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Coalitions

Organizational, Political, Command & Control Challenges

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Defence R&D Canada – Valcartier
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Abstract

Coalitions are becoming the standard in military operations, involving different organizations, services and agencies. This implies new and more complex types of interaction, the challenges of which must be situated along different dimensions. This report studies the characteristics of coalitions and discusses their political, organizational, socio-cultural, technological and Command & Control (C2) challenges. The costs and benefits of coalition building, the recent history of coalitions, the properties of military coalitions, and finally, issues faced by coalitions with regard to the transformational context and the advent of network-centric operations are investigated.

Résumé

Les coalitions deviennent la norme dans les opérations militaires, impliquant divers organisations, services et agences. Cela met en jeu des interactions d'un type nouveau et plus complexe dont les défis doivent être situés à différents niveaux. Ce rapport examine les caractéristiques des coalitions et discute leurs défis d'ordre politique, organisationnel, socio-culturel, technologique et de Commandement et Contrôle (C2). Les coûts et bénéfices liés à la formation des coalitions, leur histoire récente, les caractéristiques et les défis des coalitions militaires et, enfin, les obstacles rencontrés par les coalitions face au contexte transformationnel et l'avènement des opérations réseaucentriques sont étudiés.

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Executive summary

Coalitions

H. Irandoust, *A. Benaskeur*; DRDC Valcartier TM 2008 - 304; Defence R&D Canada – Valcartier; May 2009.

Increasingly, military operations are planned and conducted by coalition partners across different organizations, echelons, services, and other governmental and non-governmental agencies. This involves new interactions that make military operations much more complex than they were before. This report studies coalitions under different aspects and identifies the challenges that are inherent to this operation mode so that they can be accounted for when decision support is required.

First, the conditions under which coalitions are built are described, considering the costs and the benefits of such an enterprise. Properties of coalitions and the contexts in which they are formed are reviewed. The focus is then put on military coalitions and their general characteristics. A brief history of 20th century military coalitions is presented, followed by an assessment of their evolution with regard to advances in technology.

The Command & Control (C2) structure of coalitions is detailed, including decision making levels and command jurisdiction issues. Challenges to combined operations are discussed at length from political, organizational, C2, technological and social perspectives. The most important challenges remain the political commitment, unity of command, cultural heterogeneity and technical and organizational interoperability issues.

Finally, the principles of Network Centric Warfare (NCW) are exposed and compared with traditional military C2. Concepts such as *self-synchronization* are elucidated within the spectrum of military planning and control and explained with the theoretical concepts of information theory. The 'domains' and the collaborative mechanisms of Network-Centric Operations (NCO) are discussed and coalition-specific problems are identified within the NCO's conceptual framework.

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Sommaire

Coalitions

H. Irandoust, *A. Benaskeur* ; DRDC Valcartier TM 2008 - 304 ; Recherche et développement pour la défense Canada - Valcartier ; mai 2009.

Les opérations militaires sont de plus en plus planifiées et conduites par des partenaires de coalition au sein de différents organisations, échelons, services, et autres agences gouvernementales et non governementales. Cela implique des interactions nouvelles qui rendent les opérations militaires beaucoup plus complexes qu'elles ne l'étaient auparavant. Ce rapport étudie les coalitions sous différents aspects et identifie les défis inhérents à ce mode d'opération pour qu'ils soient pris en compte lorsqu'un support décisionnel est requis.

D'abord, les conditions dans lesquelles les coalitions sont formées sont décrites, considérant coûts et bénéfices d'une telle entreprise. Les propriétés des coalitions et les cadres dans lesquels elles sont formées sont passés en revue. L'accent est ensuite mis sur les coalitions militaires et leurs caractéristiques générales. Une brève histoire des coalitions militaires du 20ième siècle est présentée, suivie d'une évaluation de leur évolution compte tenu des avancées technologiques.

La structure de Commandement et Contrôle (C2) des coalitions est détaillée, incluant les niveaux décisionnels et la problématique de la juridiction de la commande. Les défis aux opérations multi-nationales sont ensuite longuement discutés d'un point de vue politique, organisationnel, technologique, social et de Commandement et Contrôle. Les défis les plus importants restent l'engagement politique, l'unité de commandement, l'hétérogénéité culturelle et les problèmes d'interopérabilité technique et organisationnelle.

Enfin, les principes de la guerre réseaucentrique sont exposés et comparés à ceux du C2 militaire traditionnel. Des concepts tels que l'*auto-synchronisation* sont situés à l'intérieur du spectre du contrôle et de la planification militaires et expliqués par les concepts théoriques de la théorie de l'information. Les domaines et les mécanismes coopératifs des opérations réseaucentriques sont discutés et les problèmes propres aux coalitions identifiés dans le cadre conceptuel des opérations réseaucentriques.

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Table of contents

List of figures

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List of tables

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1 Introduction

A military coalition is an ad hoc arrangement between two or more nations for common action. Coalition operations take place across the entire range of military operations from war to Operations Other Than War (OOTW). These partnerships can occur in both regional and worldwide patterns as nations seek opportunities to promote their mutual national interests or look for mutual security against real or perceived threats. Military coalitions have been formed since World War I, but recent changes in the nature, scale, scope and diversity of military operations have made coalition and joint operations the standard.

This report characterizes coalitions along different dimensions. Coalitions in general, and then military coalitions in particular, are studied as multi-organizational partnerships that have to accommodate political, socio-cultural, technological and Command & Control (C2) issues. These challenges are studied in the historical context of 20^{th} and 21^{st} centuries, illustrating the move from traditional C2 to future Net-Centric Warfare (NCW).

The report is organized as follows:

The conditions under which coalitions are built and the contexts in which they can be found are reviewed in Chapter 2. The costs and benefits of such ventures are evaluated. Chapter 3 puts the focus on military coalitions and their general characteristics, recounts a brief history of military coalitions in the 20^{th} century and provides an assessment of the effects of technology on their evolution. Coalitions with equal and unequal partners are distinguished and their functioning described. The C2 structure of coalitions is then detailed in Chapter 4, including decision making levels and command jurisdiction issues.

The challenges to multinational operations are discussed at length in Chapter 5 from political, organizational, C2, technological and social perspectives. In Chapter 6, we look at the principles of NCW and compare them with traditional military C2. Concepts such as *self-synchronization* are elucidated within the spectrum of military planning and control and explained with the theoretical concepts of information theory. Next, the 'domains' and the collaborative mechanisms of Network-Centric Operations (NCO) are discussed and coalition-specific problems are identified within NCO's conceptual framework.

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2 Coalition building

A coalition is a temporary alliance or partnering of groups in order to achieve a common purpose or to engage in a joint activity [1]. Most of the time, a coalition is an ad hoc arrangement formed in response to a problematic situation.

Coalition building is the process by which parties (individuals, organizations, or nations) come together to form a coalition. In this chapter, the characteristics of coalitions, the benefits and costs of coalition building, and the properties of coalitions as multi-organizational partnerships are discussed.

2.1 Benefits and costs of coalition building

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 [2]. But the benefits of coalition building go beyond increased power in relation to the opposition. In addition to increasing access to resources, a coalition results in an enhanced profile, presence and 'leverage' [3]. Coalition building may also strengthen the members internally, enabling them to be more effective in other arenas.

Some other key advantages to coalition building include [4]:

- A coalition of organizations can win on more fronts than a single organization working alone and increase the potential for success.
- A coalition can bring more expertise and resources to bear on complex issues, where the technical or personnel resources of any one organization would not be sufficient.
- A coalition can develop new leaders, in the sense that as experienced group leaders step forward to lead the coalition, openings are created for new leaders in the individual groups. The new, emerging leadership strengthens the groups and the coalition.
- A coalition will increase the impact of each organization's effort. One's involvement in a coalition means that there are more people who gain a better understanding of one's issues and that there are more people advocating for one's side.
- A coalition will increase available resources. Not only will physical and financial resources be increased, but each group will gain access to the contacts, connections, and relationships established by other groups.
- A coalition may raise its members' public profiles by broadening the range of groups involved in a conflict. The activities of a coalition are likely to receive more attention than those of any individual organization.
- A coalition can build a lasting base for change. Once groups unite, each group's vision of change broadens and it becomes more difficult for opposition groups to disregard the coalition's efforts as dismissible or as special interests.

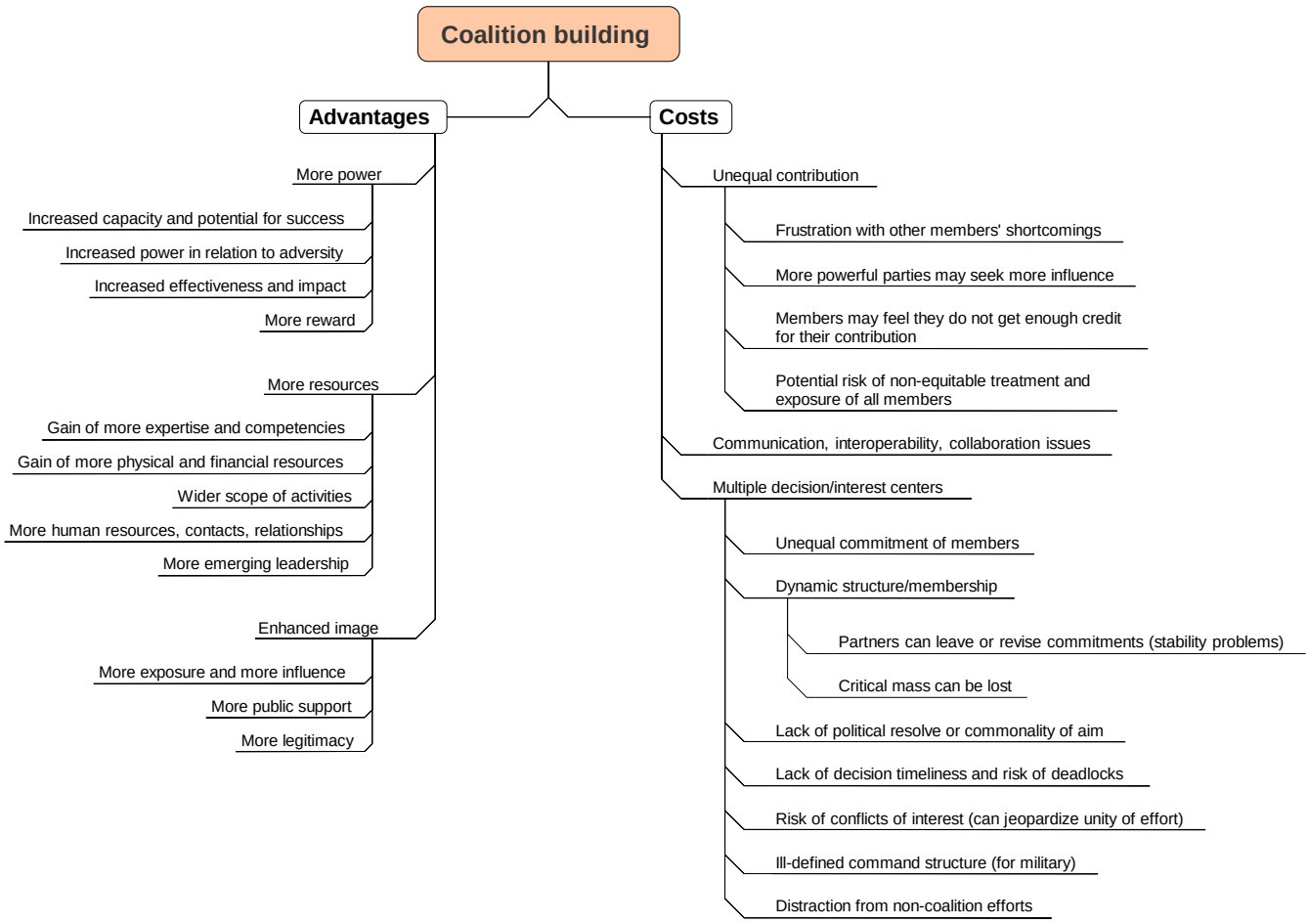

Figure 1: Advantages and limitations of coalitions

Building a coalition involves a series of steps, the first of which is the recognition of compatible interests. If acknowledging the benefits of a coalition must be done through persuasion, then one must demonstrate that:

1. The parties' goals are similar and compatible;
2. Working together will enhance both parties' abilities to reach their goals; and
3. The benefits of coalescing will be greater than the costs.

"The ability to build coalitions is a basic skill for those who wish to attain and maintain power and influence." [5]. If coalition building is successful, it may be able to dramatically change the power balance and help the coalition members successfully resist threats or make

effective counterthreats[1].

Generally, coalitions are built on the basis of past alliances. Coalition builders can bring their allies, who generally want to remain consistent with prior commitments, to join them in new endeavors. Failing to do so, it can be argued, would hurt their "long-standing alliance." This strategy is not always successful, especially if the self-interest of the other group seems to be harmed by the proposed action. France, for instance, was not willing to join the U.S. coalition against Iraq in 2003, despite a long-term alliance.

The disadvantages of coalition building are [4]:

- Coalition efforts can distract member groups from their other activities. If that happens, non-coalition efforts may become less effective and the organization may be weakened overall.
- A coalition may only be as strong as its weakest link. Each member organization will have different levels of resources and experience as well as different internal problems. It will not be possible to operate with other members at a level that they cannot afford.
- To keep a coalition together, it is often necessary to cater to one side more than another, especially when negotiating the modus operandi.
- The democratic principle of one member-one vote may not always be acceptable to members with a lot of power and resources. Organizations that provide a lot of resources and leadership may become frustrated with other members' shortcomings. The coalition must carefully define the relationships between powerful and less-powerful members.
- Individual organizations may not obtain credit for their contributions to a coalition. Members that contribute a lot may think they did not receive enough credit.

When formed, the unity of a coalition remains ill-defined. A coalition is based on a mutual perception of membership rather than on a formal structure [6]. The coalition can gain or lose members or adopt different goals as actions are taken and results are obtained.

Figure 1 summarizes the advantages and costs of coalition building.

2.2 Coalitions of agents

The phenomenon of coalition building is also studied in the context of multi-agent systems (MAS). The notion of a *coalition of individuals*, studied by the game theory community, has proved to be a useful strategy in both real-world economic scenarios and MAS where artificial agents interact together in order to cooperate, compete, or more simply coexist.

Contrary to real-world coalitions, any subset of a population of artificial agents can form a coalition. Features of coalitions of agents are [7]:

[1] Unfortunately, coalition building can also help parties initiate threats or pursue illegitimate goals [2].

- Coalitions in general are goal-directed and short-lived. They are formed with a purpose in mind and dissolve when that purpose no longer exists;
- They may be formed in populations of both cooperative and self-interested agents;
- Membership in a coalition is dynamic. Also, the coalition ceases to suit its designed purpose, or critical mass is lost as agents depart.
- Once formed, coalitions may be treated as a single atomic entity;
- Coalitions have no explicit hierarchical characteristic. Within a coalition, the organizational structure is typically flat, although there may be a distinguished 'leading agent', which acts as a representative and intermediary for the group as a whole;
- The agents in this group are expected to coordinate their activities in a manner appropriate to the coalition's purpose.

These coalitions, as one can observe, present only some of the features of real-world coalitions. The latter cannot be considered as atomic entities and even less as a flat organization. The question of power, and of command in the military domain, are of outmost importance in human coalitions.

However, the same motivation underlies both types of coalitions, that is, the notion that the value of at least some of the participants may be super-additive along some dimension and analogously, participants' costs may be sub-additive [7]. Work in multi-agent organizations underscores the principle of 'safety in numbers', which is at work in coalitions. For instance, in an economic domain, a larger group of agents might have increased bargaining strength or other monetary reward [8]. In computational domains, we might expect more efficient task allocation, or the ability to achieve goals with requirements greater than any single agent can meet [9]. In physically limited systems, coalitions have been used to trade off the scope of agent interactions with the effectiveness of the system as a whole [10].

However, as Horling and Lesser [7] argue, uniting all agents in an all-inclusive grand coalition, which would have the resources of all available agents at its disposal and would theoretically provide the maximum value, is not always a good idea, precisely because of the costs associated with forming and maintaining such a structure. As they note,

> "Therefore, the problem of coalition formation becomes one of selecting the appropriate set(s) which maximizes the utility (value minus costs) that coalition can achieve in the environment. The value and cost of the coalition are generic terms, which may in fact be functions of other domain-dependent and independent characteristics of the structure."

2.3 Coalitions as multi-organizational partnerships

A coalition may be a partnership of individuals or an agreement among nations, organizations, agencies or private corporations. The latter cooperate in a coalition in joint action,

each in its own self-interest. The coalition members have a shared goal or goals, but they retain whatever independence of action that they have in other areas. As mentioned before, a coalition may be temporary, or a matter of convenience.

In a coalition, the partners will retain, to a great degree, their own culture, doctrines and working procedures. Moreover, given that a coalition is oriented towards external goals, any decision concerning its actions will require the consultation of its participant members [6].

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. Military coalitions have been frequent throughout history, with the most recent examples being the two wars in Iraq. Various nations participated in one or both of these conflicts. The various United Nations peacekeeping forces (Egypt-Israel, Cyprus, Serbia-Croatia-Kosovo) provide other examples.

Coalitions are the most complex form of multi-organizational configuration, compared to alliances, unions, consortia or other structures, given that participating units, yet under full control of their home organizations, are required to be interoperable and therefore achieve an advanced level of information and resource sharing and activity coordination.

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3 Military coalitions

Recent changes in the nature, scale, scope and diversity of military operations have made coalitions and joint operations the standard. A military coalition is an ad hoc arrangement between two or more nations for common action [11]. Generally formed on short notice, its structure is dynamic with partners joining, leaving or revising their commitments regarding the initial arrangement. Command & Control (C2) arrangements can also evolve, which makes the complexity of this venture much greater than other multinational military operations.

Some military leaders have been wary of coalitions and have sought to avoid them, or have noted their inconveniences. Napoleon supposedly said that he would prefer to fight against an alliance than to belong to one. Churchill is quoted as saying that of all the crosses that he had to bear, the heaviest was the Cross of Lorraine. De Gaulle is said to have remarked, "Dans toute association de deux hommes, il y en a toujours un qui se fait porter par l'autre.[2]"

Throughout history, many military coalitions have been formed and each one is different, each is influenced by the political and military contingencies of its day and each has its own set of advantages and disadvantages. As Riscassi [12] writes: "There is no cookbook approach to coalition warfare. Every coalition will be different in purpose, character, composition, and scope".

3.1 Characteristics of military coalitions

A coalition is an ad hoc arrangement between two or more nations for common action. Coalition operations cross the entire range of military operations from war to Operations Other Than War (OOTW). 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. In the first case, one of the reasons for which nations conduct coalition operations is that single nations often do not have the capacity or the political legitimacy to do it unilaterally. Moreover, sometimes unique core competencies are needed on the part of non-military organizations, Non-Governmental Organizations (NGOs), and private voluntary organizations.

As a subset of multinational operations, coalitions are conducted by forces of two or more nations, which may not be allies, acting together for the accomplishment of a single mission. Coalition actions are outside the bounds of established alliances, usually for a single occasion, or for longer cooperation in a narrow sector of common interest. Coalitions, which are created for limited purposes and for a limited length of time, do not offer military planners the same political resolve and commonality of aim as alliances. Thus, planners must closely study the political goals of each participant as a precursor to detailed planning [13].

[2] In all association of two men, there is always one who is a burden for the other.

Military coalitions are subject to pressures and constraints that are not present, for example, in a consortium of private corporations. Military coalitions are, in the end, dependent on the strength of the political commitment that necessarily subtends them. Their effectiveness is affected by practical constraints on joint operations of military contingents from several sovereign countries.

3.2 History of military coalitions

In this section, we examine four coalitions that emerged in the 20th century and whose characteristics are of interest to this study. They illustrate the motivations of the participating nations, the extent of their cooperation and the balance of power within the coalitions. These can be divided into two groups: coalitions having equal partners and coalitions having unequal partners.

3.2.1 Coalitions having equal partners

No coalition or alliance is ever precisely equal, but there have been examples where the partners had about the same status.

3.2.1.1 World War I

In World War I, the Great War, France and Britain belonged to the Triple Entente, the third partner being Russia. This coalition, signed in 1907, took on some of the characteristics of an alliance towards the end of its life, but was a true coalition even through most of the war years. The partners had differing world views and objectives, but agreed that the ever-increasing military power of imperial Germany was a threat to them. Britain sought to maintain its naval dominance and to protect, even expand, its colonies, France wished to recover the territories lost in the war of 1870 and to counter German influence in Europe, while Russia feared a possible eastward expansion of the German empire. Much has been written on the origins of the Great War but we are most interested in features of the operation of the military coalition on the ground during the actual conflict.

Given the geographical separation of Russia from its partners and the limited communications technologies of the day, the Tsarist empire operated more or less independently from France and Britain, and we are less interested in its influence and behavior. However, even these latter countries, who took the field side by side, did not have anything like a unified military command until the war was almost over. Several features of their collaboration are of interest to us.

The armies committed by France and Britain to the Western Front were initially unequal, and the balance fluctuated as the war progressed. As a continental power, France had a larger army than did its island neighbor. Britain, however, had influence derived from the powerful navy that it had developed to maintain and protect its colonies. On a political

level, the two countries treated each other as equal. The equipment of the two armies was of similar nature. Infantry soldiers were equipped with repeating rifles and light machine guns. Field and heavy artillery had been extensively developed during the previous decades and, while the French led the way in developing rapid firing field guns (les soixante-quinze) both countries were about on a par by 1914. Both relied on horse cavalry for rapid manoeuvres until the tank took the field in 1918 and neither was able to put cavalry into the field against contemporary artillery. Both used a mixture of horse and motor transport to supply the front line troops. While there may have been differences in military doctrine between the two countries in 1914, the realities of the trench warfare that quickly developed led to a convergence in tactics and methods.

However, the two countries did not seek to integrate their forces, but rather to coordinate their actions. This proved difficult, as"the Allied cause lacked unity of effort and boasted little integration" [14]. A second historian [15] chronicles the difficult personal and professional relationships between the British and French commanders for much of the war. He also discusses the tensions caused by a British tendency to divert forces and effort to the middle eastern theater (Dardanelles, Egypt, Arabia, Serbia) while the French focussed on liberating their occupied territory and defeating Germany on the western front.

Note that it was only in 1918, about six months before the end of the war, that an overall military commander was appointed. In April 1918 the Beauvais Agreement entrusted strategic direction of military operations to French Marshal Ferdinand Foch [14], but even at this late date he was not given absolute command authority. Until the end, joint action was heavily dependent upon the political will of civilian and military leaders. Political and strategic direction was always controlled by the two civilian governments and there were a number of conflicts as to war policy and strategy, but from beginning to end, France and Britain remained equal partners in the military actions of the Great War. Neither commanded nor controlled the other.

Interestingly, this was not the case of the Triple Alliance that linked imperial Germany, imperial Austria and Turkey. Turkey participated fully in the war effort and at times accepted German command of its forces, apparently to take advantage of the German officers' knowledge of the tactics and practices of the attacking British armies. In the battle of Gallipoli, for example, many of the senior commanders of the Turkish army were in fact German [14].

3.2.1.2 World War II

In World War II, from 1943 to 1945, the British and United States forces functioned as equal coalition partners. The United States entered the war at the end of 1941 but it was not until 1943 that American air power was present in strength in the European theater. At this time, there was also a build-up of U.S. ground forces in preparation for the invasion of continental Europe, which eventually took place in 1944. While the American forces would become more numerous than the British and while U.S. industrial power made that country the most powerful coalition partner, the British retained virtually equal status with the U.S until the end of the war.

Unlike the case of the Great War, the powers agreed on a unified command under the American general Eisenhower, with the British general Montgomery commanding land forces under him. Command of air and sea forces was shared between the two major powers. The retention of equal status by Britain was based on a number of factors. The British had the most charismatic war leader in the person of Churchill, who maintained a close personal relationship with the U.S. president Roosevelt. In 1943, the British also had more experienced troops, staff and field commanders than did the Americans and thus were able to contribute substantially in planning future operations. Finally, the British Isles were the home base for all operations and the jumping off point for the invasion of the continent.

The unified allied command allowed a greater degree of integration of the U.S. and British forces in operations than was the case for the Anglo-French coalition in the Great War. Air operations, in particular, were coordinated in terms of the targets to be attacked and forces to be assigned to them. A number of U.S. pilots had served in the RCAF and the RAF before the U.S. entered the war and this smoothed relations between the coalition partners. While there were transatlantic jokes about "two nations separated by a common language", the fact that the two major coalition partners were English-speaking certainly lowered cultural barriers.

Silkett [14] points out the extent to which the spirit of collaboration was developed during World War II. He states:

> The American Fifth Army in Italy represents the best American, and probably the best Allied, coalition experience of the war. Non-US components composed almost half its manpower. Though not all assigned at the same time, Fifth Army fielded three US corps (11 divisions), two British and one Commonwealth corps (six British, one New Zealand, one South African, and three Indian divisions), a French corps (one French, one Algerian, and two Moroccan divisions), two Italian combat groups, and a Brazilian division. Difficulties - logistics, language, and doctrine among them - were substantial, to be sure, but not insurmountable.

The minor coalition partners fitted in around the arrangements made by the two great powers. Commonwealth countries, such as Canada, Australia, New Zealand and South Africa generally collaborated within the British military structure with which they were familiar. Polish forces, composed of both military and civilians who had escaped the German invasion of 1940, were trained and equipped by the British and essentially fought under British command. An exception was the Canadian presence in Normandy where Canadian forces had their own landing beach and area of operations.

The case of the Free French forces is interesting. De Gaulle had the support of the British but the Americans disliked him and at times tried to replace him with other senior French officers, a few of whom had been part of the Vichy regime that held power in Algeria for a time. Surprisingly, the Free French were not given a role in the initial invasion of Normandy. Nevertheless, de Gaulle had the support of most of the French resistance

forces, both political and military, and succeeded in securing power in liberated France. French military forces, equipped with American weapons and transport, fought through the European campaign into Germany until the end of the war.

Soviet Russia was most certainly a full partner in the anti-fascist coalition from 1942 until the end of the war, but its relationship with its partners was not particularly close. It did not need western manpower on its front, but, for a period, it requested and obtained arms, aircraft and food from the western powers. It was geographically separated from its partners and did not share their battlespace with Germany. It developed and maintained its own strategy and tactics, and produced its own weapons for the most part.

At the beginning of hostilities in 1939, Britain, France and the United States had armies that were equipped and trained somewhat differently. They had the shared experience of collaborating in the Great War but had not been called upon to operate jointly since 1918. By 1943, however, British war experience and American industrial power combined to unify the coalition forces. American tanks, for example, were widely used by the British, Canadians and Free French. The French and Polish, having lost almost all armament in 1940, had been equipped with U.S. materiel. Communications equipment was similar, when not identical. The coalition forces that took the field in 1943-45 had similar arms, similar training and collaborated under a unified command. The U.S. and Britain dominated the western powers as equal coalition partners, while the French, Canadians, Polish and commonwealth countries fitted in as the situation allowed.

The opposing Axis powers presented a contrasting type of coalition. The German leaders had little confidence in their Italian partners and simply replaced them in the field in both North Africa and Italy. Minor Axis powers (Romania, Bulgaria, Hungary, Czechoslovakia, Finland) weighed little in the balance outside their home territories. Some of these forces were used on the Eastern front and were closely supervised by German officers and forces. The Germans also recruited volunteers in all occupied and allied countries, including France and Russia, and formed them into fighting units under senior German officers. These units, a sort of "foreign legion", were given the feared and hated SchutzStaffel (SS) designation. The centralized and suspicious German leadership of the time appears to have attempted to largely avoid the political obligations of a voluntary coalition.

3.2.2 Coalitions having unequal partners

The Korean and the Vietnam wars exemplify coalitions with unequal partners in the XXth century. More recently, the *Coalition of the Willing* led by the United States in Iraq is the best example of such configuration.

3.2.2.1 Korean war

The Korean war represents a case of an unequal coalition of partners of unequal strength as well as a case where the political basis of the coalition was very different from that observed in the two world wars.

Two Korean states came into being at the end of the 1939-1945 war. The northern state was constituted on the Soviet model while the southern state had a republican government on the western pattern. The war started when North Korean forces invaded the territory of South Korea in June of 1950. The matter was immediately raised in the United Nations (UN) Security Council. The Soviet delegates made the strategic mistake of walking out of the debate in protest, and a motion was soon passed creating a UN force to repel the North Korean attack. The Soviet delegate was not present to veto the motion. The United States took the military lead, but a number of forces joined the coalition, mainly as a result of the fact that it was sanctioned by the United Nations.

Millett [16] offers the following information:

> Nineteen nations offered to send ground combat units [in addition to US and South Korean forces] but four proposed contributions were too little, too late. Three infantry divisions offered by the Chinese Nationalist government fell in another category: too large, too controversial. The largest non-U.S. contribution was the Commonwealth Division, organized in 1951 from British army battalions and similar units from Canada, Australia, and New Zealand. The smallest were companies from Luxembourg and Cuba. The ground forces included a Canadian brigade, Turkish brigade, New Zealand artillery regiment, and reinforced battalions from France, Thailand, Ethiopia, Belgium, Australia, Colombia, and the Netherlands. [...] Eight navies and four air arms deployed combat elements while eight nations sent air and sea transport. Six nations sent medical units, five of which (Denmark, India, Italy, Norway, and Sweden) provided only medical assistance.

The US was clearly the dominant partner in the coalition. It provided the majority of the first line troops and most of the air force and naval forces engaged. Its logistics chain supplied the forces in the field and equipped the forces of some of the smaller nations. Commonwealth forces were able to work together because they shared the British model of staff planning and, at that time, were similarly equipped and trained. Many of the UN coalition forces had collaborated as partners in the Second World War coalition and this also assisted in establishing patterns of collaboration.

A distinctive feature of this was the fact that the coalition was UN-sanctioned. This gave a clear political basis to the joint forces that was not present in the Anglo-French coalition of the Great War and which took until 1943 to develop in the Second World War. Initially, General Douglas MacArthur was appointed as commander of the US forces by then President Truman, and commander of all UN forces by the authorities of that organization. The coalition forces thus quickly attained a unity of command not reached by the Anglo-French forces of WW I and attained only in the last two years of WW II. When MacArthur was replaced by General Matthew Ridgeway after a serious disagreement on war strategy with the US president, Ridgeway also assumed the UN command.

3.2.2.2 Vietnam war

One must examine the Vietnam war in the context of a study of military coalitions, even if it is only to say that no real coalition existed in this conflict. Slantchev [17] offers a brief description of U.S. involvement in Vietnam. When the French colonial regime suffered a major defeat at Dien Bien Phu in 1954, Britain and the U.S.A. refused to join a coalition with France, which had requested, in particular, strong air support. While the U.S. had supported the French effort financially before this time, they were unable to muster domestic or British support for closer collaboration. As events transpired, however, the U.S., to all intents and purposes, eventually assumed the colonial role that the French were forced to abandon, and waged war against the communist forces in Vietnam. During this war, the U.S. trained and equipped the South Vietnamese forces and had de facto command of their involvement in the war. While several countries sent troops to Vietnam, in particular Australia and the Republic of Korea, few foreign forces, other than American, were involved in the conflict.

Table 2 covers four major conflicts of the 20th century and summarizes the characterization of coalitions existing in these wars under four headings: the coalition partners, the political bases (a characteristic of commitment), unity of command (a characteristic of leadership), and technology.

3.3 Effects of technology on military coalitions

Weapons and communications technologies affect the ease with which military coalitions may be formed and the effectiveness with which they may operate. In the Franco-British and Anglo-American coalitions of the two world wars of the twentieth century, the coalition partners had a level of technology that was similar. This level of comparability extended through the Korean war, at least as far as the major coalition partners are concerned. In the context of the NATO alliance during much of the cold war this tendency was reinforced through efforts to standardize equipment.

Let us examine the case of World War II. As military operations progressed, there were many cases of joint use of weapons produced by one of the partners. Some American units flew the British Spitfire fighter aircraft, some British units were equipped with U.S. Mustang aircraft, both fighters had versions of the British Merlin aero engine, and most coalition partners used the Sherman tank. Other weapons were of comparable reach and power. For example, B-17, B-24 and Lancaster bombers had similar ranges and capabilities. The U.S. and British naval forces had comparable ships. Communications technologies were similar, and both partners relied on voice transmissions over radio frequencies, wireless telegraphy, field telephones as well as on hand carried messages. Radar capabilities were similar, at least during the 1943-45 period when most of the joint coalition operations occurred.

The similarity of weapons and communications technologies meant that comparable units of each partner had similar combat capabilities and, for example, Canadian, British and U.S. infantry divisions might be expected to take on much the same tasks. Such units would have similar logistic needs and similar, if not identical, operating principles and doctrines.

Table 1: Past military coalitions

	Main coalition partners	Political basis	Unity of command	Weapons and Communications Technology
World War I	France, Britain (Equal partners)	Pre-war treaties, civilian government talks and relationships, sometimes divergent political objectives.	Weak, examples of conflicts among commanders, geographic separation of partners' forces, liaison officers maintain links at the junction of forces.	Technologies not identical but comparable, each partner has extensive knowledge of the other's capabilities.
World War II, 1943-45	Britain, USA (Equal partners)	Wartime treaties, relations between leaders, common objectives.	Strong unity in 43-45 period, commanders have political support of both partners, air and naval forces are well integrated.	Partners have comparable technologies, US industrial dominance leads to wide use of American technology
Korean War	USA, Korea, Commonwealth (Unequal partners)	United Nations backing, WW II habits and channels of collaboration, common objectives.	Strong unity of command, US commander also has UN mandate.	Partners have comparable technologies, wide use of U.S. technology due to its industrial dominance
Vietnam War	USA, South Vietnam (Dominant partner)	Ad hoc treaties and agreements, strong US material and financial aid.	All forces under de facto US command.	US dominance of weapons and communications technology.

In turn, a senior commander could more easily appreciate the needs of commanders of the coalition partners and anticipate their reactions to various situations. Indeed, it has been said in jest that the U.S. Navy of the day could collaborate more easily with the Royal Navy than with the U.S. Army.

By the time of the first Gulf War, this situation had changed. Quite simply, U.S. military technology had advanced far beyond that of its potential coalition partners because of the massive investments made by successive American governments. Improvements included those in night-vision, weapons range and rate of fire, computer aided fire control, missile technology of all kinds, and in satellite and aircraft surveillance and reconnaissance. Following the Vietnam War, the American move to a smaller and professional military force served to encourage the substitution of technology for manpower. These investments allowed the U.S. to surpass the military power of the Soviet Union and is said to have contributed to the end of the Cold War, but the U.S. also far surpassed the capabilities of its allies and potential coalition partners. Not all potential coalition partners could match such technology investments and many who could chose not to do so. It has gradually become more difficult to effectively integrate the forces of the coalition partners into coherent battle plans.

Not only was the fighting power of the units in question, but also the ability of coalition units to effectively join the U.S. forces communication nets. For example, U.S. fighting vehicles were equipped with computers and screens for displaying battle information and coalition fighting vehicles were not. Coalition aircraft were not necessarily equipped with radio communications that would allow full cooperation with U.S. air forces and inclusion in the tightly planned and controlled Air Tasking Orders (ATO) that are planned 72 hours in advance in great detail.

In the event, ways were found to successfully use certain coalition units. For example, in one operation a British armored division passed through the positions of a U.S. infantry division to exploit a battle advantage and to attack the rear echelons of Iraqi forces. In another case, a French armored division was assigned a sweeping flanking move that protected the left of the coalition line and was appropriate to the lighter French fighting vehicles. In both cases the coalition armored forces were not required to collaborate in the field with the U.S. armored forces having weapons and communications technologies of different capabilities.

In other cases, the integration of coalition forces was less successful. Canadian F-18's were assigned to the coalition forces and were expected to collaborate with the U.S. forces that were similarly equipped. The collaboration, however, was less successful than hoped for. The Canadian aircraft were not equipped with radio communications that would allow them to fully join U.S. communications nets. They were unable to engage in close support of ground operations because they were equipped only for air-to-air operations, but the Iraqi air forces had been rapidly destroyed in the first days of the war.

Paradoxically, improvements in communication technology may be exacerbating difficulties due to the inevitable language differences that are the lot of a military coalition. In World War I, the French and British occupied adjacent geographical territories and the use of bilingual liaison officers at the national force boundaries was sufficient to maintain effective

collaboration. In both World Wars, the British effectively employed Indian divisions and the French incorporated Moroccan and Algerian divisions into their forces despite the fact that a significant number of the troops spoke no French or English. Communications cycles were longer, communications equipment was less pervasive and it was sufficient to have an adequate number of bilingual officers to maintain effectiveness. Currently, communications devices are pervasive, particularly in the case of U.S. forces. They now include not only voice communications but internet-type computer communications and visual displays of battle information. Communication cycles have shortened and a high percentage of soldiers and junior non-commissioned officers are expected to use these communications devices. The inevitable multiplicity of languages present in a broad military coalition has taken on an importance that it previously did not have.

4 Command and control

Command and Control (C2) generally refers to what is called *operational decision making*, that is to say the way in which a theater commander expresses his will to his subordinate commanders and ensures that, as far as is possible, it will be carried out. We may assume that the theater commander chooses a course of action that is consistent with the strategies adopted at the highest military level in conjunction with the relevant political authorities. He will then set objectives for his subordinate commanders and specify certain constraints. These constraints may, for example, specify what forces, weapons and supplies are available, as well as timings. In this chapter, we first describe the three levels of military decision making, *strategic*, *operational* and *tactical*, and then describe the C2 structure in coalition operations.

4.1 Decision making levels

Decision making in a military context takes place according to a different set of norms and protocols, depending on the level at which it occurs. Let us consider three representative levels in a military organization and describe the major factors affecting how decisions are taken at each level. This will aid to comprehend the implications of different C2 configurations for simple and coalition task forces.

4.1.1 Strategic level

Military strategy is not the sole domain of military leaders and strategic questions do not only arise at a time of actual combat. Strategy involves the use and close integration of economic, political, cultural, social, moral, spiritual, and psychological power. It also involves the diplomacy through which alliances and coalitions are formed or where diplomatic pressure might be exerted to attain objectives without combat. At the strategic level, armies and nations are committed to a course of action. In World War II, for example, nations made the strategic decision to attack civilian populations from the air in the hope of breaking their enemy's morale, or to attack an enemy's petroleum sources to bring his armies to a halt. Strategy determined that a second front would be created in the west through the D-Day invasion of Normandy. The choice to use the atomic bomb rather than to invade the islands of Japan was a strategic one.

Military strategy also leads to the elaboration of elements of a doctrine. For example, in the Soviet era, Warsaw Pact countries relied on massive concentrations of manpower and armor to overwhelm resistance, whereas NATO nations instead developed technological means, principally air and tactical missile attacks, to destroy such concentrations. A doctrine will determine how a nation's resources are to be spent and will influence tactics and training. It determines how military units will be formed and what equipment they will need, that is to say military establishments and order of battle.

History shows that generals and politicians must meet and agree at this level. Winston Churchill, for example, maintained close contact with Montgomery and Tedder, the military leaders of the day. In some cases, generals themselves have a measure of political influence, as was the case with Eisenhower and MacArthur, but they still must be fully engaged with the civilian leaders of their nations. At the strategic level, generals and politicians do not necessarily see each other as equals, but they do exchange information, analyzes, insights and opinions in an effort to reach decisions that will further the aims of the military action planned or in progress. They discuss and decide the what and the when of a conflict, while the how is treated only in a general manner. One might describe the process they follow as one of consensus decision making, one which seeks the agreement of most participants, while mitigating the objections of any minority. This consensus process is particularly important in the case of coalitions and alliances because the participating nations may not have an identical set of interests and objectives. A failure to reach consensus may lead to a lack of full political commitment on the part of some participants, and this lack of commitment will be felt down to the level of the individual soldier. Negotiations of all forms and styles are common in strategic discussions.

4.1.2 Operational level

By operational level, we refer to the planning and execution of operations by larger military units, for example, those carried out by brigades or divisions. Such operations are carried out in a context where a strategy has been chosen and a high-level doctrine established. This high-level doctrine will have been interpreted and used as a basis for determining tactics down to the small-unit level, as well as detailed techniques and procedures. For the most part, there will be little variation allowed in the application of tactics, techniques and procedures, and this has given rise to the well-known expression, “by-the-book”. Units and individual soldiers will have been trained in the application of the approved procedures and tactics.

A commander at this operational level will typically function within a staff system. In the operational context, he will be tasked by his superior with the planning and execution of a particular mission. His role will be to decide how this may be accomplished in the most efficient and expeditious manner. In this, he is aided by staff officers specialized in various aspects of unit operations, ranging from operations to logistics. The role of the staff is to form a feasible plan to accomplish the commander’s intent within the material and time constraints to which they are subject. The commander bears the sole responsibility for all decisions and the military organization seeks to maintain unity of command and the chain of command. Any consensus will be based on the fact that the commander and his staff will work from the same doctrine, have similar training and similar experience. In a national army, they will share the same political basis and national objectives. Negotiations and trade-offs, as part of the staff process, will be rare indeed. The decision making process is therefore fundamentally different from that of the strategic level.

4.1.3 Tactical level

The terms "strategy" and "tactics" are used differently by different authors. In this text, we use the term "tactical level" to refer to the manoeuvring of forces of battalion strength or less to accomplish a limited objective or an immediate end. Typical tactical situations are the advance to contact with the enemy, reconnaissance and patrolling, attacking a known defended position and establishing a defensive position.

At this level, commanders and individual soldiers are concerned with the "how" of military operations rather than the "what". The choice of a course of action will be based on the commander's appreciation of the size, composition, position and quality of enemy forces as well as those of his own. He will use deception, surprise, manoeuvre and fire power, and choose a course that, in his judgement, will give the optimum chance of accomplishing his mission.

While a wise commander will be willing to accept advice from his staff and subordinate commanders, in fact, the pace of operations usually leaves little time for collective decision making at this level. Established procedures supersede negotiations. From the level of battalion commander to that of the individual soldier, actions are carried out according to schemas faithful to established doctrine and learned through training, exercises and previous operations. In most cases, this may be viewed as a process of choosing an appropriate behavior (course of action) among a learned set (tactical doctrine and tactics) rather than a decision making process per se.

4.2 Command structure in coalitions

In coalition operations, consensus building to ensure compatibility at the strategic level between partners is key. A successful coalition must establish at least unity of effort, if not unity of command. The success of a coalition operation begins with the authority to direct operations of all assigned or attached military forces.

4.2.1 Command configuration

Three types of command are common in coalition operations, namely the *lead nation* concept, the *parallel command* and the *combined structure* [13].

4.2.1.1 Lead nation

Command & Control (C2) in the majority of coalition operations will use the lead nation concept. This concept recognizes that one nation is assigned the lead role and its C2 predominates. Normally, the lead nation is the country providing the largest amount of forces for that operation.

In the lead nation concept, appropriate Command, Control, Communications, and Intelligence (C3I) procedures are determined by the lead nation, working in close consultation with the other national contingents. The lead nation should provide national component headquarters of other nations with unique C3I equipment and software, whenever possible. Other nations participating in the operation provide appropriate liaison personnel to the lead nation headquarters. Robust liaison is essential to developing and maintaining unity of effort in coalition operations.

Depending on the size, complexity, and duration of the operation, staff augmentation from other national contingents may be required to supplement the lead nation staff to ensure that the lead nation headquarters is representative of the entire coalition. Such augmentation may include designated deputies or assistant commanders, planners, and logisticians. This facilitates the planning process by providing the coalition commander with a source of expertise on coalition members. An augmentation will be required if a coalition partner possesses unique organizations or capabilities not found in the forces of the lead nation.

4.2.1.2 Parallel command structure

An alternative to the lead nation concept is the parallel command structure. Under a parallel command structure, no single coalition commander is appointed. The coalition leadership must develop a means for coordination among the participants to attain unity of effort. Because of the absence of a single coalition commander and lack of unity of command, the use of a parallel command structure should be avoided, if possible.

4.2.1.3 Combined structure

The lead nation concept and a parallel command structure can exist simultaneously within a coalition. This occurs when two or more nations serve as controlling elements for a mix of international forces, such as the Gulf War coalition. While more desirable than the parallel command structure, an effort to achieve a total-lead-nation concept for unity of command is preferable.

4.2.2 Staff

The coalition staff (Figure 2) should be composed of appropriate members in key positions from each country having forces in the coalition. Positions on the staff should be divided so that country representation and influence generally reflect the composition of the force, but is also based in part on the mission and type of operations to be conducted. Coalition commanders must also look at force composition as it applies to capabilities, limitations, and required support.

Under the Coalition Force Commander, there is the Deputy Coalition Force Commander who usually is of equal or senior rank to the subordinate force commanders. He should possess a broad understanding of the operation to be conducted. He performs special duties as directed by the commander such as chairing committees, coordinating liaison personnel, incoming and outgoing, and interagency requirements.

Normally, the deputy commander is from another country than the coalition commander. His selection may be based on the mission assigned and/or the number and type of forces in the coalition.

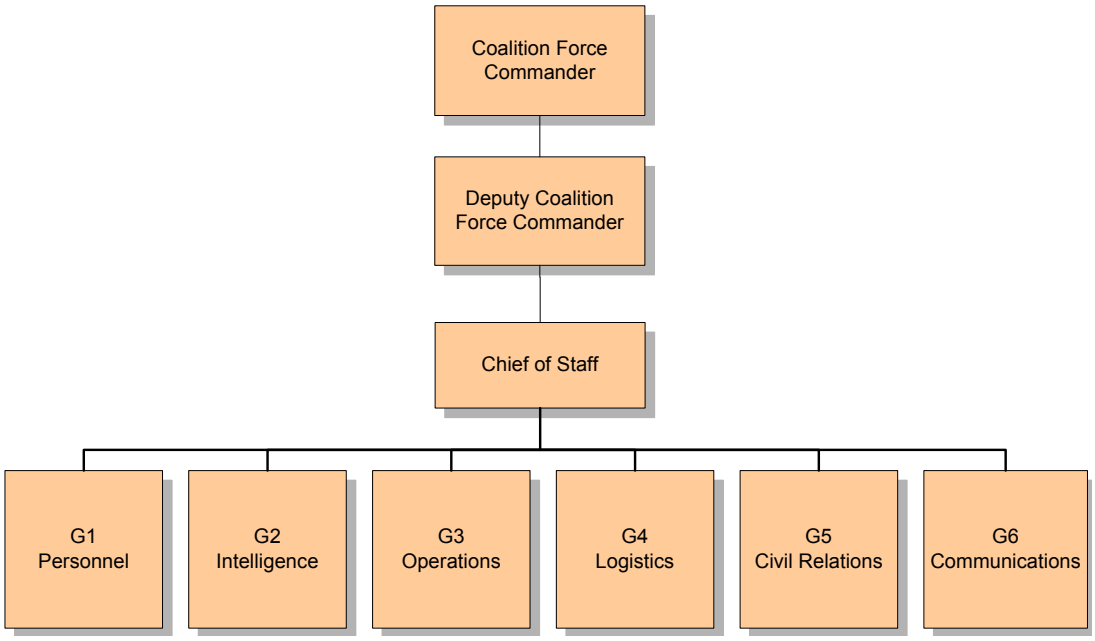

Figure 2: Coalition staff

The Chief of Staff (CoS) comes, in most cases, from the same country as the commander, probably from the same command. Because the staff may have officers from different nations, the CoS puts special emphasis on training the staff, coordinating, and directing the work of the staff divisions.

The staff includes a:

- G1 officer, who is responsible for personnel, training and replacement of losses;
- G2 officer, who is responsible for intelligence concerning local enemy troop dispositions and movements as well as information concerning the overall battle situation;
- G3 officer, who is responsible for planning operations, that is to say the details of plans designed to carry out the commanders intentions, including the brigade's troop dispositions, task assignment within the mission, and timings and synchronization with other units;
- G4 officer, who is responsible for planning and coordinating logistics, that is to say all aspects of transportation of troops, weapons and supplies and for the procurement of supplies necessary to carry out assigned missions;
- G5 officer, who is responsible for relations with local civil governments and possibly, in the case of an occupation, for the establishment of a civil government;

- G6 officer, who is responsible for communications within the brigade and from brigade units to other commands, a function whose importance has greatly increased in recent years.

4.2.3 Command jurisdiction

Command jurisdiction is the legal position of command by one national commander over the soldiers of another nation. Each nation participating in a coalition is responsible to its own national authority for the conduct of operations. Each nation will view the conflict based on its own national interests. Where those interests coincide, the coalition commander will have his greatest latitude, and where those interests vary, he will have the least. He will be dealing not only with the national force commander, but also with the national command authority of that nation. Coalition commanders always have to operate within constraints of one sort or another [13].

Command relationships

National forces can be under operational or tactical control of the coalition commander, the definition of which are given below:

- Operational Control (OPCON): The authority delegated to a commander to direct assigned forces to accomplish specific missions or tasks that are usually limited by function, time, or location; to deploy units concerned; and to retain or assign tactical control of those units. It does not include administrative or logistical control. (QSTAG 894, NATO Glossary of Terms and Definitions).
- Tactical Control (TACON): The detailed and usually local direction and control of movements or maneuvers necessary to accomplish missions or tasks assigned. (QSTAG 894, NATO Glossary of Terms and Definitions and US Joint Publication 1-02, Department of Defense Dictionary of Military and Associated Terms). TACON does not provide organizational authority or administrative and support responsibilities.

The national authorities providing forces to the coalition will normally assign national forces under operational control of the coalition force commander.

4.3 Control

There are two essential structural enhancements that improve control of coalition forces: the establishment of a liaison network and coordination centres [13].

4.3.1 Liaison

Regardless of the command structure that is established, effective liaison is needed in any coalition force. Liaison establishes connection between a command and its higher headquarters, adjacent units, supporting, attached, and assigned forces, as well as other appropriate

Host Nation (HN) and international organizations. When supporting UN operations, liaison personnel should be placed at the UN headquarters in New York and their office in Geneva, Switzerland.

The use of liaison fosters a better understanding of mission and tactics, facilitates the transfer of vital information, enhances mutual trust, and develops an increased level of teamwork. It is also a significant source of information for the coalition force headquarters about subordinate force readiness, training, and other factors. Because of differences in doctrine, organization, equipment, and training among the coalition nations, liaison structure is even more necessary in a coalition than in a purely national force.

Liaison personnel must be thoroughly knowledgeable about the capabilities and limitations of their parent units and nations, to include the structure, capabilities, weapons systems, logistics, and planning methods employed and their national interests. The task requires professional knowledge, functional expertise and linguistic skills. Once established, liaison teams become the direct representatives of their respective commanders. They monitor, coordinate, advise, and assist the command to which they are attached.

4.3.2 Coordination centres

Coordination centres are another means of enhancing stability and interaction and improving control within a coalition, especially when operating under a parallel command structure. The coordination centre can be used for C2, as well as the control of a variety of functional areas, including logistics and civil-military operations. Initially, a coordination centre can be the focal point for support issues such as force sustainment, medical support, infrastructure engineering, host-nation support, and movement control, but can be expanded to include command activities.

4.4 Evaluation of capabilities and task assignment

The headquarters conducting the mission analysis will take into account the respective capabilities, political will, and national interests of the coalition force components. Force requirements should be identified and commitments solicited from likely coalition participants. Participating members must satisfy minimum capability standards covering training level competence, logistics capabilities, deployment, sustainment, and redeployment readiness. This is a critical step as each nation determines what its contribution to the operation will be.

Many countries are not staffed or equipped to offer a full spectrum of support. Special capabilities of each country, such as airlift; special operations; intelligence collection; communications; security; and logistics, which can offset other countries' shortfalls and enhance overall operational competence, are examined.

Based upon national contributions and after determining the tasks necessary to achieve assigned objectives, the coalition force proceeds with task allocation based on capability evaluation. Other planning factors, which will impact on the analysis, include the cultural

and political situation in the area of operation. In an environment in which hostilities are likely, a portion of the coalition force, those nations authorized the full range of force, may be assigned to offensive operations. A second group, due to political constraint, may be assigned to support and protect lines of communications in the theater, while a third with greater political and military constraints may be restricted to Combat Service Support (CSS) operations.

Mission analysis is also influenced by nations's Rules of Engagement (ROE). ROE are directives to military forces and individuals that define the circumstances, conditions, degree, and manner in which force or actions may or may not be applied. Although the participants may have similar political mandates, each nation is likely to come to the coalition with a different national ROE reflecting that nation's reason for entering the coalition.

Each operation is conducted in a unique setting with its own political, diplomatic, geographic, economic, cultural, and military characteristics. Key considerations involved in planning and conducting coalition operations vary with the international situation and the perspectives, motives, and values of the organization's members.

5 Challenges to coalition operations

When two or more military forces commence collaboration in a theater of operations, they are faced with a number of practical difficulties which must be overcome if the collaboration is to be successful.

Commanders and planners must learn the capabilities of partner nations or organizations. These capabilities differ based upon national and organizational interests and objectives, political guidance, limitations on the national force, doctrine, organization, Rules Of Engagement (ROE); Rules Of Interaction (ROI), Laws Of Armed Conflict (LOAC), equipment, religions, customs, history, and a myriad of other factors.

5.1 Political and organizational issues

Coalition operations may be driven by common agreement among the participating coalition partners or through a mandate provided by the United Nations (UN). Either way, the multinational feature is an important factor because national interests and organizational influence may compete with doctrine and efficiency.

Sovereignty issues are the most difficult issues for the commander of the coalition force to deal with, both with regard to forces contributed by nations and by host country nations. Often, the commander will accomplish the mission through coordination, communication, and consensus or leadership rather than by traditional command concepts [13].

The commander must ensure equitable treatment and exposure of all units, regardless of national background. All members must have fair representation on coalition planning staffs to preclude allegations that any nation was excluded from participation in the decision making process. All participants must perceive missions as appropriate, achievable, and equitable in terms of burden and risk sharing. Capabilities are an obvious factor in assigning missions to units, but national honor and prestige may be as important to the partnership as battlefield capability. Partners should be included in the planning process; and their opinions must be sought concerning the type of mission assignment for their units [13].

The political commitment of nations contributing to a military coalition may be very different. One nation may see the joint military operations as critical to its well being and it may be prepared to aggressively engage its opponents and to suffer losses, if necessary. Another nation may see its participation as symbolic and may not be prepared to be as aggressive. A third partner, originally a strong supporter of the operations, may change its position for internal political reasons.

5.2 Command & control challenges

Command & Control (C2) are exercised differently within various military forces. Even military units of approximately the same size and capability may have different C2 processes.

Some of the issues are the differences of command style, unity of command, doctrine and training, and authority.

5.2.1 Command style

Command style can be seen as a particular case of the more general concept of organization style, which includes concepts such as centralization of authority, formalization of communication, and depth of organizational hierarchy. In the military context, one contingent may use a decentralized form of command where a local commander has a high degree of autonomy, whereas another uses communications facilities to maintain more centralized and coordinated operations.

Horii, Jin, and Levitt [18] characterize culture and cultural differences using two dimensions: practices and values. Practices refer to each culture's typical organization style, while values refer to workers' preferences in making task execution and coordination decisions. They further state that culturally driven behavior patterns have less impact on project outcomes than organization styles. Their results indicate that teams show better performance across all contexts when each works with its familiar organization style. This has often been recognized in the context of military operations. For example, Commonwealth countries collaborate easily with each other and with British forces because they have a common organizational structure and common staff procedures, not to mention similar equipment and training.

5.2.2 Unity of command

Coalition forces should anticipate that some forces from coalition member nations would have direct and near immediate communications capability from the operational area to their respective national political leaderships. This capability can facilitate coordination of issues, but it can also be a source of frustration as leaderships external to the operational area may be issuing guidance directly to their deployed national forces.

Coalition operations are affected by political agendas of participating countries. Many nations will not, or are reluctant, to relinquish command of their forces to other countries. On a case-by-case basis, national command authorities may place national forces under the operational control of a coalition commander. In such cases, there may be parallel chains of command, with part being through the coalition force and part through the national command authority. The coalition's challenge is to arrange the best possible command relationships with its subordinate forces to ensure mission success.

Differences in national interests, objectives and policies at the national level, as well as the availability of forces based on concurrent military commitments, may delay initiation of combined planning and agreement to subsequent decisions.

5.2.3 Doctrine and training

Within a coalition, there will be differences not only in doctrine but also in the application of a common doctrine. One contingent may, for example, have significantly less communication resources and assets than another. Doctrine will in turn affect the tactics and training of the military forces. Therefore a coalition force, rapidly formed to meet a developing situation, may be composed of forces that are equipped and trained for very different missions.

5.2.4 Authority

Maurer [19] highlights the questions of the legitimacy of a commander through a series of questions that must be addressed in a coalition operation. He deals with the designation of the commander and the definition of the limits of his authority.

As we have seen, this posed a particular problem in the case of the World War I Franco-British coalition. Because of the weakness of the command structure, there were conflicts as to the assignment of forces to the Western Front and as to the assignment of sectors of this front to one partner or to the other. The coalition partners did not designate an overall commander, indeed did not attempt to create such a post, until late in the war, and even then, the commander's powers were unclear.

In the case of the Anglo-American coalition (1942-45) of World War II, the political authorities, Churchill and Roosevelt, agreed on a command structure and on the specific officers who would hold key positions. The political support to the distribution of key posts was particularly important. Political authorities supported these commanders and dealt with particular issues as they arose. Despite the strong personalities of some of the generals, Montgomery and Patton in particular, the coalition was able to solve its problems effectively and was thus able to work towards victory.

In the Korean War, the overall commander was designated jointly by the United Nations and the United States, who was the dominant partner in the coalition. The decision to replace Macarthur was clearly taken by the US president and later accepted by UN authorities. Various countries assigned forces to the UN operation and acknowledged the UN designated command structure. The UN involvement gave even the smallest partner some political voice in the coalition, although the US dominance was both real and evident. It may also have helped maintain the participation of a number of countries until the final armistice.

We see from these examples that the power to designate a commander emerges from the nature of the political agreements and the power relationships among the coalition partners. If the political will is present, the commander will have clear powers and the support of the coalition partners. If the political understandings are unclear, for example because of the haste in which a coalition is formed, the commander's powers will be less clear and nations will be more likely to attempt to retain national control over their forces.

Another problem is that, presently, in coalitions command, authorities are at variance with levels of command (commanders at different levels have the same authority). The

reorganization of the integrated command structure requires review and reform of command authorities [20].

5.3 Technological challenges

A nation's military doctrine defines the broad parameters within which its military forces will be equipped and trained and within which they will fight. In Western countries, there is a reliance on technology as well as a high state of technological training of both officers and other ranks. Information processing and communications are stressed in order to provide a detailed portrait of the battlefield. Technology is used to provide effective weapons systems, and the conjunction of these elements is used to target an enemy's command, control and communications assets. By way of contrast, the former Soviet doctrine relied on massive conventional forces and preplanned missions commanded by a small but highly educated and trained officer corps.

Technology is sometimes a barrier to collaboration within a coalition. The United States, for example, uses more advanced equipment than most other nations and has more of it deployed in operational units. This is true not only of the usual radio equipment, but also of broadband and wireless devices for internet and imagery transmissions. Computer assisted decision making and operations are common in US forces. Communications processes, codes and procedures may also be quite different from one contingent to another. Weapons may differ and become a source of mismatch among coalition partners. One infantry force may have long range rapid fire personal weapons and armored air and artillery while another will be lightly armed and will tend towards smaller actions that are more widely dispersed.

5.4 Social challenges

As stated in [13], understanding the characteristics, personalities, capabilities, ambitions, and cultural habits of the various coalition partners is a prerequisite for ensuring successful teamwork and overall unity of effort.

5.4.1 Culture

Each partner in an operation has a unique cultural identity. Nations with similar cultures face fewer obstacles to interoperability than nations with divergent cultural outlooks.

Culture is a psychological and a social factor. It is shaped by psychological processes that determine what individuals think and feel, and social processes that determine the way they interact [21]. As a matter of fact, this remains one of the great challenges of multinational operations, given that individuals, the organizations in which they operate and their interactions are all influenced by culture. Culture underlies all social interactions and greatly influences people, practices, and social structures. It is necessary to understand the relationship between cultural values and behavioral consequences to achieve inter-group cooperation [22].

5.4.2 Cohesion

The military literature on motivation is rich and a cursory search will yield many articles and research studies on the subject. We have chosen two works that illustrate the nature of the debates on this topic.

In a recent study, Wong, Kolditz, Millen, and Potter [23] argue that unit (social) cohesion is a primary combat motivation. Social cohesion refers to the quality of the bonds of friendship and emotional closeness among unit members. Task cohesion, on the other hand, refers to the commitment among unit members to accomplish a task that requires the collective efforts of the unit. They state that: 'Social cohesion appears to serve two roles in combat motivation. First, because of the close ties to other soldiers, it places a burden of responsibility on each soldier to achieve group success and protect the unit from harm. The second role of cohesion is to provide the confidence and assurance that someone soldiers could trust was watching their back'.

MacCoun, Kier, and Belkin [24] have published a rival view. They defend a more traditional position that finds that task cohesion has a modest but reliable correlation with group performance, whereas social cohesion has no reliable correlation with performance and, at high levels can even undermine task performance.

5.4.3 Shared beliefs

Maurer [19] points out that while the beliefs of national contingents can be changed, the rate of change is slow. Some beliefs, particularly perceptions of hostility are hard to change. Beliefs tend to be interrelated so that one change of belief may affect other aspects of the belief system.

Wong et al. [23] describe some of the shared beliefs of US soldiers engaged in the war in Iraq, arguing that these shared beliefs contribute to unit cohesion and to combat effectiveness. They note that many soldiers interviewed in their study reported being motivated by notions of freedom, liberation, and democracy, and on "liberating" Iraq. They contend that this attitude was not nationalism or a national security issue, but a more fundamental outcome addressing the people of Iraq.

While at this time we have no data or examples of the effect of differing national belief systems on military coalition operations, it would seem reasonable to assume that similar belief systems would have a positive effect on coalition effectiveness, and that opposing beliefs would have the opposite effect, always supposing that the beliefs in question had some relevance to the military operation in progress or to the manner in which operations are habitually conducted.

5.4.4 Group dynamics

Military coalitions are, by definition, transnational and global teams. As such they face particular issues that are not present in single nation teams.

Gluesing [25] deals with the complexity facing a global team. A global team is one that is geographically distributed and linked by communications technology. Note that this represents the type of organization proposed in works on Network Centric Warfare. Gluesing states that the complexity a global team faces in meeting its objective can be characterized along five different dimensions: task, context, people, time and technology.

- Task complexity is a continuum that is comprised of four major elements: workflow interdependence, task environment, and external and internal coupling.
- Context is a way of life and work in a specific geographic area with its own set of business conditions, cultural assumptions, and unique history. Some of the dimensions of context are climate, nationality, education, politics, judicial systems, economic systems, corporate governance, management systems, and incentive, motivation or reward schemes.
- People who design, support, lead or work in global teams bring with them varying degrees of commitment, motivation, expectations, skills and identities. Global teams are internally diverse which can add considerable complexity to the team situation.
- Time constraints leave little room to adjust to the interaction styles of others or negotiate new norms for working. Further, when the pace of work is accelerated, there is often less attention given to interpersonal relationships. Global teams may need more time than a traditional collocated team to accomplish the same task.
- Technology, primarily network centric communications technologies, and the proportion of the team's work that is accomplished using virtual technologies distinguishes global teams.

Polzer, Crisp, Jarvenpaa, and Kim [26] further observe that members of dispersed work teams may be located geographically in a variety of configurations. Configurations in which team members are divided into geographically distinct subgroups may create faultline dynamics, characterized by disruptive intergroup relations between the subgroups, including diminished trust and increased conflict. These "faultlines" may cause people to categorize the members of their own subgroup as the ingroup while viewing other subgroups as outgroups.

Earley and Mosakowski [27] state that nationality is typically the most salient difference in transnational teams in part because it determines communication patterns and interaction styles. Teams with two nationality-based subgroups exhibited significantly lower team efficacy, lower team identity, poorer communication, and worse team performance than either homogeneous or highly heterogeneous teams.

Yet, communication problems are not only due to the diversity of nationalities and cultures. The dependence on electronic communications, geographical distances and the impossibility of having direct face to face interactions on a regular basis, are other obstacles to group dynamics in transnational teams.

Moreover, a recent study [28] shows that inter-team difficulties in a coalition network also appear between military and non-military groups, where the majority do not fully understand how they should work together to achieve overall goals. One necessary ingredient for intra and inter-team collaboration is the understanding of the roles and responsibilities of other participants. The lack of this knowledge can entail, as the study shows, to an unequal distribution of effort and performance, frustration and unmanageable sharing of information.

5.5 Continuum of cooperation

Clark and Jones [29] proposed a model of interoperability for Command & Control (C2) in military organizations, including coalition operations. This model, called the Organizational Interoperability Model (OIM) identifies five levels of organizational interoperability and describes them using four defining attributes, which correspond to the social, technological and C2 dimensions elaborated in the previous section. These attributes are:

Preparedness – comprises doctrine, experience and training. It is a measure of how ready an organization is to inter-operate.

Understanding – measures the level of communication and information sharing occurring within the organization and how that information is used.

Command Style – describes the management style of the organization – how decisions are made and how roles and responsibilities are allocated.

Ethos – represents the culture and value systems of the organization, the level of trust achieved and the goals and aspirations of the organization.

The model represented in the following table shows how different levels of organizational interoperability can be characterized by these features. Given this, one can say that a coalition would be situated somewhere between levels one and two, while an alliance would be characterized by a level 3 and a union by a level 4 of interoperability.

Table 2: OIM's levels of interoperability and relevant attributes

	Preparedness	Understanding	Command Style	Ethos
Level 4 Unified	Complete - normal day-to- day working	Shared	Homogeneous	Uniform
Level 3 Combined	Detailed doctrine and experience in using it	Shared comms and shared knowledge	One chain of command and interaction with home organization	Shared ethos but with influence from home organization
Level 2 Collaborative	General doctrine in place and some experience	Shared comms and shared knowledge about specific topics	Separate reporting lines of responsibility overlaid with a single command chain	Shared purpose; goals, value system significantly influenced by home organization
Level 1 Cooperative	General guidelines	Electronic comms and shared information	Separate reporting lines of responsibility	Shared purpose
Level 0 Independent	No preparedness	Voice comms through phone, etc.	Non interaction	Limited shared purpose

6 Transformational context

Coalition operations will be increasingly influenced by the model of Network-Centric Operations (NCO), the core concept that guides the transformation of the U.S. military. This is a new theory of war based on Information Age principles and phenomena, and can be summarized by the tenets of Network-Centric Warfare (NCW). These state that a robustly networked force improves information sharing and collaboration, which enhances the quality of information and shared situational awareness. This enables further collaboration and self-synchronization and improves sustainability and speed of command, which ultimately result in dramatically increased mission effectiveness.

In this chapter, we look at the principles of NCW and compare them with traditional military Command & Control. Concepts such as *self-synchronization* are elucidated within the spectrum of military planning and control and explained with the theoretical concepts of information theory. Next, the 'domains' and the collaborative mechanisms of NCO are explained and coalition-specific problems are identified within NCO's conceptual framework.

6.1 Traditional control versus self-synchronization

To understand the mechanisms of NCW, it is important to first understand the concept of self-synchronization and its difference with traditional military control.

6.1.1 Hierarchical control structure

A traditional military force has a hierarchical authority structure. Senior commanders set objectives for subordinate commanders and constrain their actions through orders that may be more or less detailed, depending on the situation and on the personal and professional relationships between the commanders at all levels. A sub-unit commander may command several subordinate units but has only one superior. Within this structure, communications flow up and down through the chain of command.

Intelligence is gathered by the forward units through reconnaissance patrols, probing attacks, the capture and interrogation of prisoners, and keen observation of the battlespace. Knowledge of conditions at the points of contact with the enemy, such as the disposition of enemy forces and casualties on both sides, are among the information gathered to be transmitted to senior commanders. Units prepare intelligence reports that are summarized and passed up the chain of command. Technology allows the collection of further intelligence through the use of aircraft, satellites and unmanned drones. This form of intelligence is passed directly to senior commanders and is not seen in raw form at the sub-unit level. The senior commander may then choose to disseminate all or part of this information back down through the hierarchy to all units that might be concerned.

A commander's orders may be thought of as information that flows vertically down through the authority levels of the hierarchy. Orders flow down the chain of command from senior to subordinate commanders. A military order specifies the mission and a general view of how

it is to be executed, forces in presence and timings. It also contains a situation description which includes an intelligence summary concerning enemy forces, their strength and their disposition. Typically, it will seek to contain sufficient information to allow the competent execution of the mission, but no more.

There is little horizontal communication among sub-units, little opportunity for the exchange of information or for coordinated action outside of that specified in orders from superior commanders. Communications concerning logistics may be carried out through the same physical networks that are used for C2, but can be seen as a distinct overlaid network.

This traditional form of organization has the advantage of reinforcing the principle of unity of command and the use of the chain of command. It maintains the focus of the military force solely on the intent of the commander. It tends to protect the confidentiality of intelligence by limiting its distribution on a "need to know" basis. It has the disadvantage that the restrictions on the availability of intelligence may lead to poorer decision making at the sub-unit level.

6.1.2 Self-synchronization

Current thinking in military forces seeks to use information technology to establish a flatter hierarchy that has a degree of what is termed "self-synchronization". This term is taken to mean the ability of a subordinate commander, perhaps in collaboration with other units, to initiate operations that are consistent with the senior commander's intent, but without having received specific orders to do so.

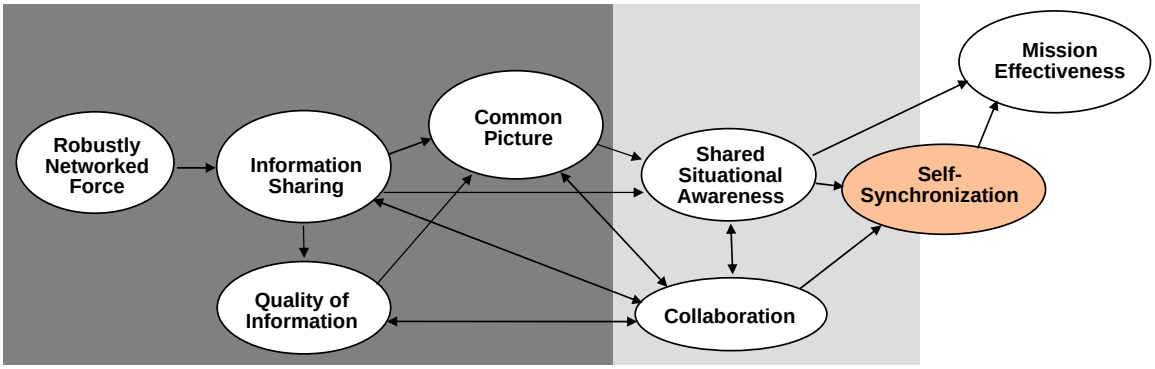

Figure 3: Achieving self-synchronization

A rough comparison is sometimes made with civilian logistics systems in which goods are ordered and delivered to retail outlets without specific human intervention, taking into account current purchasing patterns and seasonal and secular trends. This flattened, self-synchronized hierarchy would be obtained through increased sharing of information. All information concerning friendly and enemy force dispositions, as well as details of ongoing operations, would be maintained in widely available databases. Subordinate commanders could access these databases and initiate operations consistent with the senior commander's

intent and the overall picture. Individual weapons holders, so-called "shooters" such as tank commanders, missile controllers and pilots, could use the information in the database together with a set of "rules of engagement" to attack targets independently without having had specific orders to do so. To ensure that all units had the same information, a Common Operational Picture (COP) would be created and maintained through the aggregation and fusion of data obtained from every possible source. Forgues [30] provides a view of the nature of this form of military organization and of what is required to implement it in practice.

6.2 Spectrum of planning and control

Traditional and self-synchronized forces are not just two contrasting models, they are part of a large spectrum of planning and control. Alberts and Hayes [31] have enumerated six styles of decision making that have been used by successful military organizations in the past century. These styles cover the spectrum from centralized planning and control to decentralized planning and control.

6.2.1 Cyclic style

The cyclic style corresponds to centralized C2 using fixed time periods. In this approach, detailed orders are issued on a regular basis, for example on each day, from a central command. The command authorities monitor progress in carrying out the orders and whatever correctives are required form part of the orders at the next cycle. Such a style is found where communications are limited or where central commanders are not confident that subordinate commanders will have the skills or initiative to exercise more independent command. It may also occur where central commanders are unsure of the political reliability of subordinate commanders. This was the approach adopted by the Tsarist commanders in 1914 when they launched major attacks against the German and Austrian forces with disastrous results. Alberts and Hayes report that it was used more successfully by Soviet forces in some phases of the 1939-1945 war. They also suggest that it is the basis of the US air forces Air Tasking Order (ATO) even today.

6.2.2 Interventionist style

The interventionist style is centralized C2 using irregular time periods. This approach is similar to the previous one, however it assumes a greater battlespace surveillance capacity and communications ability. Orders are issued and modified as central commanders see fit according to changing battlefield conditions, opportunities and threats. The military forces become more responsive to changing conditions, but centralized control is maintained. Soviet era command followed this pattern for a period.

6.2.3 Problem-solving style

This style consists in decentralized C2 within detailed constraints. Senior commanders specify objectives and detailed constraints concerning timings, available forces and supplies,

terrain boundaries, transportation and communications facilities and so on. Subordinate commanders have the challenge of creating the detailed plans that will allow them to reach required objectives within specified constraints. This style of C2 is the basis of the staff system used by the western powers during World War II and through much of the cold war era.

6.2.4 Problem-bounding style

This style consists in decentralized C2 within loose constraints. Senior commanders specify objectives and minimal constraints on how operations are to be manned and carried out. Subordinate commanders have the initiative to create viable detailed plans without close supervision and control from senior levels. Examples of this style of C2 may be drawn from certain phases of World War II operations involving experienced forces, commanders and staffs.

6.2.5 Selective control style

This is decentralized C2 with contingent central intervention. In this form of command and control, subordinate commanders are assigned missions, areas of operation, forces, weapons and supplies and are required to exercise command and control independently within this zone of responsibility. Centralized senior commanders will intervene only if new information or an emerging situation requires it. Alberts and Hayes [31] affirm that modern Israeli defence is organized in this manner.

6.2.6 Control-free style

This is decentralized C2. In this form, subordinate commanders are allowed a high degree of discretion in carrying out assigned missions. This style of operational and tactical decision making requires highly trained and professional commanders and staffs as well as experienced troops. It requires a logistics system that will respond to the needs of commanders without requiring the intervention of high-level commanders and staff. It requires a senior command that will not yield to the temptation to intervene in operations that, in principle, are the entire responsibility of subordinate commanders. It may be that the emergence of this style of C2 is contingent of the existence of particular conditions, for example when overall operations have become so complex that it is not possible to attempt any form of central control and where subordinate commanders are highly trained and professional. Alberts and Hayes suggest that the German army of 1939-1945 was able to use this style successfully.

6.3 Network-centric warfare

Network-Centric Warfare (NWC) is a new warfighting concept set out in a U.S. government policy paper entitled Joint Vision 2010. While this concept is not yet fully developed or implemented, it is the subject of discussion and partial implementation in various military forces throughout the world. Alberts, Garstka, and Stein [32] define NCW as

> "an information-superiority enabled concept of operations that generates increased combat power by networking sensors, decision-makers and shooters to achieve shared awareness, increased speed of command, higher tempo of operations, greater lethality, increased survivability, and a degree of self-synchronization."

Wesensten, Belenky, and Balkin [33] highlight an underlying assumption upon which NCW principles are based. They write:

> "An underlying assumption of information-sharing is that the latter translates into a shared situational awareness and self-synchronization through shared mental models of the current situation and of the desired end-state (synonymous with commander's intent, i.e., the object of the operation), leading to a warfighting advantage."

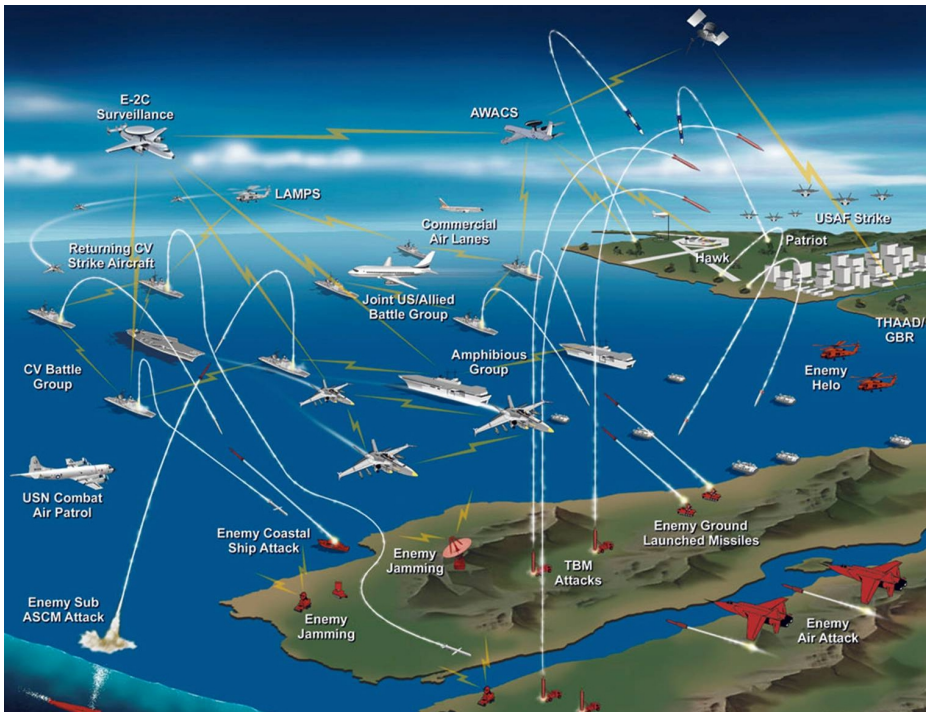

Figure 4: Network-centric warfare (Unknown source)

The advent of NCW is largely based on the technological advances of the so-called Age of Information. Computer-based representations of the disposition of friendly forces and their movements, and to some extent, the course of future operations can now be constructed and maintained in great detail. Enemy force dispositions and movements can now be observed and recorded using technologies not available at the end of the cold-war period, a scant twenty years ago. The resolution of satellite observation has improved to the point that, using an internet application (Google Earth), any citizen can distinguish houses, cars and other details in any North American neighborhood. Military systems can see such detail and more and refresh the picture with regularity. Air reconnaissance has also improved by using high-speed, high-definition numerical cameras and computer-based picture analysis. Local observation has been improved by small, unmanned low-level aircraft. In addition, many

individual weapons systems have their own sensor systems, such as radar and heat-sensitive scanners that can locate and identify enemy weapon emplacements and movements.

A key element of NCW is the pooling of all of the information that can be obtained from these many sources so that both senior and subordinate commanders can have access to the same rich picture of the battlespace. This so-called Common Operating Picture (COP) would be constructed and maintained in something approaching real-time by the aggregation and fusion of information from all sources. An ubiquitous network using both wired and wireless technologies, including satellite uplinks and downlinks, would ensure wide availability of the centrally maintained information base throughout friendly forces. To improve availability and survivability, complete or partial replications of the central database and COP could be distributed throughout the network and updated at suitable intervals. Unlike the case of the traditional military structure, intelligence would flow freely both up and down through the chain of command. Alberts et al. [32] cite the following characteristics of the concept:

> "NCW focuses on the combat power that can be generated from the effective linking or networking of the warfighting enterprise. It is characterized by the ability of geographically dispersed forces (consisting of entities) to create a high-level of shared battlespace awareness that can be exploited via self-synchronization and other network-centric operations to achieve commanders' intent. NCW supports speed of command - the conversion of superior information position to action, NCW is transparent to mission, force size, and geography. Furthermore, NCW has the potential to contribute to the coalescence of the tactical, operational, and strategic levels of war."

NCW, as described, would have a number of advantages. The wider and more complete distribution of information, for example regarding both friendly and enemy troop dispositions, would tend to improve the quality of the quick decisions required on the battlefield, as would an improved understanding of the commander's intent. The existence of a common operating picture would improve the self-synchronization of friendly forces and thus produce better combat results.

6.3.1 Theoretical considerations

As shown earlier, the type of organization advocated by NCW is very different from that of a traditional military force which is organized as a hierarchical structure. These two visions of how a military force might operate may be examined in the light of theoretical considerations drawn from information theory and algorithm design.

6.3.1.1 Message passing model

The traditional military structure may be thought of as operating using a form of "message passing" as its principal means of communication throughout the hierarchy. Each individual unit maintains its own "memory" concerning its own and enemy troop dispositions, unit

morale, the orders it has received and so on. According to established protocols and schedules, the unit extracts information from its memory and transmits it to the next higher level in the hierarchy. The extraction involves a process of evaluating and summarizing available information. This process is repeated through the hierarchy until the level of the senior commander is reached and the information received is recorded in the highest level of memory. Relevant portions of this information are then passed down the hierarchy, along with orders concerning current and future operations. From information theory, one can identify the costs implicit in this communications schema:

- important information might be lost as information is summarized for passing either up or down the hierarchy;
- there are inherent time delays in distributing information because messages are passed at intervals determined by established protocols, and critical information might be unavailable when needed;
- decision making will be less effective than it could be because all information is not available at all times.

However, "message passing" is relatively efficient in terms of bandwidth use; it does not require complex technology. To mitigate the costs enumerated above, military forces spend time and resources to train staff officers to identify, summarize and transmit relevant and critical information through the structure.

6.3.1.2 Shared memory model

The flattened, self-synchronized structure may be thought of as using a form of "shared memory" as its principal means of communication. Information from satellites, aircraft reconnaissance, unmanned drones, weapons and other sensors is directly connected using advanced information and communications technology, aggregated with that from subordinate units and fused into a COP maintained in a database. Note that the database itself might be physically distributed throughout a network, although it would be seen as a single entity. Unit commanders and even individual fighters could then obtain access to the COP as required, and thus be more able to plan and execute operations. Again, from information theory, one can identify the costs implicit in this communications schema:

- subordinate units will require a high bandwidth to access the COP;
- the maintenance of a large, centralized database is, in itself, a costly undertaking;
- while raw data might be recorded as it arrives, it might not be possible to correctly process and aggregate arriving data in real time;
- errors in recording or in processing raw data may then be propagated throughout the structure;
- operational conditions may prevent units from obtaining access to the database as frequently as they wish;

- unit commanders may suffer from information overload;
- senior commanders may yield to the temptation to micro-manage subordinate units using the COP and communications systems.

Yet, information technology is improving to the point where, in the future, the technical disadvantages may be, for the most part, removed. Perhaps the thornier task will be to train commanders and staff officers to operate efficiently within this new environment.

6.3.2 Issues in Network Centric Warfare

One cannot claim that network centric warfare has been fully implemented and tried in battle. Many of the technologies required by this concept are not yet fully mature. Others are relatively mature and operational, but cost, production constraints or other factors have prevented them from being fully deployed. A revision of training content and methods will be required to make Network Centric Warfare (NCW) a reality in fighting units. A revision of military doctrine may be required to implement the concept throughout a fighting force. There is some danger that the rich picture being distributed throughout friendly forces through the network might fall into enemy hands through hacking or through captured equipment. Nevertheless, NCW has been partially deployed in the second Iraq war and some experiences have been analyzed.

The technologies required for NCW are not yet mature. Reporter Greg Grant [34] describes a case where, on April 2, 2003, a U.S. Army battalion seized a Euphrates River bridge, designated Objective Peach, and held the bridge for 24 hours against a punishing Iraqi counterattack by 8,000 soldiers backed by 70 tanks and armored personnel carriers. The presence of the Iraqi force, camouflaged by simple netting and trenches, was not detected and represented in the operational picture available to the front line troops. Information that was available in the central database could not be accessed by the constantly moving front line forces because of slow data transmission rates and other technical issues. Whitehead [35] also cites this incident in an article dealing with the future implementation of NCW.

Barnett [36] warns against the possibility of distortions in the COP and of micro-management of operations. He writes:

> "The COP cannot really be shared in the sense that ownership will remain a top-down affair. [...] information technology [...] reduces the traditional asymmetries of information that define superior-subordinate relationships. [...] the picture [may] be less a raw representation of operational reality than a command-manipulated virtual reality. At worst, I envisage command staff engaging in a heavy-handed enforcement of commander's intent, all in the name of shaping and protecting the COP."

Indeed, Barnett is pointing out that NCW will have a major effect on authority relationships within the military and on the operation of the chain of command. Senior commanders will no longer be, for their subordinates, the source of intelligence concerning the battlespace

situation. Self-synchronization may also give the initiative for action to subordinate commanders rather than to the senior commander. Wesensten et al. [33] would appear to concur in their conclusions. They write:

> "Such self-synchronization shifts the balance between bottom-up organization and top-down control in favor of bottom-up organization."

Barnett further suggests that the hierarchy may seek to "redress" this situation by manipulating the COP.

This sombre view may or may not turn out to be how NCW affects military operations, but it does highlight the fact that weighty human and organizational issues remain to be dealt with before this approach becomes the standard operating principle.

6.4 Coalitions and NCW

Some of the issues pertaining to NCW, and to Network-Centric Operations (NCO) in general, are amplified in coalitions. This is the case of problems related to communication technologies and command practices, elaborated in the first part of this section (see also § 3.3, § 5.2, and § 5.3). But coalition participants may also encounter problems which are more of a social nature. To explain the latter, the social and cognitive dimensions of NCO are explained. Some of these are serious challenges to coalition operations in a net-centric environment.

6.4.1 C2 and technological issues

Military coalitions necessarily comprise a number of national contingents coming from nations that may have very different levels of military communications technology, as well as different command structures and military cultures. Yet, NCW requires tight integration of communications technologies and compatible command practices.

NCO require the compatibility of:

- Combat capacities and resources
- Operation principles, ROEs, procedures, policies, doctrines and information security needs
- Communication means
- Command structures

McIntyre and Flemming [37] point out the following:

> "A net-centric capability of any degree is built upon reliable and secure data links coupled with networking and procedural standards shared by participating units. This insures that required information can be exchanged, be it sensor data, environmental awareness information or C2 directives. Achieving such a capability is

> a challenge for national forces but it is a far greater challenge for coalition forces where the units participating in NCO may have different equipment, policies, procedures, and information security needs."

Nations often seek to form coalitions at short notice, and it is unlikely that all prospective partners would possess the means to engage in a network centric action at short notice. Indeed, even in long-term alliances such as NATO, it is not clear that all partners would agree to the large expenditures for equipment and training that acquiring a NCW capability requires. Nor is it clear that command structure issues raised by the establishment of a NCW enabled force would be easily solved in a multinational force. One possible effect of the adoption of a high level of NCW capability by a major prospective coalition partner, such as the United States, could be to virtually exclude less well-equipped forces from engaging in joint military actions with the dominant partner.

Even in the recent past, coalition operations have largely been carried out within a traditional military hierarchy, using the message-passing model. In a coalition, where forces may use a different language or different communications technologies, the message-passing model has somewhat reduced the difficulties inherent in such a situation. For example, if adjacent units do not use the same language, it is probably sufficient that bilingual officers be available at the interface with the senior commander for orders to be correctly transmitted. A small number of bilingual liaison officers or translators may be used to maintain communications with adjacent or supporting units. In a highly integrated shared-memory structure, the situation is more difficult. Both language difficulties and technological differences might prevent some units from participating fully in the communications structure.

Technology alone will not flatten the hierarchy or permit the efficient use of a shared-memory structure. Officers must be trained to use such a command and communications arrangement effectively and to trust it. It cannot be taken for granted that all coalition partners will have this level and type of training.

6.4.2 Social and cognitive dimensions of NCO

In order to understand NCO, it is essential to recognize that military activities occur across four domains: physical, information, cognitive, and social.

The physical domain is where strike, protect, and maneuver take place across the environments of land, sea, air, and space. It is also where the infrastructure that supports NCO exists. The information domain is where information is created, manipulated, value-added, and shared. It can be considered as the "cyberspace" of military operations. The cognitive domain is where the perceptions, awareness, understanding, decisions, beliefs, and values of the participants are located. These intangibles are crucial elements of NCO.

The interactions between the four domains can be sketched as follows: the physical and information domain provide the infrastructural and informational foundation for information sharing. People perceive information (in the cognitive domain) and turn it into knowledge.

This entire process takes place in the social domain where people interact collectively and collaboratively to solve complex problems.

The social domain is an innovation of the NCO Conceptual Framework [38]. It is where force entities interact, exchange information, form awareness and understandings, and make collaborative decisions. It overlaps with the information and cognitive domain but is distinct from both.

The intersection of the cognitive and social domains can be seen in the transition from shared awareness to shared understanding to collaborative decision making, where the individuals' cognitive activities are directly impacted by the social nature of the exchange and vice versa. This process is referred to in NCO literature as (collaborative) *sensemaking*, a concept introduced in organization theory by Karl Weick [39].

The social domain is all the more important since increasingly, military operations are planned and conducted by individuals from different organizations, across different echelons, services, coalition partners, and other governmental and non-governmental agencies. This involves people interacting in ways that require new and more complex collaboration. What makes this particularly challenging is the fact that individuals, the organizations in which they operate, and their interactions are all characterized by different cultures.

The social domain also emphasizes the belonging of actors to different organizations. Across organizations, there can exist very dramatic differences in terms of what rules, roles, and relations are operative. Therefore, having background knowledge about the organizational culture of military operations is necessary if we are to understand military decision making and action.

Sensemaking

At the collective level, sensemaking is represented as a collaborative process involving different perspectives. Military operations involve the coordination of many different functional elements, each of which will be 'seeing' specific emerging threats and opportunities from their own perspective. Different interests might also exist across organizational boundaries within a coalition. In order to achieve operational synchronization, these perspectives must be melded into a common problem framework where the different aspects of the operation are integrated into a single vision. Thus, shared sensemaking becomes a crucial part of the Command, Control, Communications, Computer, Intelligence, Surveillance, and Reconnaissance (C4ISR) process.

As Leedom and Eggleston [40] point out, a major activity of C4ISR organizations and networks is for the stakeholders to collaboratively engage in knowledge work – the presentation of different operational views with the purpose of achieving a shared awareness and appreciation of the specific goals, constraints, threats, and opportunities developed within each perspective. Achieving this common ground of understanding involves the exchange of both information (bottom-up) and positions (top-down) among the collaborating parties. While computers still offer C4ISR organizations a great information-processing capability,

the need to consider and reconcile the variety and complexity of interpretations of information outputs generated by humans and computer systems remains. Understanding the various views directly impacts the strategic and operational direction of the organization.

This need for considering and reconciling the perspectives of multiple stakeholders and experts reflects a key advantage of moving towards network-centric C2 operations. But, just as information technology does not necessarily bring about the automatic improvement of decision making performance within a single organization, so too the electronic linkage of multiple C2 organizations does not necessarily bring about automatic improvement in collaboration and the synchronization of operations [40]. Rather, one must begin to identify and assess the various factors that influence the creation and management of actionable knowledge across a networked C4ISR system.

Such factors include [40]:

1. Information technology in the form of information displays, decision aids, and collaborative work aids;
2. Training and standards of staff performance at both the individual and collective level;
3. Personnel management policies as they affect levels of staff expertise and the maturity of social networks;
4. Staff process and battle rhythm as they enable the overcoming of various technical, cognitive, social, organizational, and procedural obstacles;
5. Cultural differences as they affect staff interactions and information exchange;
6. Organizational design as it facilitates and orchestrates appropriate patterns of collaboration, work flow, and decision making.

Considered together, each of these factors can be said to influence the collaborative sensemaking and knowledge management activities of a networked C4ISR system in important ways.

6.4.3 Synthesis of coalition challenges in a net-centric environment

Figure 5 represents the conceptual framework of NCO and the interdependencies between the cognitive, social, physical and information domains, indicated by colors. These elements have been structured differently from the original diagram in order to make our legends more legible and also situate the elements in two different interoperability spaces. The first one, which corresponds to the orientation - decision phase is embedded in the socio-cognitive domain where individuals' expertise is combined with available information to develop situation awareness and situation understanding, frame decisions and guide actions. The second space, relative to the physical domain, is the execution phase. Interoperability takes place between several C2 nodes, unified by a common goal, as described by the mission. These two spaces are supported by the technological infrastructure which allows information sharing.

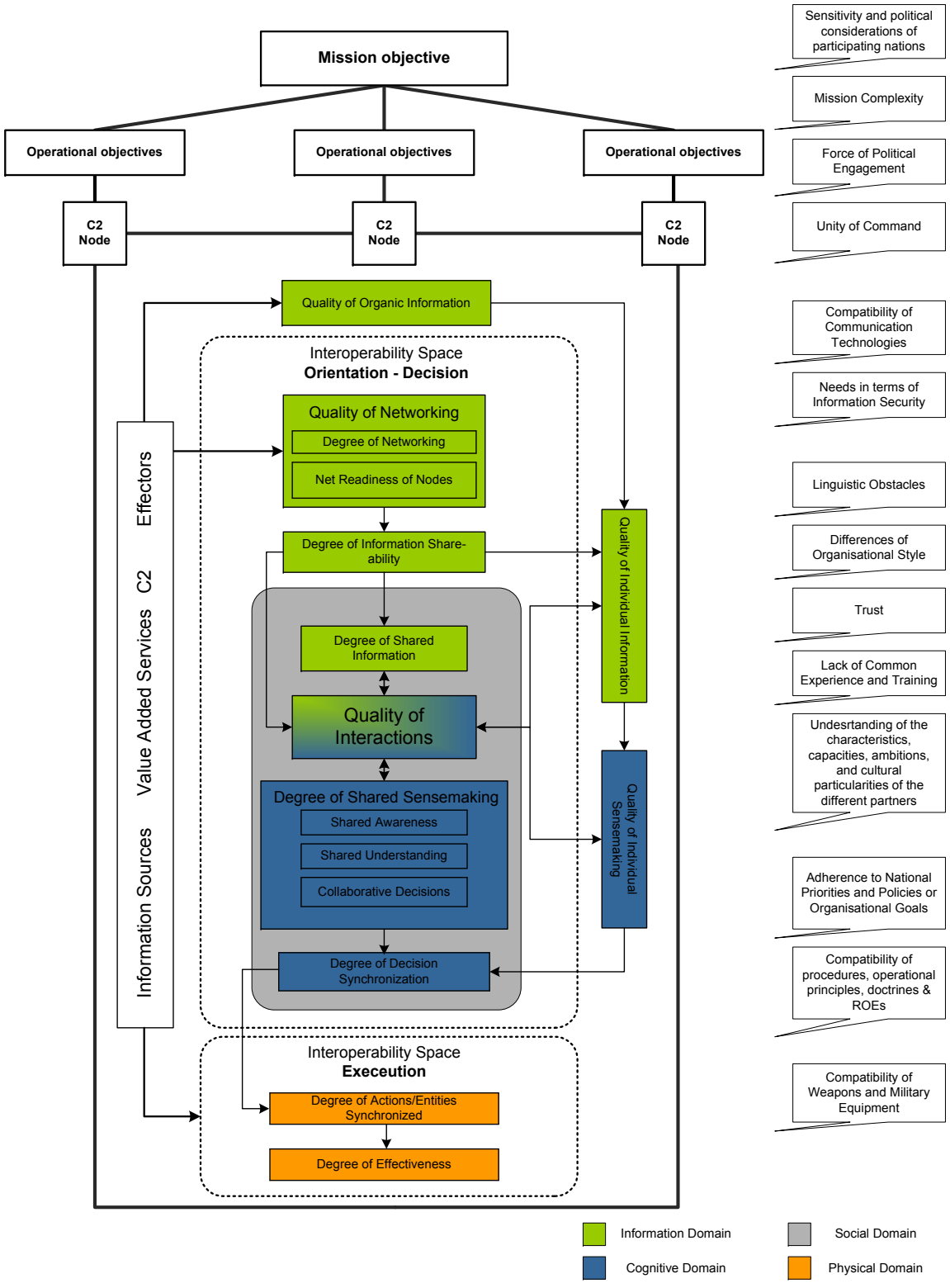

Figure 5: Coalition challenges in the NCO model

Yet, as argued throughout the document, the technological structure linking the different C2 organizations cannot enhance collaboration and the synchronization of the operations on its own. In a joint or coalition military environment, these processes can be complicated by a number of technical, cognitive, social, organizational, cultural and operational factors. These factors, which can potentially infringe interoperability are indicated by legends on the diagram.

Most of the legends have been already commented in different sections. Let us remind that military coalitions are short-term arrangements created in response to a punctual need or event. The participating members, allowing for exceptions, do not have a common experience and should construct procedures to be able to work together. The only common ground between the different entities is a high-level objective that bring them to engage in a common mission and coordinate their actions.

In a nutshell, the challenges related to coalitions are the following.

Given their ad hoc nature, coalitions face the problem of the political engagement of their members. In the military context, this brings about the problem of unity of command. Furthermore, given their heterogeneous composition, they face, at the micro-level, the problems related to the interactions between the different actors, and at a larger scale, those related to the interoperability of the forces.

6.4.4 Long-term solutions

A traditional way of responding to at least some of these challenges has been geographical separation. For example, in the First World War, British and French forces each had a section of the front in which to operate. They coordinated strategies and large scale operations at the highest political and military levels, but except at the juncture of their forces, they did not require intense liaison at lower levels. They did not share the same battlespace. In the second Iraq war, British and US forces have largely adopted the same type of geographical separation, but this is not always possible.

A number of measures are sometimes proposed for dealing with coalition challenges. These include:

- adoption of a common doctrine and tactics;
- joint training exercises;
- adoption of standardized technologies;
- adoption of common rules of engagement;
- lasting political agreement on command structures and responsibilities.

While each of these measures might indeed improve military effectiveness of a coalition's forces, each is essentially a move towards a long-term alliance. Each will require strong and real political support within the nations involved and various measures may represent a

radical change in practice or political status. As such, some of these measures may in fact be antithetical to the rapid establishment of an effective ad-hoc military force. Nations are unlikely to wholeheartedly undertake such measures unless they have a clear and critical national interest in the outcome.

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7 Conclusion

This document overviewed many different aspects of coalitions in general and of military coalitions in particular. At the general level, the conditions in which coalitions are formed and the costs and benefits of coalition building were identified (synthetized in Figure 1). Coalitions provide their members with more power, more resources and an enhanced profile. Yet, the ad hoc and temporary nature of coalitions and the fact that members remain under the control of their home organizations compromises resolve and unity of effort and brings about control and decision making issues.

At the particular level, military coalitions were characterized as an ad hoc arrangement between two or more nations for common action, formed on short notice, with a dynamic structure and ill-defined Command & Control (C2) arrangements. Coalitions were analyzed in different historical contexts going from World War I to the recent Iraq war and to the net-centric battlefield of the future. We showed that new warfare concepts such as Network-Centric Operations (NCO) and its enablers such as collaborative situation analysis and self-synchronization are heavily dependent on technology. The technological factor, be it for combat systems or communication assets, is one of the most serious challenges for coalition operations. Other factors such as politico-organizational, socio-cultural and purely C2 issues were also discussed, both for multinational operations and NCO. Coalition-specific problems were represented within the NCO conceptual framework.

The C2 structure of coalition operations was detailed. The strategic, operational and tactical levels were exposed for a better comprehension of decision making mechanisms in coalitions. Finally, within the spectrum of military planning and control, we compared the dynamics of traditional hierarchical military organizations with that of self-synchronized forces and identified the implications of this transformation for coalition operations.

The point that stands out all through the document, is that coalitions are less efficient than other types of organizations because of their ad hoc nature and the hybrid mechanisms that characterize them. Coalition participants are required to closely collaborate with each other as in a single organization, while they are in reality, controlled by their home organizations and are subject to their interests and priorities. The problem of the political engagement of coalition members is rendered in the military context, as a lack of unity of command. Furthermore, given their heterogeneous composition, coalitions face, at the micro-level, the problems related to the interactions between the different actors, and at a larger scale, those related to the interoperability of the forces.

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Coalitions are becoming the standard in military operations, involving different organizations, services and agencies. This implies new and more complex types of interaction, the challenges of which must be situated along different dimensions. This report studies the characteristics of coalitions and discusses their political, organizational, socio-cultural, technological and Command & Control (C2) challenges. The costs and benefits of coalition building, the recent history of coalitions, the properties of military coalitions, and finally, issues faced by coalitions with regard to the transformational context and the advent of network-centric operations are investigated.

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