

Future Conflicts and Cruise Missiles

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Preamble

It is impossible to know what future conflicts will occur, at least using a reasoned approach. All that an observer can do is attempt to draw upon lessons from contemporary conflicts and then apply these lessons to identify trends that are likely to prevail in the future. As emphasized by Colin S. Ray: "*Beware of those who are addicted to the use of the thoroughly misleading concept, the foreseeable future. The future is not foreseeable period*"¹.

Objectively, it appears that the nature of military conflicts has not changed fundamentally for several decades. The Algerian and Vietnam wars are striking contemporary examples of so-called asymmetric² conflicts, like the Boer war in the XIXth century. This observation suggests that "new forms of conflict" are not likely to occur in the future.

This study starts by making an attempt to characterize *possible forms* of future wars in which Western powers (United States, Europe and their allies) would play a role. Therefore, the aim is to determine the general structure of adverse entities, their action means and general objectives, and to define the possible missions of Western forces faced with such adversaries.

Starting from this work, we will attempt to understand how existing cruise missiles, or cruise missiles that we might be able to develop based on current technological progress, will play a role in how these conflicts will be conducted by our armed forces.

¹ Colin S. Gray, "How Has War Changed Since the End of the Cold War?", May 2004 (Paper prepared for the conference on the "changing nature of warfare" in support of the "Global Trends 2020" project of the National Intelligence Council), p. 4.

² Thus, the term "*asymmetric conflict*" was already used in the 1970s, see Andrew Mack, "Why Big Nations Lose Small Wars: the Politics of Asymmetric Conflict", in *World Politics*, Vol. XXVII, January 1975.

PART ONE:

CHARACTERIZATION OF FUTURE CONFLICTS

1 – Typology of conflicts

As shown by contemporary progress in the theory of conflicts, the types of war that prevail at the moment are not really new. But while the 19th and early 20th centuries were marked by conflicts between Nations, the second half of the 20th century (from the end of the Second World War) and the beginning of the 21st century saw the development of conflicts involving non-state players (decolonization wars, insurrections, civil wars).

One must notice that the major conflicts at the beginning of this century (sometimes referred to as war against terrorism in Iraq, Afghanistan, Chechnya) oppose States (or groups or States) to non-state groups.

However this does not mean that conflicts between States will disappear. There are already many sources of tension between States, although the United States hegemony makes the emergency of rivals that could defy American Military power to pursue their interests very improbable in a short term. Everything suggests that this situation should change in the medium term, particularly due to the leveling of military technologies³.

1.1 – *Parameters characterizing conflicts*

Although it is difficult to predict future conflicts, it is possible to define the **parameters that characterize them**:

- ◆ Conflict type (depending on players):
 - ⇒ War between States (between two or more States);
 - ⇒ Internal war (between a State and a non-state group inside its frontiers);
 - ⇒ Hybrid war/extra-systemic⁴ conflict (between one or more States and a non-state group, transcending national frontiers);
 - ⇒ Sub-state war (between non-state participants, for example between a security company and a terrorist group).
- ◆ Objectives and motivations of participants/stakes:
 - ⇒ Political (conquest or maintaining power);
 - ⇒ Geographic (territorial control);

³ Colin S. Gray, "How Has War Changed Since the End of the Cold War?", op. cit., p. 13.

⁴ Colonial wars are often put in this category.

- ⇒ Economic (access to resources, personal profit);
- ⇒ Ideological (religious identity, ethnic claims).
- ◆ Means and rules: economic, technical, military and informational capabilities of players, strategic choices⁵, ability and will to respect common rules for conducting the conflict (war law).
- ◆ Intensity⁶ and duration of the conflict.

1.2 – *Is symmetry a characteristic of conflicts?*

The concept of **symmetry** is not a parameter in itself, but it can enable an understanding of the level of interaction between the proposed parameters. It can be applied at two levels, namely objectives and means (including rules). As theorized by E. Simpson⁷, these two levels alone could be sufficient to structure the study of contemporary conflicts.

The symmetry of the end objectives of existing opponents⁸ has an influence on the progress and result of conflicts. It affects the relative political resolve of players to engage and continue the armed struggle. For example, if one of the camps fixed an existential objective (political or physical survival) and the other fixes a geographic objective (to hold or to conquer territory), the former will tend to continue the combat regardless of the cost while the second, for which the ratio of the cost (political, economic, human) to the expected benefits is potentially greater, may abandon before achieving its result⁹.

A priori, symmetry of means is applicable to several sub-categories:

- ◆ Hardware (and military) means: obviously, the relative capacity of opponents to carry out military and civil-military operations has an influence on the result of conflicts. Although the ratio of military force between participants may not be sufficient to structure an entire conflict by itself, it will constrain their strategic choices¹⁰.
- ◆ Strategies¹¹: Arreguin-Toft puts forward a theory according to which the symmetry of opponents' strategies is of overriding importance for the issue of conflicts. It opposes direct strategies (applicable to armed forces) and indirect strategies (applicable to political resolve), indicating that the weaker players tend to defeat the stronger players in confrontations between direct and indirect strategies, by

⁵ According to Ivan Arreguin-Toft "How the Weak Win Wars", *International Security*, Vol. 26, Summer 2001.

⁶ That is characterized by the number of victims.

⁷ E. Simpson, "Thinking about Modern Conflict: Hybrid Wars, Strategy, and War Aims", Paper presented at the Annual Meeting of the Midwest Political Science Association, 7-11 April 2005.

⁸ That the first theories on asymmetric conflicts describe as being the main cause of the defeat of large powers by the small powers. See Andrew Mack, "Why big Nations lose small Wars", *World Politics*, Vol. 27, N° 2, January 1975.

⁹ Which also assumes that players are rational, although this is not necessarily the case in all conflicts.

¹⁰ In the clausewitzian sense of the term, the strategy refers to methods of using armed forces to achieve fixed political objectives.

¹¹ Strategy: Plan for the use of armed forces to achieve political or military objectives, Ivan Arreguin-Toft, "How the Weak Win Wars", *International Security*, Vol. 26, Summer 2001, p. 99.

increasing the duration and the cost of conflicts. For example, he mentions in particular the theories of Mao Tse Tung on guerrilla warfare (indirect strategy), and states that they will only work if the adversary chooses a direct strategy (offensive or defensive battle).

- ◆ Rules: one of the oldest characteristics of war is related to the design of rules designed to govern the use of armed forces¹². Contemporary conflicts seem to be characterized by the loss of reference to "common game rules", tending to make conflicts more anarchic (or uncontrolled). This loss of common references is another factor of asymmetry between state players (that more or less apply the rules of war) and non-state players that do not accept them and do not apply them¹³.

2 – Characterization of conflicts

2.1 – *Infra-state conflicts*¹⁴

The possibility of an inter-state conflict that involves us bursting out by 2015 appears relatively low, although it cannot be entirely eliminated. Although there is no reason to believe that this type of conflict will disappear permanently, the Post-Soviet period is characterized by the appearance of infra-state crises in which western or Russian armies fight against more or less militarily structured groups (militias, para-military organizations, terrorist organizations, armies of bankrupt or near bankrupt States). In reusing our typology, and assuming that the trend observed between 1991 and 2005 will continue in the short term, most conflicts that will involve western States by 2015 should be of the hybrid type¹⁵.

Players involved in this type of crisis include States or non-state organizations (militias, gangs, terrorist groups) and also local populations who may be used by the various players as a source of information or wealth, or more directly as a "backup force".

Regardless of his form, the adversary will usually be equipped with simple material and at the best will be capable of setting up and performing simple inter-army operations. However, he can exploit several significant advantages:

- ◆ Urban agglomerations as refuges, sanctuaries or combat zones. The use of towns to limit the maneuvering capacity (political and military) of western countries could become common place.
- ◆ More or less time sensitive centers of gravity. The mobility and stealth of high value elements of the opposing disposition would make them less vulnerable to the use of force.
- ◆ Strong media coverage of conflicts. The adversary can take advantage of the presence of non-combatants (media and non-governmental organizations) to affect the determination of western public opinions.

¹² In the Christian West, Grotius defined the framework for the use of force in armed conflicts in "*Law of War and Peace*" (1625). The Geneva conventions are international in scope and have made the law of war universal.

¹³ William S. Lind, "Understanding Fourth Generation War", *Military Review*, Sept-Oct 2004, pp. 12-16.

¹⁴ See Appendix 2 for a more detailed description.

¹⁵ Starting from this point, any armed conflict between non-state players is excluded from the study (for example private war).

2.2 – Conflicts between States¹⁶

The emergence of conflicts between States, for example based on questions of access to resources (energy, water, raw materials) or domination of regional areas is still possible. Control of shipping routes, possession of submarine resources and domination over small portions of territories (islands), could poison relations between neighboring States in the Indian Ocean and in the China Sea, and also in the Persian Gulf area. These tensions are exacerbated by the rarefaction of some resources and the increasing importance of world trade.

Another influential factor is the emergence of new nuclear powers that could modify the security structure as it has been built up since the end of the Cold War. The Iranian and Korean crises are interstate conflicts that generate tensions in the regions concerned and internationally, and could lead to armed conflicts involving regional and global powers. The recurrent tension between India and Pakistan could lead to military conflicts between the two States, although the situation appears to have calmed down over the last few months¹⁷.

Although equipment available to potential adversaries beyond 2010 are unlikely to be competitive with those of the Western powers, they might develop or purchase some systems that they could use to exploit the vulnerabilities of our armed systems or our deployments. In particular, the States considered might have:

- ⇒ Medium range precision strike means (ground attack, antiship missiles);
- ⇒ Stealth platforms (submarines, aircraft);
- ⇒ Electronic warfare tools;
- ⇒ Zone denial means (mines, air defense);
- ⇒ Non-conventional weapons.

3 – Conclusions on future conflicts

There are several structuring aspects to conflict development trends affecting the Armed Forces of a Western State, related both to the management of operations and hardware means.

Firstly, time acts against Western Armed Forces. From a strictly operational point of view, conflicts should require short reaction times because the adversary takes advantage of the mobility and discretion of his forces when faced with better armed and better trained western armies. Non-state adversaries need to rely on attrition in order to succeed. The increase in human, financial and political costs of conflicts for western states could become quite disproportionate to the stakes, such that they might renounce continuing armed action.

The ambiguity of territorialization in some conflicts further increases the difficulty for western forces. In the lack of any clear geographic location of the adversaries, the use of

¹⁶ See appendix 2 for further details.

¹⁷ Michael O'Hanlon, "Future Military Scenarios Involving American Forces", Testimony before the House Armed Services Committee, October 26, 2005.

force can become particularly difficult. Exploitation of the urban environment by some adversaries as an operational sanctuary also tends to make operation control more complex. On the other hand, in territorialized conflicts, one of the difficulties may be the question of the capacity of western forces to access the theatre of operations.

In this respect, the relative unbalance of forces and means present could play a structuring role in future conflicts. Regardless of the opposing entities, they should not have an operational capacity equivalent to Western Armies, either in terms of equipment or military capacity. However, it is quite possible that some of them might have some means just as efficient or even more efficient than those existing in the West, in some specific fields. These adversaries might then take advantage of these means to target vulnerabilities of the Western forces (for example anti-access strategies, anti-network operations). Furthermore, the asymmetry of means between Western Nations and their potential adversaries could lead to the use of indirect strategies, regardless of the adversary.

Future conflicts should also continue to be characterized by a large number of non-combatants. They may be structured organizations (media, non-governmental organizations) that indirectly influence how operations are carried out, or the political development of the conflict. But local populations could continue to play several roles, particularly as a resource for adversaries; either willingly in the form of an armed crowd or recruits, or unwillingly, by providing physical support for enemy forces.

The media should also play a central role, by controlling perception of the conflict by the public (western and local), both in terms of its causes or its conduct. The management of the media aspect of the conflict should be a primary objective for the players concerned. For Western forces, this means limiting collateral damage and therefore demonstrating its capacity to make precision strikes on elements clearly identified as being combatant.

PART TWO:
THE CONTRIBUTION OF CRUISE MISSILES
TO THE MANAGEMENT OF FUTURE CONFLICTS

1 – Typology of cruise missiles

A cruise missile is an unpiloted and self-propelled vehicle using aerodynamic lift during its flight and fitted with a destructive warhead.

Only ground attack missiles will be considered in this study. This choice reflects the diversity of actions that may be assigned to this type of missile and also one significant development, namely the dual function of some anti-ship missiles (anti-ship and coastal attack). In generic terms, the missiles that are studied are intended firstly to threaten, neutralize or even destroy fixed or mobile land targets.

The success of the missions assigned to a cruise missile is based as much as its intrinsic performances as on the efficiency of related elements participating more or less directly in mission preparation and accomplishment. Thus, a cruise missile forms part of a complete system for which the main elements are :

- ⇒ The carrier: surface ship, submarine, aircraft or land launcher.
- ⇒ Mission preparation means, targeting means and means for damage assessment (and consequently the intelligence loop).
- ⇒ Decision loops (including firing coordination tools).

The following performances that can be selected for the characterization of cruise missiles are:

- ⇒ The range: the maximum distance that the missile can travel from its launcher before hitting its target.
- ⇒ The precision: in other words the ability to hit a determined target without error.
- ⇒ Robustness of the guidance system: in other words the ability of the missile to hit its target if the target is camouflaged or if it is provided with some counter-measures.
- ⇒ The penetration ability (stealth, low altitude flight).
- ⇒ The efficiency of the warhead.

The effects of using cruise missiles on non-fighting populations (collateral damage, media impact) must also be taken into account, although this is not a genuine measure of performance.

2 – Action of cruise missiles in future conflicts

Now that more than 2000 cruise missiles have been fired since *Desert Storm*¹⁸, including 802 Tomahawks for the *Iraqi Freedom*¹⁹ operation alone, everything suggests that cruise missiles have reached their mature stage.

Conventional cruise missiles have become one of the central components of power, by providing armed forces and political authorities with the ability to conduct precision strikes on distant targets. These two aspects (precision and range) are structuring elements of their use making them suitable for use in striking high value targets in a logic of coercion or reprisal, while minimizing human and material loss on each side. This is illustrated by the repeated use of cruise missiles by the United States in the context of diplomatic maneuvers in the 1990s (e.g. against Iraq and Serbia).

However, the question of the different possible ways in which cruise missiles can be used arises when looking at different types of conflicts and particularly if these conflicts involve players characterized by a lack of persistent centers of gravity and strong mobility. The objective is to determine how to use the performances of these missiles to obtain the best benefits.

2.1 – Adaptation of distant precision strikes to future conflicts

2.1.1 – Typology of elementary effects for distant strikes

Elementary effects that can be obtained by distant and precision strikes - and the conditions under which these effects can be obtained - form a concrete measurement of their usefulness within a wider framework of strategies designed to reach determined final states²⁰.

Elementary effects may be classified depending on their type (direct²¹ or indirect²²), the application points considered (fixed or mobile structure, military or civil person, legal entity or resolve of the adversary, etc.), and the moment at which they can be obtained (peace, pre-conflict, conflict).

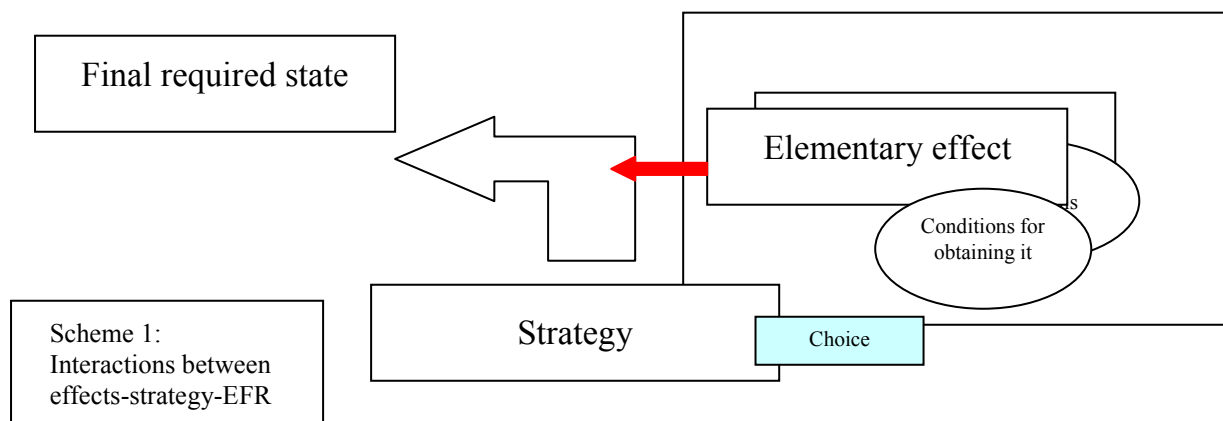
¹⁸ <http://www.danshistory.com/operations.shtml#cruisestat>

¹⁹ http://www.findarticles.com/p/articles/mi_m0IBQ/is_1041/ai_115694518

²⁰ This once again introduces the concept of *Effects Based Operations (EBO)* in the American sense of the term - *A process for obtaining a desired strategic outcome or "effect" on the enemy, through the synergistic, multiplicative, and cumulative application of the full range of military and non-military capabilities at the tactical, operational, and strategic levels.* <http://www.jfcom.mil/about/glossary.htm#RDO>

²¹ Destroy an object, neutralize a capability.

²² Coerce or threaten an object, a capability or a person.



The required elementary effects can be determined depending on the defined objectives and therefore the conflict considered. Whether or not they can be obtained also depends on internal factors (related to the system used) and external factors (related to the operational environment and the general situation).

In the remainder of this study, we will consider the effects that could be obtained using cruise missiles and the contribution of these effects to the objectives of a western force (coalition or other) for each type of conflict. We will also determine what conditions have to be satisfied to obtain this effect.

2.1.2 –Cruise missiles in infra-state conflicts and crises

Western States may consider eight generic final states in the context of infra-state conflicts and crises²³:

1. Withdrawal and dispersion of enemy forces

As we have seen, enemy forces are characterized by their mobility and their ability to blend into their environment. They attempt to avoid regrouping in order to escape to direct armed action that would disorganize or disarm them.

However, if they cannot regroup even temporarily, it will be impossible to make sufficiently large-scale engagements so that they can achieve their objectives. Therefore, regrouping of forces is essential.

Within the framework of isolated operations, the adversary may be obliged to regroup his material and human resources to achieve his aims. To assure security during this type of operation, the adversary will attempt to hinder western forces as much as possible in their attempt to identify and attack his forces. For example, by working in or from strongly populated urban areas.

In any case, the adversary will be vulnerable to direct actions during the period of these regroupings (or concentration of forces).

²³ These Required Final States (EFRs) are inspired by generic operational scenarios developed by the FRS. Several final states may coexist for a given crisis.

Cruise missiles can be used to create several elementary effects that could participate in obtaining the final required state:

- ⇒ **Direct effects:** the objective is to destroy or neutralize military capabilities, to eliminate military commanders, and to cause losses to units (composed or not). Application points must be considered as being mobile and military in nature. These effects are required in times of crisis or conflict, or even in some cases in post-conflict periods.
- ⇒ **Indirect effects:** the objective is essentially to dissuade the adversary from assembling his troops and to keep them dispersed, through the threat of precision strikes. The application point is the political will of the adversary.

2. Elimination, neutralization, disorganization of an adversary

The concept of neutralizing adversaries in infra-state conflicts is a complex problem because they may not have any persistent centers of gravity that can be destroyed (or for which destruction could be threatened) so as to disorganize them sufficiently to neutralize their action.

This is the case of non-state entities operating in the forms of cells practically independent of each other, drawing upon their criminal resources and acting in and from complex and dense environments. However, vulnerabilities of this type of organization may occasionally be exposed: this may relate to sources of income, executives working together to plan an action, training areas, or identified "command centers".

Better structured non-state players regularly discover their economic, political and operational centers of gravity that may sometimes be or become persistent. For example this will be the case of an armed rebellion attempting to structure itself into a proto-State²⁴. National proto-State type entities have persistent centers of gravity, which could be neutralized to contribute towards obtaining the required effect.

The elementary effects aimed at by the use of cruise missiles with the objective of neutralizing or destruction of an adversary could be as follows:

- ⇒ **Direct effects:** the objective is to destroy or neutralize vital enemy centers (command structures including leaders of the organization, vital economic infrastructures (e.g. distribution of water, electricity, resources). Application points are fixed or mobile and may be civil or military.
- ⇒ **Indirect effects:** the objective is to dissuade an organization from pursuing its objectives by threatening its interests or its centers of gravity. The application point is the political resolve of the adversary.

3. Consolidation of power/restoration of order/peace

In this case, it can be assumed that the strategic objective of the adverse entity (and its allies if any) is to overthrow an existing government so as to replace it. Therefore, it will carry out armed actions against vital centers of the existing government so as to disorganize it and attempt to conquer territories to progressively reduce the extent of the area controlled by government forces.

²⁴ For example, setting up a proto-communist State in China during the 1930s corresponds to the visible emergence of non-state structures of the CPC.

The difficulty for western forces will depend on the nature of the belligerents. Neutralization or destruction of one of the parties is not generally a solution that will lead to a long lasting peace, particularly in the case of a conflict almost exclusively among national players. On the other hand, the proven existence of supports by a state external to the country can provide application points for the use of cruise missiles. Western forces will also essentially have to put themselves between the fighting factions to prevent degradation of the initial situation.

Cruise missiles could be used to obtain the following effects, in an effort to reach the final required state:

- ⇒ **Direct effects:** the objective is to respond to direct aggression on western or governmental forces by destroying or neutralizing vital elements of the enemy disposition or even elements participating in their support from a neighboring State. Application points are usually fixed, but they may be valid only for short periods.
- ⇒ **Indirect effects:** the objective is to oblige the adversary to renounce some action modes or an operation by threatening his interests or his centers of gravity. The application point is the political will of the adversary.

4. Making a zone or an installation secure, protection of a population

Western forces attempt to stop adverse entities from being able to threaten, neutralize or destroy essential infrastructures or persons, over a short or long period. *A priori*, the protected zone, structure or persons represent a target for aggression carried out by the adversary.

To reach this final state they must provide physical defense in the case of an engagement, and they must oblige the adversary to renounce undertaking an action against the protected target.

For a non-state adversary, the range of action modes is generally offensive and cruise missiles will not obviously be capable of producing effective direct effects. This is particularly the case because operations are likely to be clandestine - for example through terror attacks.

On the other hand, in order to achieve his aims, the adversary needs to plan an operation (even if the planning is done in a tent at the middle of the desert or in a non descript building), and then assemble and arm his forces and finally execute the action. Therefore, there are some vulnerabilities in the decision loop that can be exploited through the use of precision strikes.

The use or existence of these cruise missiles can produce effects that contribute towards obtaining the final state, although they cannot help to reach it directly:

- ⇒ **Direct effects:** essentially, to make preparation for an enemy operation aimed at protected zones, infrastructures or persons, fail during its conceptual, preparation or execution phase. It can be assumed that the mobile or fixed application points are time sensitive.
- ⇒ **Indirect effects:** cruise missiles can be used to respond to any action against protected objects or persons. The required effect is to convince the adversary

not to persist in attacking his target. The application point may be a fundamental military capacity, a center of gravity or an important infrastructure.

5. Evacuation of foreign nationals

Achieving this final state involves firstly protecting the security of persons during their evacuation. In a conflict situation, these persons may be threatened by the adversary or the adversary may try to use their presence to influence our political decision making process²⁵.

Furthermore as we have already seen, non-state players are likely to circumvent generally accepted rules of conflicts. Consequently, from their point of view, the use of violence against the civil population is a legitimate mode of action. When taken against nationals of enemy powers, it is a genuine tool in asymmetrical warfare that can affect the political resolve of these enemy powers.

As in the previous case, cruise missiles will not directly contribute towards obtaining the final required state. However, when used as reprisals for actions against our own nationals, they may be useful as a tool for applying pressure on the adversary's political determination. Application points may be enemy centers of gravity, including persons belonging to the enemy organization.

6. Restoring and achieving security of a procurement (raw material, energy)

This final state can be required when an adversary blocks the procurement of a raw material from a country in which he is located. For example, this blockade may be obtained by occupying a critical infrastructure, or by systematically sabotaging extraction or transportation means by isolated actions.

Therefore in some cases, Western forces need to capture installations or means that are under the control of an adversary, so as to restore the procurement considered²⁶. In particular, the objective is to assure that control can be taken without hindering fast restoration of the procurement.

There are two possible ways in which western decision makers can achieve this. It might be possible to convince a non-state adversary to renounce control over the procurements, because the cost of their possession can quickly become unsupportable if threatened by action by western forces. Taking the installations or means considered back by force could also be considered, but there is a genuine risk for the long term procurement if the adversary decides to sabotage them before losing control.

In this context, cruise missiles can be used to obtain the following effects:

- ⇒ **Direct effects:** the objective is to destroy or neutralize enemy elements participating in the defense of installations or means to be recovered, without affecting them. Means assigned to defense of the site, or a building sheltering enemy forces, are all potential targets for an action carried out by cruise missiles.

²⁵ For example, remember the publicized and political use of American Nationals in 1990 just before the Gulf War - with mitigated success.

²⁶ Cases for achieving security have already been studied above.

- ⇒ **Indirect effects:** to force the adversary to abandon control of procurement means or installations or to force him to cease disruptive operations on them by threatening important elements in his military or political disposition. The application point is the political will of the enemy entity.

7. Secure reopening of shipping or land trade routes

Restoring security of a trade route threatened by a non-state entity consists of neutralizing the means that he uses to materialize the threat. Vehicles (land or sea) using the route considered also need to be protected.

As we have seen, the adversary is only likely to use light equipment parsimoniously in fast and quickly executed actions against poorly protected or unprotected adversaries.

Consequently, the protection must be applicable at all times and universally (cover the entire threatened route) and it must be reactive. Therefore to reach the final required state, Western Forces must be capable of neutralizing every threat to vehicles passing along the trade route. Cruise missiles could be used to destroy some enemy means threatening a friendly vehicle or a civil vehicle using the route.

8. Disarmament of a faction or a force - destruction or neutralization of adverse capabilities - prevent access to capabilities or their use

Even a cell type entity whose forces remain scattered and practically unseizable needs to access to weapons in order to achieve its aims. Its military equipment must be acquired, transported and stored before it is finally distributed to users.

This relatively long logistic chain has many vulnerabilities that can be partly compensated by its underground and opaque nature and by a large number of redundant networks capable of fulfilling the acquisition-delivery and storage functions. Therefore, complete disarmament of a non-state organization is a long term task obtained by a series of complementary actions. However, isolated operations can neutralize some of these networks thus contributing to reducing the armament level and therefore the threat.

Each phase (acquisition-delivery-storage) has its own specific vulnerabilities, that a Western power could exploit fully in order to fully or partly disarm an adverse entity.

Procurement may be made through illegal sales networks (intermediaries, weapon dealers), by robbery or pilfering, by local production, and in some cases from "friendly" States. In this latter case, pressure could well be applied on the countries concerned to oblige them to terminate or reduce the supply of equipment. Dismantling of illegal networks is another means of achieving this aim. Local production means could be destroyed, but collateral effects have to be minimized in the case of dangerous materials.

Equipment is vulnerable to direct actions during the transportation phase. Routes used are usually predictable and include compulsory transit points (roads, ports hubs, air corridors). Obviously, for some types of traffic, transportation can be done by discrete means (such as using diplomatic routes). However, it could legitimately be assumed that these cases are limited to the transport of small quantities of equipment. Even then, direct action during transport can considerably reduce the acquisition capacity of the adverse entity.

Vulnerability of the equipment includes the storage phase. However, it is clear that dispersion of weapons to combatants will make disarmament very difficult in cell type structures. This dispersion should be limited for territorial organizations, and there will be caches or warehouses in which the equipment necessary to sustain the military efforts will be stored. These storage locations are naturally vulnerable to direct actions by western forces attempting to neutralize or capture them. Yet, their direct destruction can raise technical or environmental difficulties in the case of non-conventional weapons (for example chemical weapons).

Therefore, in pursuing the policy to reach the final state, cruise missiles can help to obtain the following useful effects:

- ⇒ **Direct effects:** destroy the equipment during production, transport or storage. Neutralize the means used to convey military equipment while minimizing collateral damage.
- ⇒ **Indirect effects:** oblige a State supplying equipment to the adversary to cease or suspend its support. Actions against installations belonging to this State dedicated to production or storage of weapons could be envisaged. The application point is the political will of the sponsor State.

2.1.3 –Cruise missiles in inter-state conflicts and crises

In addition to generic EFRs developed within the framework of inter-state conflicts, there are also final states that are desirable to obtain specifically in the case of inter-state conflicts. Pursuing some of these states can depend on the organization of a coalition and be one of the internal aims of the coalition. Others are the result of the nature of the adversary or the methods or tactics he can use.

EFRs previously studied in the previous section, and the expected effects of the use of cruise missiles, are largely still valid when dealing with nations rather than non-state organization. We have seen that nations are *a priori* more sensitive to coercitive maneuvers than non-State entities, for example in the framework of symmetric stakes with western powers.

Concerning inter-state conflicts, a medium sized power may attempt to reach five final generic states:

1. Prevent a military action being initiated by a State

During the period before a conflict is started, in peace time or during a crisis, a State might envisage the use of force to reach its strategic objectives. Before choosing this option, it has to take account of the general equilibrium of forces and the resolve of these potential adversaries to take part. This includes taking account of the political will and the capacities of western powers concerned to block or to react to a new military operation²⁷.

Consequently, the military power of western States may appear to be a dissuasive instrument to a country with hostile intentions. In particular, their ability to react quickly and decisively may make the future adversary reconsider the military option,

²⁷ As an illustration of the reflection before starting a military operation, see Frontline's interview with Tariq Aziz in September 1996 about the Iraqi invasion of Kuwait. www.pbs.org/wgbh/pages/frontline/gulf/oral/aziz.

and to choose other courses instead. In this prospect, the determining factors are the presence of western forces in the region concerned capable of taking action or the ability of States to conduct operations from a long distance.

In fact, the **possession of missiles that can be used under all circumstances** (i.e. without constraint) and capable of striking all or most of the territory of a State produces an effect that directly contributes to obtaining the final required state. It affects the decision making process of the State concerned.

2. Blocking maneuvering of the enemy forces and forcing negotiations

If a State decides to use force to achieve its political objectives, western forces may need to take action to block its forces or its action before attempting to make it choose non-military methods of settling the conflict.

Blocking an enemy maneuver consists of preventing enemy forces from achieving their objectives or obliging them to abandon the gains already obtained. For example in the case of a naval blockade, western forces should guarantee passage for all ships or neutralize hostile enemy means. The objective in the case of an armed invasion is to stop the adversary from making progress, and to oblige him to abandon the territories under his control as much as possible.

Some state adversaries may have anti-access or zone denial capabilities (particularly air defense), enabling them to limit the operational options of a player external to the region. Therefore, neutralization of these capacities should be one of the priority effects required to reach the final state (see below).

Once access to the conflict zone has been obtained, western forces should be capable of neutralizing the offensive potential and sufficiently degrading the enemy capacity for coordination so as to inflict land military defeat on the enemy and force him to withdraw.

The effects expected by cruise missiles are:

- ⇒ **Direct effects:** neutralization of the enemy's military means and coordination capabilities.
- ⇒ **Indirect effects:** oblige the adversary to terminate military operations by threatening his centers of gravity (economic complex, vital infrastructures, decision making centers).

3. Protect national interests and prepare a response

Faced with the possible materialization of a conventional military threat, forces are required to guarantee the safety of national interests (protection of territory, national installations in other countries) and to be capable of responding to any aggression. For example, this situation corresponds to an explicit threat of the use of ballistic or cruise missiles against a French city.

Such a situation could develop in the framework of a crisis or a conflict opposing France (or a coalition including France) to another State²⁸. Therefore the preventive use

²⁸ As was the case for Israel and some countries in the Persian Gulf targeted by Iraqi SCUD missiles during *Desert Storm*.

of force to neutralize enemy threats would be politically and legally legitimate under article 51 in the United Nations Charter.

Operationally, the objective would be to neutralize means that could be used against our interests. Politically, threats of reprisals could be used against the adversary in an attempt to make him renounce materializing his threat or to interrupt actions taken against our interests.

The use of cruise missiles could be envisaged to attempt:

- ⇒ **Direct effects:** neutralize threatening capacities before they are used. Application points would be these threatening capacities, and also any associated command and planning center.
- ⇒ **Indirect effects:** affect the will of the adversary to continue with a policy that endangers national interests. Punishing an adversary who has attacked national interests.

4. **Make air-land action against an adversary possible (access)**

As we have seen, in the case of a conflict, some adversaries could use strategies aimed at hindering the build up in power and conduct of the operation by:

- ⇒ Slowing or preventing routing of military means in a zone;
- ⇒ Dissuading potential host countries from hosting a western deployment;
- ⇒ Preventing the access of western forces to the theatre of operations or to some of the zones essential to the theatre of operation.

Western forces must be capable of setting up a series of complementary political and operational solutions so as to gain access to a theatre of operation under these conditions. Neutralization of enemy means (weapons systems and chain of command) dedicated to this strategy must be envisaged fairly early in the conflict to reduce the threat level.

Neutralization of adversary's coastal and air defense networks is a compulsory passage point in the pursuit of an air/land operation.

Similarly, western forces will also need to attempt to prevent the adversary from using his "strategic" type systems (ballistic missiles, cruise missiles) against their regional allies. The difficulty in this respect is related to the mobility of systems used by the adversary²⁹.

Therefore, the effects expected from the use of cruise missiles are essentially **direct**. The aim is to be capable of destroying time sensitive targets that can be defended by the enemy's air defense network.

5. **Performing a guiding role in a coalition**

Since action in a coalition should characterize participation of western powers in interstate conflicts, it would appear legitimate that some western powers will attempt to

²⁹ Thus, attempts to destroy SCUD launchers during the *Desert Storm* operation were not very efficient due to their mobility.

reach a degree of responsibility for political and operational choices made during the crisis.

In order to reach this final state, unique or rare capabilities will be needed³⁰ in order to perform an essential role in conducting operations or political management of the crisis. By making its capacities available to the coalition, a country will enter the circle of allies that can decide upon their use. Furthermore, if these capabilities need to be aggregated within an assembly (e.g., in-depth precision striking capacity), the owner State will be in a position to play a decisive role in making strategic choices of the coalition.

A priori, cruise missiles form part of strategic capacities which, if possessed, determine the place of a State in a coalition. For example, the British choice to obtain a complementary family of cruise missiles satisfies a logic of pre-eminence in carrying out operations within Europe and in coalition with the United States³¹.

Therefore cruise missiles can contribute to creating an **indirect effect** of influence for the construction of a coalition by supporting the claims of a member to participate in its management structure.

2.2 – Cruise missiles faced with operational needs (conditions for obtaining effects)

In order to create the required effects, several conditions have to be combined that depend on technical, operational and political factors that need to be optimized to achieve the best results. Cruise missiles have to be considered as parts of a **long-range power projection system** to define these factors and analyze their impact. Apart from the effector itself, this system includes two complementary and indissociable functions:

- ⇒ Transportation and launching;
- ⇒ Mission management (preparation, evaluation of effects, coordination).

2.2.1 – Desirable characteristics

Considering the effects expected from this system, it would appear that it should combine a number of essential operational characteristics³²: knowledge of targets, discretion, precision/efficiency of the payload, flexibility of use, reactivity.

1. Knowledge (and reconnaissance) of targets

It is essential to know where targets are located, how they are differentiated from their near environment and how they are defended, so as to be able to neutralize, destroy or even threaten them. All these elements are necessary to obtain the desired effects.

Application points may be difficult to target, either because they blend into a dense environment, or because their validity duration is short. Therefore it is essential that the

³⁰ This may consist of human tools (e.g. information search unit) or effectors (e.g. strategic bombers)

³¹ See B. Gruselle, "The use of conventional cruise missiles: a mutating concept", FRS note, February 2006

³² J.-J. Patry, "Air power against terror", book to be published.

power projection system should be capable of discovering them quickly, identifying them and characterizing them with respect to their near environment.

Neutralization of targets related to weapons programs causes particular problems. Firstly, it is difficult to establish an evaluation of the result of a specific action³³, particularly because the means associated with the programs can be moved quickly if the adversary has the slightest doubt about their vulnerability³⁴. Furthermore, burial and dissimulation of some sites makes identification and characterization chancy and complex. Finally, the need to reduce environmental risks following a destruction action assumes excellent knowledge of the site concerned so as to be able to neutralize a capacity without causing the dispersion of dangerous products.

Other difficulties arise for non-material targets (e.g. human targets), particularly in terms of discrimination between the target and its environment. For example, the identification of small groups of persons dissimulated within a non-combatant population requires a permanent, reactive and reliable human and technical intelligence system.

Consequently, the speed at which information about targets is transmitted and processed, and the precision (detail level) and reliability of this information, are *sine qua non* conditions for an efficient system. The existence of an intelligence chain dedicated to management of the system appears to be the key factor in optimizing its operational performances³⁵.

This intelligence chain must perform two types of missions with different requirements:

- ⇒ **Fast targeting:** based on a short cycle related to a given conflict, the objective is to discover and precisely characterize the targets for a strike. This part of the chain forms part of a fast "acquisition, decision, action" cycle. The objective is to provide information with a limited time validity and which can be used as a basis for action, to the rest of the system. Elements forming part of this information include the nature of the target (building, vehicles, person) and its environment (particularly defense means), its position and the validity duration. This fast targeting is also based on quality of information returned after use of missiles (battle damage assessment) and the possibility of distributing this information into the chain of command quickly enough to conduct further operations.
- ⇒ **Generic knowledge cycle (cold planning):** this part of the intelligence chain is complementary to the first part, and is based on long term work to determine key elements for a series of generic targets. In particular, this cycle must make it possible to form a catalogue of targets each having the necessary elements to enable the system to neutralize it. For example which building in a factory manufacturing chemicals should be destroyed to neutralize production. Furthermore, during a crisis or a conflict, this cycle (related to the first) must be

³³ For example see James Russel "WMD Proliferation and Conventional Counterforce: The Case of Iraq", *Strategic Insight*, July 3, 2002.

³⁴ Ibid. The example of American strikes against Iraqi missile programs in 1998 illustrates the capability of a State to keep its most sensitive means under shelter.

³⁵ Vice Admiral Lowell E. Jacoby (Director, DIA), "A New Definition of Precision Strike", ISR Integration Conference, 15 November 2004.

capable of defining the best path for hitting a given target. Note that if it is to be fully efficient, this intelligence cycle must be organized with users in a coordinated manner. Users will need to define exactly what information has to be supplied so that they can use the system.

This intelligence chain must also be based on a reliable, powerful and fast communication system enabling a human operator to transmit information – including technical data (e.g. images) – to an expedient combat system in quasi-real time.

2. Discretion

The system should be confronted with some targets characterized by their time criticality. Therefore, the system must be capable of using the element of surprise to hit these targets before they disappear.

Several conditions have to be satisfied to take advantage of the element of surprise with cruise missiles:

- ⇒ **Discretion of preparation and operation:** this applies to the entire input side cycle, acquisition of information and decision, and also the operation itself until the missile is fired. Some particularly discrete carriers might be preferred to maximize the surprise effect.
- ⇒ **The missile penetration capacity** combining low altitude flight and stealth, to maintain discretion of the operation until neutralization (or destruction) of the target.

This capacity provides an important credibility to the indirect use of cruise missiles against the political will of an adversary. The threat of action against time sensitive centers of gravity will be more plausible if the adversary is convinced that its materialization would not be preceded by precursor signs. Conversely, deciding to advertise a capacity that could be used close to a crisis or conflict zone can have advantages in terms of indirect use of cruise missiles. In particular, the adoption of a high profile could have a coercitive effect against players likely to using force. The discretion function multiplies effects (direct and indirect) depending in the option selected by the political authorities.

Two operations illustrate the variety of possible choices in terms of discretion. Thus, during the *Infinite Reach* operation in 1998, the United States chose to respond to Al Qaida's bomb attack against the *USS Cole* by striking targets including an assumed terrorist training camp, but the chosen targets and times were kept secret. Conversely, during the *Desert Fox* operation against Iraqi installations related to the missile program, Washington had warned Saddam Hussein's regime (thus allowing him to evacuate the sites concerned to remove essential machine tools).

3. Precision/efficiency of the warhead

The required effect can be obtained if it is possible to hit a given target with a sufficient degree of precision and to neutralize or destroy it. The precision/warhead combination has to be efficient due to the variety of targets and the increasing complexity of their environment. Furthermore, precision of the order of one meter that is possible with existing guidance/navigation technologies, compensates for the relative low power of the warhead in a missile compared with a bomb.

The use of urban environments by adversaries as shelter in which they can conceal and protect themselves will probably be one of the determining characteristics of future conflicts. Therefore the precision of the means used must minimize collateral effects on non-combatants. Apart from rules imposed by the law of war, this is essential due to the inevitable coverage of civil victims by the media (and indirectly by non-governmental organizations). This coverage acts against the Firing State and has a long-term negative effect on its determination, consequently reducing its capability to achieve its objectives.

The most effective precision/warhead combination possible is also necessary to neutralize military hardware production and storage sites, or means of transport. The objective is to reach a vital part of the system and to destroy it without damaging nearby elements. This part can also be protected by passive systems (hills, burial, shielding) or active systems (anti-missile defense system), therefore it would appear necessary to have a series of warheads to deal with a series of different targets.

The robustness of the precision/warhead combination, in other words the ability to hit a target that is not at the indicated location but near it, is essential to maintain a certain degree of effectiveness against time sensitive or mobile targets. This robustness is also based on the ability to use the system in all times and in all weathers: during the day/at night, jammed environment.

Finally, the effectiveness of the precision/payload effect combination contributes to the credibility of the system as a means of coercion or reprisal, particularly against adversaries taking advantage of camouflage, mobility and intermittence of its centers of gravities to protect them.

4. Flexibility of use

Desirable characteristics for an in-depth striking system include access to targets regardless of their location, the possibility of firing under all circumstances (peace, crisis, conflict), proportionality of a reprisal and the ability to assign sufficient quantities of missiles to the targets considered.

The variety of effects expected by the direct or indirect use of cruise missiles and application points of these effects can only be obtained by optimizing the flexibility of the system. The objective is to be able to use diversified system usage options, and equally to adopt decision cycles adapted to the different conceivable circumstances (tactical use versus strategic use). In short, both technical and operational flexibility is required.

Therefore, it is based on three main elements:

- ⇒ **Command and control loops:** the command and control cycle must be sufficiently rapid to react within a few minutes, thus insuring the needed flexibility of the long-range power projection system. Two interdependent decision loops, one long term and the other short term, must be coordinated. The first is the responsibility of political authorities and is based on system usage conditions in general (definition of a strategy) and as a function of a crisis (choice of posture, pre-selection of targets for reprisal/coercion actions), but should also attempt to delegate [entirely] use of the system to the military authorities. The second, for which military authorities are responsible, would

consist of defining strike plans (targeting, quantity of ammunition per target, firing time, launch means) and engaging time sensitive targets. This short loop should also integrate short intelligence cycles (fast targeting), particularly by encouraging better coordination with operational levels - units in the field. In particular, these units must be able to make direct requests to use missiles against targets located in their operational area.

- ⇒ **Complementarity of carriers/launchers:** possession of a variety of launchers provides a means of increasing the range of circumstances in which the power projection system can be used. A threefold aviation/submarine/surface ship disposition offers the best configuration for action in peacetime, during a crisis or a conflict, either to obtain indirect effects (coercion) or direct effects (neutralization, support, response/reprisal)³⁶. As we have seen, the usefulness of launchers also depends on their visibility (or discretion) that is necessary as a function of the required effect. The possibility of operating under degraded environmental conditions, particularly in meteorological terms, is also essential to guarantee the flexibility of use of cruise missiles.
- ⇒ **Complementarity in range:** faced with the development of strategies aimed at hindering access of western forces to operation theatres and surroundings, the system must be based on a number of variable range missiles so that it can be used both against targets close to its launch means (thus limiting flight times), but also distant targets for which the approaches are too well defended to enable nearby firing. For example, in the framework of scenario SG3 (and even SG4), it would be preferable to fire cruise missiles from ships at a safe distance rather than an airborne firing faced with a dense and well-structured anti-aircraft defense.

5. Reactivity

Although reactivity is actually a sub-category of flexibility of use, it needs to be dealt with separately because some plausible adversaries do not have persistent vulnerabilities (centers of gravity, means).

The entire system must be usable and be used within short times, which means that necessary times between target detection, firing of the missile and its impact on the target should be minimized. The need for reactivity might also mean the possibility of modifying the missile target during the mission. A retargeting capacity is even more meaningful for missiles for which flight times (transit times) are fairly long so that they can be redirected to a different quadrant and target.

However, apart from major technological changes³⁷, this requires the ability to integrate tools into the C2 short loop to enable operators to choose a target from a changing catalogue, during the mission.

³⁶ Dr Lee Willett, "Tomahawk in Diplomacy and Combat", *RUSI Journal*, October 2002.

³⁷ M.L. Cummings & S. Guerlain, "The Tactical Tomahawk Conundrum: Designing Decision Support Systems for Revolutionary Domains", 2003. http://web.mit.edu/aeroastro/www/people/missyc/pdfs/Cummings_Guerlain_SMC2003.pdf

2.2.2 –Cruise missiles and ship carriers: the case of France

The diversification of French cruise missile carriers in the Navy is not obvious in itself. At the moment, the Navy is capable of making sea-to-land strikes using its fleet air capacity. So why is it necessary to add redundant capacity?

In the past, the Navy's missions have been concentrated particularly on the question of control over the sea, rather than support for air-land forces. But two factors confirm the advantages of improving the capability of this component to take action on land:

- ⇒ The development of strategies designed to limit access of western forces to theaters of operation, including in coastal areas. The increased density of low and medium altitude air defenses of some adversaries makes it difficult to use the air force alone for suppression (SEAD) missions or bombing missions against strategic objectives. As a reminder, this situation had led American forces to use only strategic bombers and Tomahawk missiles fired from submarines during the first SEAD³⁸ phases in the *Desert Storm* operation. Similarly in recent conflicts, the first cruise missiles were fired from naval platforms³⁹. Furthermore, the appearance of a credible naval and submarine threat in some countries makes it difficult to bring a fleet air arm unit close enough to use its aircraft efficiently, particularly if the selected targets are far from the coast. For example, in scenario SG4 and even *more so* in scenario SG2, shipping approaches would be almost impractical for part of the conflict due to the existence of a submarine threat or mines. Finally, in scenarios in which the adversary at least temporarily achieves zone⁴⁰ denial, action from the sea is the safest and most effective way of circumventing this blockade. Light ships (not including a fleet air arm unit) have sufficiently good maneuvering speed and range to apply reactive tactics to bypass obstacles.
- ⇒ Improvement of effects that might be expected from precision strikes made possible by technical progress for the entire system (intelligence cycle, C2 and missiles): possession of a naval component provided with a conventional missile firing capacity is essential to achieve the flexibility required by some of these effects. In particular, the discretion of some platforms (i.e. submarines) provides an essential advantage against mobile or time sensitive targets. Furthermore, the relative freedom of action offered by Navy Ships⁴¹ provides political decision makers with the flexibility of use that they need under some conditions. Even if shipping movements are becoming more transparent, the Navy still has few constraints, particularly for the submarine component. The expansion of information technologies also suggests that there will be an improvement in coordination between ships, to make more efficient use of an arsenal of cruise missiles. Finally, the necessary increase in the quantitative

³⁸ "Precision Strike From the Sea: New Missions for a New Navy".
http://web.mit.edu/ssp/Publications/confseries/strike/strike_report.html

³⁹ <http://www.usni.org/Proceedings/Articles03/proCostelloIraq.htm>

⁴⁰ No access to a land operations base close to the theater.

⁴¹ Statement of RADM Mark P. Fitzgerald, DC Naval Ops, director air warfare before the House armed services committee, projection forces subcommittee on Navy Capabilities for conducting conventional long range strike, March 3, 2004.

precision striking capacity, that is a corollary to the multiplication of required effects, can only be obtained through diversification of carriers⁴².

Even so, the choice of an investment in the field of action onto land should not be made at the detriment of missions to control the seas. Changes to maritime threats⁴³ justify modernizing our capacity in the field of the anti-ship combat. But it may be useful if the missiles to be developed for this type of mission could also contribute towards increasing the capacity to take action on land, for example in the search for coastal effects (neutralization of batteries, centers of gravity close to the coast⁴⁴). Furthermore, development of this dual capacity would significantly increase the number of missiles available during a crisis, even if it cannot create all desirable effects by itself since some targets of interest are remote from the coast.

Other investments could be made to provide all ships concerned (surface and submarines) with command and communication tools adapted to the mission of optimizing use of the Navy component as part of the power projection capacity. The required connectivity between carriers, and particularly submarines, and with the system as a whole (intelligence loops, effector) should take account of specific features related to the required effects (decision and implementation speed, flexibility, double anti-land/anti-sea action) and the launchers themselves, particularly discretion of the submarine component.

The Navy component also makes it possible to assure a permanent presence in a potential conflict area. This should enable closer control over the crisis and then the conflict in the long term, by making it possible to use cruise missiles at the beginning of a crisis and until a conflict develops. The Navy component should make it possible to scale the use of the power projection function as a function of political and military constraints specific to the situation and thus to have better control over escalation of the conflict.

This is particularly true because ships have fewer constraints due to environmental conditions than the fleet air component, and particularly the weather. Therefore, they provide a permanent firing capacity on predetermined objectives or time sensitive targets.

Finally, development of the Navy component should make it possible to satisfy the need to reinforce capacities of the power projection system, taking account of changes to threats that will affect all forces in future conflicts at all times during their development.

2.3 – Cruise missiles and coalitions: the media and political stakes

We have seen that setting up a family of cruise missiles should enable us to take a controlling role in coalitions that will be formed in future conflicts. It is also a capacity with an important media aspect. In particular, the fact that cruise missiles are the first missiles fired during recent conflicts and the quantities used (802 Tomahawks for the

⁴² "Precision Strike From the Sea: New Missions for a New Navy".
http://web.mit.edu/ssp/Publications/confseries/strike/strike_report.html

⁴³ See the generic scenario, SG2.

⁴⁴ Ibid 41, "Over 80% of the world's population lives within 200 nautical miles of the sea".

*Iraqi Freedom*⁴⁵ operation alone) mean that this capacity has a special image in public opinion, demonstrating firstly military efficiency and secondly the will of States to limit the effect of the conflict on surrounding populations⁴⁶.

The media impact for States who have a precision strike capability generates a potential for political exploitation. By demonstrating the effect of their use, they can demonstrate to their own public that the conflict is being conducted respecting their international commitments (limitation of civil victims). They can thus strengthen the legitimacy of their action in the battle of images, and maintain the support of their populations.

2.4 – Technical missile choices and technological missile options

2.4.1 – Technical composition of a cruise missile

A modern cruise missile includes 6 structuring subassemblies:

- ◆ Propulsion: there are three possible types of propulsion, apart from anaerobic propulsion (by a rocket engine):
 - ⇒ by a turbojet system capable of achieving relatively high speeds (transonic and possibly supersonic) but that consumes large quantities of fuel thus actually limiting the range of the missile. Cruise missiles with a range of between 300 and 500 km use turbojets. The SCALP is equipped with a turbo-jet.
 - ⇒ by a turbofan system that is much more economic in fuel but that can only achieve subsonic speeds. This type of system is used on Tomahawk and Russian AS-15 cruise missiles.
 - ⇒ by a ramjet system that operates at supersonic speeds (and must be accelerated to above the speed of sound before they can operate). The Russian SS-N-22 anti-ship missile is based on a ramjet. Heat produced during combustion is easily detectable.
- ◆ Structures consist of the missile envelope, its control surfaces (fins) and lift surfaces (wings). Material choices (aluminum or special steel alloys, composite alloys, wood, etc.) will influence the detectability of the missile. The forms chosen also participate in reduction of signatures.
- ◆ Navigation: the navigation system guides a missile from its launcher to the area in which its target⁴⁷ is located. Schematically, a cruise missile can be based on a relatively simple navigation system that is sufficient to obtain a satisfactory precision:
 - ⇒ an inertial control unit: that gives the position and attitude of the missile based on integration of data obtained by accelerometers and gyroscopes;
 - ⇒ a radioaltimeter: to calculate the altitude of the missile and possibly update its path;

⁴⁵ http://www.findarticles.com/p/articles/mi_m0IBQ/is_1041/ai_115694518.

⁴⁶ For example, see satellite images supplied during the *Desert Fox* operation. <http://www.globalsecurity.org/military/world/iraq/al-sahra-imagery.htm>

⁴⁷ In fact, a navigation system may be sufficient for firing on coordinates in which it is not necessary to hit a particular target, but simply a zone.

⇒ an automatic pilot to pilot the missile along the planned path.

However, other means are available for low altitude and/or long-range flight trajectories to improve the positioning precision and the final precision. The use of satellite positioning means (GPS, GLONASS or GALILEO) or terrain comparison systems (TERCOM, DSMAC) is called hybridization.

- ◆ Terminal guidance: once this subsystem is in the zone in which the target is located, it guides the missile to the target assigned to it. A precise image of the target (radar or optical image) is compared with the image taken by an imager integrated into the missile. Terminal guidance technologies are essential to enable precise firing on predetermined targets. Note that the Tomahawk missile does not have terminal guidance at the moment.
- ◆ The warhead
- ◆ The onboard computer and onboard systems: contain essential mission data (flight path, target) and if necessary associated devices (for example communication system).

2.4.2 –Desirable technical and technological choices

Several developments to the different subassemblies making up a cruise missile appear desirable nationally to quickly obtain a family of systems usable in future conflicts, so as to satisfy operational needs generated by the development of the possible need to project power in future conflicts.

Improved range is an assurance of operational flexibility, and will only be possible through the development of a turbo-fan to reduce specific consumption of the missile. Thus for constant dimensions⁴⁸, it would appear possible to obtain the ranges necessary for a disposition including a naval component. In the longer term, a supersonic or even hypersonic option should be pursued, which would considerably reduce missile flight times and thus facilitate fast processing of time sensitive targets. Considering the technical difficulties associated with the hypersonic option⁴⁹, everything suggests that the effective development of a hypersonic land attack missile is a long-term prospect.

The reduction in missile preparation times depends essentially on other elements of the system (e.g. intelligence). However, work carried out on digital mapping and target models for the SCALP program provide a sound basis for the future. Implementation times, in other words times between reception of the firing order and the firing itself, should be reduced to a few tens of minutes so that time sensitive targets⁵⁰ can be processed. The extension of mission preparation to include a tracking (and redirection) function during missile transit as far as zone area in which the target is located, would make it possible to make the best use of the flight time to redirect the missile onto a new target if necessary⁵¹. In short, the missile should be able to receive a series of secondary

⁴⁸ Note that dimensional aspects are less restrictive for naval carriers than for aircraft.

⁴⁹ The United States carried out the first test on a hypersonic vehicle in 2005, and the most optimistic date envisaged for commissioning of a ground attack missile is the middle of the next decade. See <http://www.globalsecurity.org/military/systems/munitions/hyfly.htm>

⁵⁰ <http://www.usni.org/Proceedings/Articles03/proCostelloIraq.htm>

⁵¹ It would be possible to consider a loitering cruise missile concept, in other words that remains in an area for a certain time waiting for a target.

targets to which it could be redirected depending on mission needs, in addition to the main target data. Such a function, that appears useful to increase system flexibility, requires that the missile should be provided with a data link connecting it to the launcher or to a firing network that could modify its mission.

Setting up such a link, that is one of the lines of progress claimed for the *Tactical Tomahawk*⁵², could also enable a missile in flight to transmit some data recorded by its sensors. These data could be useful particularly to improve the quality of evaluation of the effects of precision strikes (BDA) and therefore the global efficiency of how the system is used. For example, these data could be transmitted by relay platforms located in the line of sight of the missile (endurance drones).

The penetration capacity of cruise missiles has now been demonstrated and technologies on which it is based are relatively well controlled. The use of altimetry and terrain tracking means enable low altitude flight regardless of the type of relief (or lack of relief) and in all weather conditions (night, bad weather) and are relatively insensitive to jamming and independent of an external supplier. The low altitude penetration capacity of systems should continue to be based on these means. Furthermore, improvements in stealth could be envisaged based on existing technologies.

The use of a navigation system must be complemented by efficient and robust terminal guidance, to achieve the best possible precision. For navigation, internal update means (altimetry, terrain tracking) could be used with external data, for example originating from a satellite network (GPS, and eventually Galileo). However, the system navigation should not depend on these data to assure a sufficiently high precision class to bring the missile into its firing zone. It appears essential to have a dedicated guidance loop in this final phase to achieve the necessary precisions of about a meter, and to obtain specific effects. Furthermore, integration of terminal guidance must assure that the missile remains effective against mobile, time sensitive and even camouflaged targets.

The warhead must be modular to process different natures of targets adapted to all possible circumstances. Possession of a family of complementary warheads capable of performing the following missions would seem particularly desirable:

- ⇒ Destruction or neutralization of unhardened targets (blast-burst);
- ⇒ Destruction or neutralization of hardened targets (penetration);
- ⇒ Neutralization of many targets distributed on a zone - for example airfield (submunitions);
- ⇒ Neutralization of non-military structures (for example electrical network).

Even if it is not essential to have all of these capacities immediately, the diversification of warheads is an essential development theme for the acquisition of a durable family of cruise missiles.

There are very many desirable developments in technical fields associated with cruise missiles and it would be expensive and probably take a long time to achieve all of them. The best approach would seem to be to advance one step at a time, so as to limit the financial cost and to make consistent progress while keeping operational needs in mind.

⁵² http://www.prnewswire.com/cgi-bin/micro_stories.pl?ACCT=910473&TICK=RTNB12&STORY=/www/story/05-27-2004/0002183112&EDATE=May+27,+2004

Improved range, robust precision and shorter firing preparation times are *a priori* priority fields to be defined over the next decade to achieve a first set capable of producing most of the desired effects.

Another question that arises is the cost/efficiency ratio related to the use of cruise missiles: should an expensive cruise missile be used to neutralize visible low value targets (a pick-up, a tent)? The answer from operational and political points of view is yes, provided that the effect obtained is actually the required effect. Achieving an effect depends very closely on the system performance, which itself is related to the technical and therefore financial investment. Furthermore, everything suggests that the cost/efficiency ratio of cruise missiles for bombing missions is better than for ballistic missiles or for fighter aircraft⁵³. In conclusion, since they satisfy operational needs and the expectations of politicians, the development of cruise missiles is a reasonable investment in comparison with other power projection means.

Considering its probable importance in future conflicts, the power projection system is a central instrument of national power. In this respect, maintaining an independent European development and production capacity in terms of cruise missiles is necessary to enable the European Union and France to play a controlling political role in future coalitions, and even to be able to conduct some conflicts alone. Therefore the power projection system is one of the central elements of our operational sovereignty.

⁵³ David J. Nicholls, "Cruise missiles and modern war", pp. 10-11.

SUMMARY TABLE OF THE RELATION BETWEEN EFFECTS/OPERATIONAL CHARACTERISTICS AND TECHNICAL NEEDS

Legend: ++: essential +: necessary 0: not essential to the system		SEARCHED EFFECT								
		Neutralize or destroy a vital enemy center	Perform a controlling role in a coalition	Oblige an adversary to renounce action modes	Make enemy preparations for an operation fail	Neutralize adverse defense elements	Oblige an adversary to abandon control of a site	Neutralize an enemy military threat	Destroy enemy hardware or human capabilities	Convince a State to suspend its support to an adversary
DESIRABLE OPERATIONAL CHARACTERISTICS	Knowledge of targets	++	+	+	++	++	+	++	++	+
	Discretion	0	0	0	++	++	+	++	+	0
	Precision	++	++	++	++	++	++	++	++	0
	Flexibility of use	++	+	+	+	++	+	++	++	++
	Reactivity	++	+	+	++	+	+	++	++	+
Legend: ++: Contributes directly +: Contributes indirectly 0: no contribution		DESIRABLE OPERATIONAL CHARACTERISTICS								
		Knowledge of targets	Discretion		Precision		Flexibility of use		Reactivity	
TECHNICAL or TECHNOLOGICAL CHANGE related to MISSILES	Propulsion	0	+		+		++		+	
	Air structures	0	++		0		0		0	
	Navigation	+	++		+		+		++	
	Terminal guidance	+	0		++		+		+	
	Warhead	0	0		0		++		0	
	Onboard systems	+	0		+		++		++	

COMPARISON TABLE FOR PLATFORMS PROVIDED WITH CRUISE MISSILES

	Flexibility of use	Discretion	Vulnerability to anti-access strategies	Firing capacity	Main disadvantages
Surface ship Long range missiles	<ul style="list-style-type: none"> ❖ Use in all weather ❖ Prepositioning and permanence in a zone ❖ Good endurance ❖ Maneuverability and reactivity 	<ul style="list-style-type: none"> ❖ Visible means 	<ul style="list-style-type: none"> ❖ Carrier can withdraw ❖ Low for the missile 	<ul style="list-style-type: none"> ❖ Medium carrying capacity ❖ Large number of platforms 	<ul style="list-style-type: none"> ❖ Limited endurance
Submarine Long range missiles	<ul style="list-style-type: none"> ❖ Use in all weathers ❖ Prepositioning and permanence in a zone ❖ Very good endurance ❖ Maneuverability and reactivity 	<ul style="list-style-type: none"> ❖ Discrete means 	<ul style="list-style-type: none"> ❖ Low for the carrier ❖ Low for the missile 	<ul style="list-style-type: none"> ❖ Low carrying capacity 	<ul style="list-style-type: none"> ❖ Low carrying capacity
Fleet Air Arm/Aircraft Tactical missiles	<ul style="list-style-type: none"> ❖ Use limited by weather conditions ❖ Prepositioning and permanence in a zone ❖ Good endurance ❖ Need to enter the enemy air space 	<ul style="list-style-type: none"> ❖ Highly visible means 	<ul style="list-style-type: none"> ❖ Carrier can withdraw ❖ Aircraft vulnerable before the enemy air defense suppression phase 	<ul style="list-style-type: none"> ❖ High carrying capacity 	<ul style="list-style-type: none"> ❖ Anti-access vulnerability
Regional Air base/Aircraft Tactical missiles	<ul style="list-style-type: none"> ❖ Permanently on zone ❖ Need to penetrate the air space ❖ Access to an allied base 	<ul style="list-style-type: none"> ❖ Visible means 	<ul style="list-style-type: none"> ❖ Base and aircraft vulnerable 	<ul style="list-style-type: none"> ❖ High carrying capacity 	<ul style="list-style-type: none"> ❖ Need to access a regional site

Appendix 1

THE USE OF CRUISE MISSILES SINCE 1991

About 1800 Tomahawk and Storm Shadow missiles have been used in military operations by American and British forces since 1991. The targets of these firings have been varied: command centers, air defense means, critical infrastructures, training sites, production sites, etc.

In all operations considered, cruise missiles were used either alone or at the beginning and during a large-scale military campaign. In any case, it appears that their use has generally obtained the required effects, although it is difficult to make a practical evaluation of the degree of success in some cases, for example the *Infinite Reach operation*.

Western cruise missiles have been used on nine occasions. The panorama of these uses illustrates the spectrum of missions accomplished by these systems and the increase in the numbers of missiles in comparable conflicts.

➤ **Operation Desert Storm (1991 – Iraq)**

About 290 Tomahawk Block-II missiles were fired during the early days and throughout the operation aimed to force Iraqi forces out of Kuwait. Two attack submarines and several surface ships were used as platforms for these launches.

The targets were apparently Iraqi air defense sites and enemy command centers in the framework of the air campaign. Firings against decision-making centers in Baghdad were also made from F-117 strategic bombers.

➤ **Reprisal strikes against the Iraqi disposition (1993)**

Two American ships (a destroyer and a cruiser) fired 23 Tomahawk Block II missiles against Iraqi secret services in response to an attempt to assassinate President Bush.

➤ **Operation Deliberate Force (1995 – Serbia)**

On September 10 1995, 13 Tomahawk Block III missiles – integrating a GPS receiver and with a longer range than the Block II - were fired against the Serbia air defense site in Banja Luka as part of the *Deliberate Force* campaign engaged on August 30 1995.

➤ **Operation Desert Strike (1996 – Iraq)**

On September 3 1996, President Clinton ordered firing of 27 cruise missiles from B-52 bombers, surface ships (destroyers and cruisers) and attack submarines, against air

defense sites and command centers in Southern Iraq, in response to movements of Iraqi troops towards Northern Iraq.

17 other missiles were fired from surface ships and attack submarines on the next day, to complete the missions of the previous day.

➤ **Operation Infinite Reach (1998 – Sudan and Afghanistan)**

In response to Al Qaida's bomb attacks against the American Embassies in Tanzania and Kenya, the President of the United States decided to fire 75 naval cruise missiles against an Al Qaida conference in Afghanistan and against a pharmaceutical products factory in the Sudan supposedly sheltering the production of chemical products for Al Qaida, on August 20 1998. The two targets were destroyed and according to Secretary Perry in his report to the Congress commission on the September 11 2001 attacks, the strikes missed Osama Ben Laden by a few hours.

➤ **Operation Desert Fox (1998 – Iraq)**

After Iraq's refusal to cooperate with the United Nations Special Commission (UNSCOM) as perceived by the American administration, President Clinton ordered American forces to destroy a series of Iraqi sites related to missile and drone programs, on December 16 1998. British ships in the Persian Gulf participated in the operation.

More than 400 cruise missiles - including about 90 CALCMs fired from strategic bombers and more than 300 Block III TLAMs fired from surface ships and submarines - bombarded Iraqi infrastructures for 3 days.

➤ **Operation Allied Force (1999 – Kosovo)**

Following the Serbian Authorities' refusal to accept a peace agreement for the Kosovo crisis, the Atlantic Alliance triggered the Allied Force operation on March 24 1999 to oblige Belgrade to negotiate and force Serb forces to withdraw from Kosovo.

A total of about 218 Block-III Tomahawks fired from American ships and the British HMS Splendid nuclear attack submarine were fired against a series of Serb military and strategic targets, including elements of the electrical network.

➤ **Operation Enduring Freedom (2001 – Afghanistan)**

The Enduring Freedom Operation and its British counterpart Veritas were launched on October 7 2001, following the September 11 2001 bomb attacks against the World Trade Center and the Pentagon to end the Taliban regime's support to the Al Qaida organization.

During the air phase of the campaign (from October 7 to 13 2001), American and British ships fired several tens of Tomahawk Block-III⁵⁴ missiles against Taliban defense sites and command centers.

⁵⁴ According to the financial estimate made by the Center for Strategic and Budgetary Analysis, the American Navy fired about 90 TLAMs during this conflict.

➤ **Operation Iraqi Freedom (2003 – Iraq)**

American ships began the *Iraqi Freedom* operation on March 19 2003 designed to overthrow Saddam Hussein's regime, by firing Tomahawk Block-III missiles on Iraqi defense installations and on high value targets in Baghdad.

The American Navy fired about 800 Tomahawk cruise missiles during the conflict for suppression of enemy air defense, neutralization of the Iraqi command system, and support to forces missions .

The British *Royal Air Force* fired more than thirty *Storm Shadow* missiles, as part of the *Telic* operation.

Cruise missiles became the precision weapon used most frequently by the United States Air Forces and Navy during this conflict.

SOURCES:

<http://www.pbs.org/wgbh/pages/frontline/gulf/weapons/tomahawk.html>

<http://www.strikenet.js.mil/pma-280/timeline.html>

http://www.operations.mod.uk/veritas/summary_oct-dec01.htm

<http://www.fas.org/man/dod-101/sys/smart/bgm-109.htm>

http://www.globalsecurity.org/military/ops/desert_strike.htm

http://www.globalsecurity.org/military/ops/deliberate_force.htm

[http://www.9-11commission.gov/hearings/hearing8/cohen_statement.pdf#search='william %20cohen %209 %2F11 %20testimony'](http://www.9-11commission.gov/hearings/hearing8/cohen_statement.pdf#search='william%20cohen%209%2F11%20testimony')

http://www.globalsecurity.org/military/ops/strike_930626.htm

<http://www.answers.com/topic/operation-infinite-reach>

<http://www.danshistory.com/operations.shtml#strike>

http://www.findarticles.com/p/articles/mi_m0IBQ/is_1041/ai_115694518

Press conference at the British Ministry of Defense, April 4 2003.

http://www.operations.mod.uk/telic/press_4april.htm

Dr Lee Willett, "Tomahawk in Diplomacy and Combat", *RUSI Journal*, Oct 2002

Appendix 2

CHARACTERIZATION OF CONFLICTS

Characterization of infra-state conflicts

Stakes and required objectives

It seems a good idea to define the stakes at the center of the conflicts considered, to characterize them more precisely. They may involve:

- ⇒ economic stakes: control of all or part of a territory and resources located in it (secession);
- ⇒ power stakes: intended to modify the political regime (coup d'état, armed revolution, insurrection);
- ⇒ ideological or sociological stakes: marking of a religious, cultural or ethnic identity.

The objectives of potential adversaries can then be deduced depending on the type of conflict:

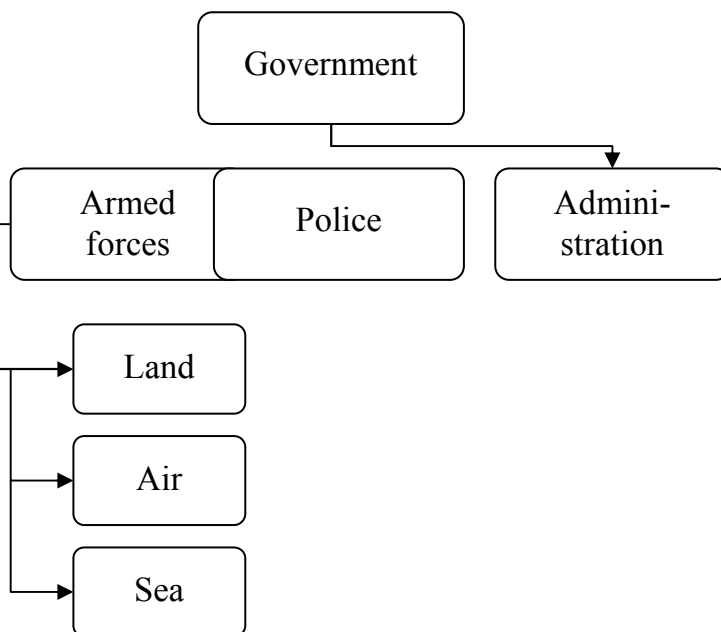
- ⇒ Secession conflict: in this case, the objectives are physical conquest and conservation of territories or coveted resources. The final required state is reached when all the territories and/or resources are obtained sustainably. Using the initial typology, the objectives of this conflict may be geographic or economic.
- ⇒ Succession conflict: the adversaries aim firstly to overthrow the existing regime and secondly to setup a regime favorable to their interests (or their ideological vision). For example, the existing situation in Iraq is a conflict of succession. The objectives in this type of conflict may be either ideological or political.

Characterization of the conflict

Foreseeable conflicts during the next decade are likely to take place in restricted geographic areas controlled by the adverse organizations.

Furthermore, these organizations can undoubtedly bank on the support of the population (either willing or forced), in particular providing them with relatively precise information about western forces. In some cases, the population will act as a nursery for the recruitment of combatants, or for caches for friendly combatants or their weapons. Indirect support for operations by the non-combatant population is also possible (through the supply of food or fuel).

These conflicts should also be characterized by the existence of sanctuary zones used as logistic bases for the enemy. These may be towns or camps outside the control of Western Forces or the existing Government. The urban fabric should also be an area in which there is probable confrontation with some adversaries wishing to limit the maneuvering capability of western Forces. Although combats should essentially be low intensity (bomb attacks/guerrilla; skirmishes), they could generate into sporadic high intensity confrontations in restricted areas.



Finally, the potential existence of tactics to hinder access of western forces to the territories considered is a possible characteristic of these conflicts.

Description of players

Several generic adverse players may be active in hybrid crises. The differences between these entities are related partly to their organization and strategies, action modes (tactical) and their equipment. The following players could be active:

- ⇒ government organizations (proto-government, opposition group);
- ⇒ paramilitary organizations (militias, armed bands);
- ⇒ criminal or terrorist organizations (terrorist groups, mafia bands).

Government type entities

This type of entity is organized around a political management that controls hierarchized military forces and a more or less important functional administration. For example, it may be the government of a bankrupt or near bankrupt State, or on a smaller scale, warlords (based on the Afghanistan/African or Chinese⁵⁵ model) that have military, and also economic, social and political functions.

If the political management controls the military/security and bureaucratic organization, with political management fixing objectives to the military/security and bureaucratic organization satisfying its own interests, the fact that the political institution prevails over the security institution is not necessarily true in all cases.

The government type entity is also characterized by its installation on a given territory that it at least partially controls and that it administers. It then has political, economic or military neuralgic installations over this territory.

⁵⁵ John Mackinlay, "Defining warlords", published in Monograph 46, Building Stability in Africa, Feb. 2000.

The military command usually includes several services with a classical structure (land/air/sea), each of which has organizational means and missions. However, it is possible that there is only a land army and that there are no air or sea forces in some cases.

Mobilizing finances and resources is an absolute necessity for government entities who need to equip, feed, and pay all forces under their control. Means are acquired based on mixed financing including internal sources (trade, local production) and external sources (protective powers, diaspora). Hardware means are accessed essentially through acquisitions from the entity's allies or the countries providing support to it (possibly by violating international embargos). The use of illegal acquisition strategies (for example through arms dealers) is only chosen for highly specialized goods that are inaccessible otherwise (for example NBC). Finally, local manufacturing of simple weapons can characterize some players of this type.

Another remarkable characteristic of this type of organization is the possible existence of support by internationally recognized states pursuing their own political objectives (for example the hope of replacing an enemy regime). It may result in the formation of executives and combatants (possibly on site) by the direct supply of weapons or logistics means, by financial aid or by the provision of rear bases or sanctuaries within its territory.

In terms of means, armed forces will have old equipment, including particularly:

- ⇒ For the land component, sufficient means to conduct combined medium scale land operations (infantry, engineering, artillery).
- ⇒ For the naval component: a light fleet capable of operating close to the coast and a coastal defense capacity against light ships.
- ⇒ For the air component: an air defense capacity with BA (air defense batteries) not covering all of the territory considered. Some simple medium altitude coverage means and aircraft may also be available for ground bombardment.
- ⇒ For transverse units: electronic warfare means (including interception and jamming). It is impossible to be sure that there are no simple chemical or biological weapons. These players might have a few high performance means (for example short range ground-air missiles).

Although the very structure of the chosen entity is important, the strategies that it sets up to achieve its objectives through the use of force are one of the essential elements to characterize future conflicts. It can be assumed that for conflicts involving Western Powers, the selected strategies will be based on the observed unbalance of the forces present. Their design also benefits from a good knowledge of Western strategies and the constraints affecting them⁵⁶.

The guidelines for these strategies could be as follows:

- ⇒ protect survival of forces (scattering, mobility and discretion);
- ⇒ hinder enemy operations (anti-access, sabotage, skirmishes);
- ⇒ protect the political system and critical infrastructures;

⁵⁶ V. Goulding, "Back to the Future with Asymmetric Warfare", in *Parameters*, Winter 2000-2001, pp. 21-30.

⇒ cause severe damage to the enemy's military system.

It may be in direct⁵⁷ or indirect⁵⁸ forms.

Non-governmental entities

Non-governmental entities are characterized by the lack of a three-part government-army-bureaucracy system, and by the existence of an organization that is more horizontal than vertical composed of a series of groups acting more or less independently from each other. Each group can operate almost independently, for example with reference to a global strategy (case of terrorist groups or armed rebellions) and possibly by applying the directives of a leader or political management.

There is also a relation between the entities considered and given territories, even for organizations with no territories. The territory may be a conquest or domination stake, a theater of operation, or a rear base. The most highly territorialized (in other words entities for which recruitment is essentially indigenous) benefit from good knowledge of the geography, familiarity with the land and links with the non-combatant population. Although territorialized, such an entity does not have a genuine and persistent center of gravity that would cause collapse of the entire organization if it were destroyed.

Another essential characteristic is that these entities tend to ignore the law of war as it is generally practiced by States, for ideological or practical reasons. Consequently, there are no *a priori* limits to the forms, targets, intensity and duration of violence. This is particularly true for western powers since these value systems used by the entities considered are unknown to western powers.

This type of organization is less dependent than proto-governmental entities on access to internal resources and financing to maintain its operation. However, it must be able to obtain arms and to feed and clothe its combatants and even pay them. It achieves this essentially by using internal sources (trafficking, pilfering, theft) and, to lesser extent, external sources (donations). More centrally, the question of recruitment of combatants is usually solved either by enlisting part of the population, or by ideological involvement possibly including from other countries.

Weapons available to this type of entity are composed essentially of lightweight means (individual weapons, explosives, converted civil vehicles) adapted to small-scale actions. This type of armament corresponds to a desire to carry out a war of attrition against a western adversary for which the duration of the conflict (and therefore its human and material cost) are the controlling parameters, giving preference to tactics taking account of the unbalance of forces and its relative advantages (knowledge of the field, access to information, mobility).

The strategy of such an organization is essentially indirect, and may be organized about the following guidelines:

- ⇒ disperse forces, merge into the local population and make use of crowds;
- ⇒ avoid groups and give priority to isolated actions;

⁵⁷ Quantitative effort designed to cause attrition of the adversary's system by opposing him with a greater mass.

⁵⁸ Exploitation of weaknesses in order to cause a failure or disorganization of the enemy defense system.

⇒ inflict human losses on adversaries over the long term.

Non-combatant entities

Apart from military entities, these alliances may include non-combatant organizations that can influence the conduct of the conflict:

- ◆ Media: media coverage of the conflict is one of the few elements available to the populations of allied countries to forge their opinion on its progress and management. The level of global and individual public support for the alliance and the countries from which it is composed will be a more or less direct result of this coverage. Used by opponents to involvement in the conflict, it contributes to erosion of the political will of the countries involved to continue their participation under the original conditions, in the long term⁵⁹. This is particularly the case if the capacity of populations to accept the use of force depends strongly on their understanding of the stakes and their agreement with the objectives⁶⁰.

Media domination is often one of the objectives aimed at by the various players in the conflict. It forms part of the wider framework of the political action particularly through the image projected by the use of force (and its effects) through the media.

- ◆ Non-governmental organizations: the influence of non-governmental organizations in conflicts is difficult to quantify simply due to the large number of activities that this type of entity can perform. However, it is possible to make a few observations about their involvement:
 - ⇒ the safety of non-governmental organization personnel is usually assured by Western forces. Therefore, it is an additional mission for these Western forces;
 - ⇒ non-governmental organizations may deliberately or accidentally act as information sources for media and also for the forces present, due to the involvement of some of them in (or close to) the areas in conflict;
 - ⇒ independence claimed by non-governmental organizations and the media, as a guarantee of their operation, assures a genuine influence over public opinions of western States.
- ◆ Crowds: control of the local populations by enemy entities can include the creation or even control of crowds (violent or not). Although these crowds do not represent a genuine operational risk for the forces, they do create situations that are politically and technically difficult to manage (problem of the use of force against civil populations and publicity by the media). Furthermore, crowds are useful for dissimulating combatants, and can literally be used as platforms for armed action (bomb attacks, assassinations).

⁵⁹ Andrew Mack, "Why Big Nations Lose Small Wars: the Politics of Asymmetric Conflict", in *World Politics*, Vol. XXVII, January 1975, p. 187. A. Mack emphasizes that opponents objectively help adversaries by weakening the political will to continue the military conflict.

⁶⁰ Colin S. Gray, "How Has War Changed Since the End of the Cold War?", May 2004 (Paper prepared for the conference on the "changing nature of warfare" in support of the "Global Trends 2020" project of the National Intelligence Council), p. 16.

Inter-state conflicts

Even if intra and infra-state conflicts are likely to exist for a long time, their fundamental characteristics should be practically identical to the characteristics described in detail in the first part.

Conversely, future inter-state conflicts could be characterized by technological leveling in terms of armaments, with western Nations maintaining a certain lead in some (but not necessarily all) fields. Eight spheres of technological investment can be defined using the fields proposed by the OSD work in 2001⁶¹:

- ⇒ Long-range precision strikes;
- ⇒ Zone denial from land, sea or space;
- ⇒ Star wars;
- ⇒ Electronic warfare;
- ⇒ Robot controlled war (automation - robots, UCAV, UAV, UUV, etc.);
- ⇒ Non-conventional means (biological, chemical or nuclear weapons);
- ⇒ Stealth (platforms);
- ⇒ Projection of forces/power.

Stakes and required objectives

Stakes should be essentially limited in future inter-state conflicts and should not threaten the survival of the players concerned as States.

They may firstly be territorial, in other words focused on conquest and control of geographic areas disputed by two or more players. Furthermore, sea or land territories or areas may be disputed.

There may also be proliferation conflicts in which a State is attacked in the framework of a military operation to deprive it of a particular military capacity or to prevent it from acquiring it.

In terms of objectives, these stakes are broken down as follows:

- ⇒ Territorial conflict: in this case, the objective is to annex a parcel of territory, or long term control of a sea area so that resources can be exploited, or to maintain rights of way⁶². Therefore the military occupation must be followed either by replacement of the existing government by a friendly government, or the conquering State must set up a directly controlled administration.
- ⇒ Proliferation conflict: the country concerned attempts to protect and defend its existing capabilities or its capabilities under development against a limited military operation designed to destroy them. If necessary, it could attempt to prevent an imminent military action by using force.

⁶¹ M. Vickers & R. Martinage, "Future warfare 20XX wargame series: Lessons learned report", Dec. 2001.

⁶² Note that many conflicts of this type could be solved peacefully (financial or other compensation).

Characterization of conflicts

Symmetry of objectives between adversaries may be restored, so as to clearly define conditions for victory and defeat of the players involved in the conflict. These conflicts could also take place outside land belonging to the adversaries⁶³ and thus not threaten the existence of the States involved. However, the use of asymmetric strategies by each party should continue in the long term, alongside asymmetric means.

Consequently, the essential data used to determine the outcome of the conflict should be the balance between the forces of the players concerned; in short, relative quantities of equipment and the armed forces engaged, the correspondence between doctrines and real conditions encountered during the operations (including adverse doctrines) would once again become objective parameters used to evaluate the corresponding chances of winning the conflict.

Such a confrontation would contain a dialectic dimension between the adversaries, each being capable of varying his objectives as a function of the military equation based on a calculation between costs and benefits related to pursuit of the initial objectives. Therefore, negotiated solutions could emerge as the conflict develops in order to solve its military component.

Finally, these conflicts should be characterized by opposition between composite coalitions including States, local organizations and non-state entities. These players could participate in the conflict more or less directly and discretely, but this participation would have an influence both on the conduct of military operations and on the nature and the result of political dialogue between the engaged opponents.

Description of the players

The adversaries

In this type of conflict, adversaries of western powers consist of States with a political structure, armed forces and security forces and an existing administration (bureaucracy). In general, they will be non-democratic regimes in which the political structure prevails over military forces, even if the elites of these military forces participate in exercising power.

These adversaries are also characterized by the existence of structured armed forces applying rules similar to the rules on the law of conflicts applied by western powers. These armies are based on a professional core, possibly enlarged by conscripts who are largely integrated into administration structures. In the case of a total war, a reserve may be integrated into the armed structure, mainly in land units.

There are no or few organized counter-powers. In particular, access to information is strictly controlled within the country and the media are controlled by the administration.

It is assumed that the State in question controls, organizes and administrates all of its territory, its population and its economy through its bureaucracy and its security forces. It draws its resources from the national economy and at least partly from normal operation of the global economy.

⁶³ Invasion or blockade of a territory or a neighboring area.

For the development of its military disposition, the adversaries may have been engaged in an indigenous local development effort in some key domains since the 1990-2000 decade. For example, they could access critical technologies by legal or illegal acquisitions from western companies (including Russian), through which they can obtain modern weapons with a technological level at least comparable to weapons held by western powers in some of the domains defined above.

In particular, the States considered can use:

- ⇒ medium range precision strike means (anti-land, anti-ship);
- ⇒ various stealth platforms (submarines, aircraft);
- ⇒ electronic warfare tools;
- ⇒ modern zone denial means (mines, air defense).

Adversaries should also take advantage of defensive positions adjacent to their own territory and a sufficient projection capacity to perform amphibious and/or air-land operations from their territory to neighboring States or territories. Furthermore, their combat doctrines could have been adapted to changes in the doctrines of western powers in order to counter them.

Some should also have a nuclear and/or non-conventional capacity that may or may not be structured by a dissuasive and/or usage doctrine. In particular, this dimension should create a factor limiting the amplitude (and nature) of military actions that could be undertaken by each side.

Alliances

For western players, since the 1990s, there has been a trend of building up coalitions of various state or non-state entities for the control of conflicts, and this trend should be confirmed or even strengthened in coming years,

Their heteroclite composition has an effect on the initial coherence of objectives to be achieved, adoption of operating methods and maintenance of cohesion as the conflict progresses. In short, such alliances are difficult to setup because they require a consensus about objectives and their implementation between players, and these alliances are difficult to maintain because disagreements between members may arise as the conflict progresses.

However, they do have some potential advantages:

- ⇒ in military terms, they encourage complementarity of means and increase operational capacities;
- ⇒ in political terms, they increase the pressure applied on adversaries (diplomatic, media, etc.).

Alliances should continue to be characterized by the relative strength of allies and its immediate translation into planning and management of operations. Allies may occupy more or less important roles in planning and control of military operations, depending on their relative strengths and capacities; this varies the influence on control over the entire conflict.

Appendix 3

GENERIC SCENARIOS

The essential objective in using examples to illustrate possible forms of a conflict after about a decade is to define realistic cases for missions, the final state expected from a participating western force, and possibilities of using cruise missiles.

➤ **SCENARIO 1: The revolutionary national liberation front attempts to overthrow the government of Matenbo (SG1)**

2008. Matenbo, an African country on the Atlantic seaboard rich in raw materials (copper, manganese, nickel), has been suffering for several months by an armed insurrection led by the revolutionary national liberation front (FRLN). The armed forces of the country have gradually abandoned the territory occupied by the FRLN and concentrated on protecting the capital and the surrounding region. However fighting has not stopped and the rebels are continuing to extend their control over the country. The Eastern part of the country, and particularly the main port city, are already under the control of the FRLN forces that have set up an administrative disposition designed to replace the existing government, once victory has been obtained. Several buildings contain official services, including the headquarters of FRLN forces and political management.

The FRLN claims control of the country in the name of one of the country's majority ethnic groups (power struggle). It also advertises its will to exploit all the country's natural resources, questioning economic agreements with foreign companies (economic challenge).

Its army, that is said to be trained and equipped by a neighboring country, is composed essentially of land forces from regular troops. It is organized as follows:

- ⇒ a Headquarters;
- ⇒ a regular mechanized division (including support and assistance elements);
- ⇒ an air defense regiment (essentially using SA-7 manpad type systems);
- ⇒ combatant with vehicles (militias), for which the number is not well estimated (5000-10 000).

Western forces can take action in this conflict in several ways:

- ◆ Evacuation of foreign nationals from conflict areas or threatened areas: in this case, the mission of western forces consists of securing entry points (airports, ports) to protect foreign nationals and their evacuation. Armed confrontations with the forces present will essentially be defensive. The final required state in this operation is evacuation of all western foreign nationals. Western forces should be withdrawn

once the mission is accomplished, with no engagement against the existing forces and limiting civil losses.

- ◆ Insertion between the two factions, under the United Nations mandate: in this case, western forces should be deployed in the territory of the country and should separate the belligerents if necessary by the use of force. Western forces may be assigned additional missions (protection of local populations, foreign nationals, security). The final required state is termination of hostilities between the armed forces of the two factions and maintenance of the *status quo*.
- ◆ Action in favor of one of the belligerents: Western forces may take action in order to protect the interests of one of the factions, for example due to the existence of a security agreement. In this case, the missions of western forces may be to:
 - ⇒ reconquer areas occupied by the FRLN forces;
 - ⇒ assist the government in restoring public order and internal security;
 - ⇒ prevent new emergence of a separatist movement.

The final required state is security of the country's frontiers, long term disarmament of the FRLN armed forces and restoration of public order.

Possible use of cruise missiles

An incident breaks out between FRLN members and the French force during evacuation of European foreign nationals. About ten soldiers are injured and three are killed. A FREMM (multi-mission destroyer) located off the Matenbo coast fires five cruise missiles against installations controlled by the FRLN after a few hours of skirmishes, and particularly a building housing the movement's press, causing severe damage. There are no civil victims, due to the high precision strikes. The President of the Republic issues a public message emphasizing the need for the evacuation to continue and that any new excesses will be severely punished.

A few weeks later, two French attack submarines secretly deployed off the coast of the country, fire 12 missiles against FRLN air defense installations. Several fighters take advantage of the opening to bomb the movement's main weapons and fuel depots. At the same time land forces initiate an operation designed to arrest leaders of the movement. Two days later, French forces arrested the president of the FRLN, its supreme commander and his main assistants. In order to complete disarmament of FRLN forces, the FREMM fired several salvos of cruise missiles against weapons depots of the ex-organization.

➤ SCENARIO 2: Post-Maoist ideological guerrilla (SG2)

2011. An island in the North-West of the Indonesian archipelago is the victim of an Islamic terrorist movement that demands independence from Djakarta and the departure of western (American) forces from the territory. The movement is close to Al Qaida and has engaged shipping actions aimed at traffic passing through the Strait of Malacca.

In particular, it successfully sank a container carrier in transit towards Asia after having taken control over it by armed action. Although this action does not affect other traffic in the Strait, it is still possible that transport costs (insurance) will increase.



The terrorist group is composed essentially of inhabitants in the region, many of them having been trained in Iraq or Afghanistan. It has a large number of fast and lightweight boats, some of which are equipped with anti-ship missiles (Iranian copies of the Chinese C-801).

Chinese C-801



Singapore decides to call upon Western forces and its neighbors to assure secure transit of goods through the Strait and to terminate the terrorist threat that generates insecurity.

The missions of western forces in this conflict are to:

- ◆ Assure a presence on the shipping lane passing through the Strait of Malacca: patrols are organized by allied ships in the strait. Transport ships could be escorted if a particular risk is identified.
- ◆ Neutralize any hostile elements: patrol ships must board and search, and if necessary, neutralize any unidentified ship or a ship with an unusual behavior, in accordance with the Law of the Sea.
- ◆ Assist local authorities in neutralizing the terrorist group: Western forces can carry out armed actions against terrorist elements in cooperation with the local authorities.

The final required state is the long term security of activities in the Strait of Malacca and neutralization of the terrorist group.

Possible use of cruise missiles

France forms part of the Western strike planning headquarters through the deployment of two destroyers and two attack submarines equipped with cruise missiles, and may make a decision about the choice of targets for disarmament or reprisal actions.

Despite patrols, a cargo ship flying a Panama flag is seriously damaged after having been fired upon by an anti-ship missile. Western services learn that the guerrilla is preparing a larger scale operation on an oil tanker. The coalition intelligence collection means identify a C-801 storage area in a small island. A strike plan is prepared within a few hours and executed by the coalition's dispositions. French ships fire a first salvo of twenty cruise missiles against the installation. After analyzing the effects of the operation, allied submarines fire a new salvo that completely destroys all remaining missiles a few hours later.

➤ SCENARIO 3: Land invasion of a Siberian Republic⁶⁴ (SG3)



Illustrative regional map

September 13 2025.

The United Asian Republic (RAU), a nuclear State as defined in the NPT, the boundaries of which cover approximately half of continental China, decides to invade the Republic of Siberia (RS) to seize its natural gas reserves in its soil, at the frontier between the two States. It justifies this operation for the protection of oppressed Chinese

populations living in the South of the RS. This operation is launched following a series of declarations by the RAU, reaffirming the right of its nationals to security.

The army of the United Asian Republic begins its operation with an air phase to achieve control over the sky. A land force of about 50 000 men supported by precision strike means crosses the frontier between the two States and moves towards the gas fields of the RS to take control of them and to annex them to its territory. It quickly controls the frontier towns that it occupies.

The force engaged by the RAU also includes:

- ⇒ A fleet organized around an aircraft carrier, missile launching ships (4 submarines, two destroyers and about 10 light ships) and accompanying ships (4 destroyers, 4 anti-submarine/mining warships) crossing north of the China Sea. Its missions are to support the expeditionary force and to block access to the RS by sea.
- ⇒ An artillery division comprising about a hundred ballistic particularly precise missiles launchers⁶⁵. They participate both in operational support for the expeditionary force and possibly an anti-ship strategy designed to block access to the RS by sea. Available information suggests that they could be equipped with conventional, biological or even nuclear warheads. The artillery division is deployed on the territory of the RAU.
- ⇒ An electronic-Computer Warfare and Star Wars unit: dedicated to the collection of intelligence and also to sabotage/pirating actions against enemy information means.

The missions of an allied force in this scenario could be:

- ⇒ interrupt maneuvers of RAU forces;

⁶⁴ Scenario inspired from the report by CSBA, M. Vickers & R. Martinage, "Future Warfare 20XX Wargame Series: Lessons Learned Report", Dec. 2001. The attached map illustrates the geographic layout of the States considered.

⁶⁵ The missiles may be equipped with maneuvering re-entry vehicles.

- ⇒ reconquer territories annexed by these forces;
- ⇒ assure security and restore order in the reconquered territories. Restore the administration of the RS;
- ⇒ assure routing of humanitarian aid and security of personnel working for non-governmental organizations;
- ⇒ get ready to neutralize non-conventional tactical means of RAU forces.

The final required state is the withdrawal of RAU forces and achieving security of territories coveted by this State.

Possible use of cruise missiles

French naval elements integrated into the coalition disposition participate in the RAU suppression of air defenses phase. Several tens of cruise missiles are launched simultaneously towards enemy installations so as to prepare the air battle. The stock of destroyer missiles is replenished from a supply ship stationed in Singapore.

A few days later, French cruise missiles launched from aircraft and attack submarines target several ballistic missile launchers identified by coalition intelligence means. A quick evaluation of the damage is made, and a new salvo is then sent from American and British destroyers and French frigates.

The President of the Republic calls upon the authorities of the RAU to withdraw their troops, threatening precision destruction of political objectives if they do not comply. The American President and the British Prime Minister make similar declarations.

➤ **SCENARIO 4: Shipping blockade of the Strait of Ormuz⁶⁶ (SG4)**

June 21 2010.



Iran has imposed a total blockade on shipping traffic in the Strait of Ormuz over the last five days. The Iranian President has also indicated that any operation designed to break this blockade would result in a major reprisal against the "world oil economy", also suggesting that in the long term the forces of the Islamic Republic could destroy the extraction and transport capacities of Gulf economies.

The Western intelligence community considers that Teheran might have about ten nuclear weapons. Iran has

probably militarized about twenty lethal biological weapons. The services also estimate that Iran has about a thousand ballistic missiles with a range of between 500 and 1000 km and about thirty launchers. The cruise missiles arsenal includes about 300 missiles, essentially anti-ship missiles including about fifty modern missiles and also about ten ground attack missiles. Considering their effective range (not more than 150 km), these missiles are distributed on the Iranian south coast. Some are deployed on Navy surface ships and some on upgraded fighter-bombers.

Mining operations in the Strait began on about November 16. Pasdaran command and the country's political leaders moved into underground shelters at the same time.

The republic's naval forces consist of:

- ⇒ some surface ships and submarines purchased from Russia in the early 2000s: 5-10 minelayers, 1-2 missile launcher destroyers, 2 Kilo class submarines;
- ⇒ a large number of fast light ships (patrol boats) capable of operations in shallow water and equipped with anti-ship missiles and mines.



Ra'ad anti-ship missiles

⁶⁶ Scenario inspired by A. Krepinovich, "Navy Strike Operations In the 21st Century – Crisis: The Strait of Hormuz", 1997.

Teheran can also call upon a relatively modern fleet of short and medium range air defense systems delivered by Moscow between 2005 and 2010⁶⁷. This air defense network consists of about thirty mobile SA-15/TOR-M1 systems and about twenty S-300 batteries.

Allied forces are required to perform the following missions:

- ⇒ assure safety of civil ships passing through the Strait and the main oil installations belonging to Gulf monarchies;
- ⇒ restore free long term passage through the Strait of Ormuz;
- ⇒ get ready to neutralize Iran's non-conventional capacities.



SA-15/TOR M1

The final required state is achieved when Iran is no longer capable of threatening shipping traffic and critical economic installations in the region.

Possible use of cruise missiles

Apart from the GAN (French Fleet Air Arm), France sends a FREMM and an attack submarine into the Persian Gulf region. The Ministry of Defense declares to the press that the destroyer is equipped with cruise missiles capable of precisely destroying objectives in the heart of the country.

The submarine Barracuda is deployed discretely. It reaches the zone after receiving about ten of potential Iranian target sites by satellite, updated by the CPCO targeting cell as a function of information obtained by the services and units deployed on site. The submarine can remain at a distance from the coast due to the range of missiles that it carries.

While Iran is threatening Saudi Arabia with a ballistic missile strike on the Raz Tanura oil terminal, the President of the Republic orders a coordinated strike against Iranian sites. French strikes, coordinated with operations of the same type carried out by American ships, successfully destroy about twenty launchers and neutralize the main command sites of the Iranian ballistic force.

⁶⁷ "Russia to continue export of anti-aircraft missile systems", *RIA Novosti*, December 16 2005.

➤ **Conclusions and comments on scenarios**

In the scenarios involving a government, the question that arises for a medium power (such as France) is its military and political role in an alliance (coalition). The nature of missions that its forces can carry out should partly determine its influence over how a campaign is controlled in a coalition.

Concerning a conflict between two major powers, the military contribution of the allies should not be of overriding importance for most operations. However, it can have an influence on progress of the conflict, provided that it takes place in high value fields for the allied power (*a priori* intelligence, counter-forces/counter-proliferation, access to the theater).

The case of a conflict with a medium power is particularly important for sizing, provided that control may be directly or indirectly assigned to States (belonging to the EU or NATO), possibly France.

Western forces in intra-state scenarios face territorialized threats: adversaries depend on a given geographic location. However, the mobility and dispersion of their forces in the theater of operation can lead to the absence of durable centers of gravity on which it would have been possible to apply pressure by weapons.

There are always high value targets for military action, but they are time critical. As an example, a terrorist camp may be an interesting target for a given period, if decision makers of the adverse organization are present in it or if the means of conducting an operation are located in it.

Obviously, this is the worst constraint from an operational point of view. In the case of a fully territorialised enemy entity (case for scenario 1), the centers of gravity are persistent in time even if the entity is not a State, and the situation is relatively conventional.