy
$\mathcal{C}_L$	Coalition
$\mathcal{C}_R$	Consortium
$\mathcal{C}_U$	Coordinating Unit
$\boldsymbol{E}$	Efficiency
$\boldsymbol{e}$	Effectiveness
$\mathcal{N}_W$	Network
$\mathcal{T}_A$	Tacit Agreement
$\mathcal{U}_N$	Union

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Increasingly common in political, military, and business worlds, inter-organizational partnerships lead to the creation of hybrid structures which are controlled by several organizations. This document presents a typology of such multi-organization systems that emerge from the interaction of several organizations or are deliberately created by them. Multi-organization systems (and multi-team) systems offer a very interesting framework for the analysis of novel forms of cooperation implemented in response to new constraints or new opportunities. It is shown that these systems can be modelled using three features, which are purpose of partnership, control and cooperation structure, and dynamics of membership. The costs and advantages of different multi-organization systems are discussed individually, but also through their representation as a spectrum where movement in either direction implies a trade-off between autonomy and effectiveness. A middle zone is identified where lie the most efficient multi-organization systems.

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