Space Strategy: From Words to Actions

“Strategy is knowledge, will and ability”

Admiral Raoul CASTEX

Should we be talking about space geostrategy or simply space strategy?

What method should we use to approach this subject?

What are the key factors that may influence this strategy?

This first chapter aims to answer these preliminary questions.

1.1. Geostrategy of space and space strategy

Experts from the “space strategy workgroup” take issue with the use of the word strategy when it comes to space beyond our atmosphere. The consensus is that most countries will employ space policies rather than space strategies.

Among them, four nations can nonetheless claim to be developing a true space strategy in an aim to militarize space:

– the United States without a doubt;

1 The members of the “space strategy” group can be found in the acknowledgments section.
2 United States, Russia, China, France, Japan, India, Canada, Germany, Italy to name only the more active countries in the area of outer space.
3 Official American legislatures such as the National Space Policy of the United States of America, June 28 2010, and the National Security Space Strategy, January 2011, moderate the
– Russia, which has officially created an aerospace army as of August 2015;
– China, which considers any common space as “critical security domain” for its country;
– India, which is now a major power in the field of outer space.

The European Union has struggled to develop a space policy that matches its own economic and geopolitical weight, as demonstrated by the difficulties experienced during the Galileo program. A few European states (France, Germany, Italy, United Kingdom, Spain) have separate military aerospace assets that they try and coordinate together, but there is no proper national space strategy. Japan has the skills and the technological resources necessary to develop a real space strategy, but chooses not to for constitutional reasons. Lastly, Brazil, which does not yet have its own individual access to space, cannot be considered a military aerospace power.

Figure 1.1. La guerre en orbite, Serge Grouard, 1994 (© Economica)

aerospace weaponization race by putting forward the need for peaceful international cooperation in this area. These documents can be found at the following links:

4 Aerospace, along with the ocean, cyberspace and nuclear energy, is considered one of the four “critical security domains” of the country according to a white paper report titled “China’s Military Strategy”, published by the State Council Bureau of Information according to the Chinese white paper report made public in May 2015: Xinhuanet news: http://french. xinhuanet.com/chine/2015-05/26/c_134271381.htm.
In order to define the word “strategy”, we start with that of General André Beaufre, subsequently quoted by Serge Grouard in his book, “La guerre en orbite”\(^5\). To them, strategy is “the art of discourse of parties using force to resolve a conflict”\(^6\).

The military definition of strategy that was taught in the French war school\(^7\) by professor Hervé Coutau-Bégario\(^8\) descends directly from the previous one: “Strategy is the dialectic of opposing intelligences within a conflict, based on the use or the threat of using force towards political aims”\(^9\).

This definition stresses the importance of intelligence, rather than determination, as “strategy is about intelligence, tactics are about determination”\(^10\). The reference to “within a conflict” aims to exclude any situation where there is no risk of fighting (diplomacy, economics, commerce, etc.). The “threat of using force” takes into account deterrence strategies. Lastly, “toward political end” means that strategy remains conditional to politics, which determines the ends and assigns the means to the strategist.

For General Vincent Desportes and Jean-François Phelizon, “Strategy is the way to best solve the equation between the aim, the method and the means”\(^11\). This definition that overlooks the double restriction of a conflict and the submission to political ends supposes that the strategist has three parameters at his disposal, which he can affect: “aim, method and means”. This definition is quite different to the one offered to us by professor Hervé Coutau-Bégario who considers that the strategist only has access to the method, as the ends and means are set by politics\(^12\). It is also worth noting that for General Vincent Desportes and Jean-François Phelizon, strategy is not

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5 GROUARD S., op. cit., p. 151.
7 Ecole de Guerre.
9 COUTAU-BÉGARIE H., Traité de stratégie, op. cit., p. 78.
12 This of course does not apply to circumstances where the strategist is also the politician (Take the historic example of Emperor Napoleon, but not of General Bonaparte).
necessarily a military tool, it can also be used by companies, sports’ teams and any collective that is considered to be *agonistic*\(^\text{13}\).

As far as the other word appearing in the title and to avoid any confusion, the word space refers to extra-atmospheric or exoatmospheric space that cannot be distinguished from the *exosphere*. While this notion of ‘exterior to our atmosphere’ that the word space inherently carries is not necessarily difficult to grasp, the boundary between air and space cannot be defined since its atmospheric pressure and altitude decrease quite regularly, and we cannot identify a separation like the line that separates the surface of the oceans. The issue of the limit between the aerial domain and the aerospace domain remains crucial and will be discussed in Chapter 2. Let us, however, note that the consensus is that the atmosphere lies under an altitude of about 60 km where lift remains possible. Anything beyond an altitude of around 200 km and where a satellite can perform a number of orbits without being slowed down by residual particles can be considered extra-atmospheric space. Between these two altitudes, there is an area where objects cannot maintain altitude easily and that can only be crossed by *rockets* or *atmospheric re-entry crafts* at our current level of technological advance.

![Figure 1.2. Atmospheric reentry craft\(^\text{14}\) (© ESA)](image)

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14 Example of an atmospheric re-entry craft: *Atmospheric Re-Entry Demonstrator* (ARD) from the ESA.
We can now look at the association of the words “strategy” and “space”. Hervé Coutau-Bégarie dedicates the last of his work titled *Traité de stratégie* to what he calls “space geostrategy” to highlight the notion that space is a global domain\(^{15}\). He presents outer space as a fourth strategic dimension, with land, marine and air being the other three. However, the functional approach that looks toward space applications to benefit strategy as a whole does not actually help in developing a working conceptualization of space strategy. We therefore need to approach the question differently.

If we consider geopolitics to be the study of great global balances, it grants us, for a given moment, a static view – like a photograph – of the state of the world. Basing ourselves on this definition, geostrategy is a natural progression of geopolitics, the same way hydrostatics leads to hydrodynamics: the height of the barriers and the amounts of water they contain that determine the energy of a waterfall. This power would, nevertheless, remain unusable without the engineer who knows how to harness it and, for example, turn it into electric energy. Geostrategy is, therefore, about applying the intelligence and will of man (the strategist) to a geopolitical situation acting in order to evolve said situation favorably according to whatever his objectives are.

Going forward, we will mark a distinction between space geostrategy, which accounts for the implications pertaining to the aerospace domain of the various geostrategies of different actors (States and international organizations), as opposed to space strategy that pertains to the use or the threat of using force from, within or toward space. Space geostrategy is a direct result of space policies and covers all economics, media and security aspects of the use of extra-atmospheric space. It arches over a broad spectrum of subjects and fields that have already been the center of numerous studies.

On the other hand, space strategy is much more specific to the military, even if the ends and the means that are allocated to achieving them come directly from space policies that cannot rightly be ignored.

To recap, the definition of space strategy that we will retain for this book is the following: “The dialectic of intelligences based on the use or threat of using force towards political ends, from within or toward outer space”.

It is thus space strategy, as defined above, that will be the subject of this book. We will now present the principles and methods that allow us to approach the complexity of space strategy.

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1.2. Principles and methods to the systemic analysis approach

Before looking into the methods, we must briefly discuss the principles of strategy. We have all heard about it, but what is it exactly?

Hervé Coutau-Bégarie offers the following definition for the principles of strategy:

“The principles are general rules aiming to not be ruled by the enemy and ensure superiority on the point(s) that has(have) been selected with a swift and determined action”\textsuperscript{16}. We must note that “these principles are valid both strategically and tactically even if there is no actual mechanical link between them”\textsuperscript{17}.

But how many strategic principles are there?

– Almost as many as there are authors!

For General Beaufre, “the struggle for freedom of action is the essence of strategy”\textsuperscript{18}. This effectively makes everything conditional to increasing one’s own freedom of action and reducing one’s opponents. Foch establishes three: “the sparing of one’s own forces, freedom of action and the pairing of certainty-surprise”\textsuperscript{19}. One must simply consider that the strategist is constantly angling to acquire advantages, while denying advantages to his opponent: situational awareness, simplicity, initiative, mobility, concentration of efforts, swiftness, safety, etc. But there is no secret, there comes a time where one must choose an action and accept the risks to topple the opponent.

These principles are not universal and history is full of examples where ignoring one principle or another does not guarantee defeat. However, there are few defeats that cannot be explained by a failure to comply to them\textsuperscript{20}.

Having briefly discussed the matter of “principles”, the strategy can now be approached as a matter for reasoning. In his book Traité de stratégie, Hervé Coutau-Bégarie dedicates an important chapter to this subject\textsuperscript{21}. Strategy cannot be reduced to

\begin{enumerate}
\item \textsuperscript{16} Coutau-Bégarie H., Traité de stratégie, op. cit., p. 307.
\item \textsuperscript{17} Ibid.
\item \textsuperscript{18} Beaufre A., Introduction à la stratégie, p. 185, Hachette Littératures, Paris.
\item \textsuperscript{19} Foch F., Des principes de la guerre. Conférences faites en 1900 à l'Ecole supérieure de guerre, Paris, Berger-Levrault, 1918.
\item \textsuperscript{20} Readers who wish to cover the principles of strategy in further depth should see Coutau-Bégarie H., Traité de stratégie, op. cit., section III – Les principes de la stratégie, pp. 307–331. This essay refers to further sources that also cover this subject.
\item \textsuperscript{21} Ibid., Chapter IV, pp. 271–360.
\end{enumerate}
a unique universal method, but strategic reasoning combines a number of different historical, geographical, realistic, rational, culturalist and even prospective approaches. For lack of a proper mastery of the philosophical strategic method developed by Sun Tzu and Clausewitz, and which has been described as “a sublime aspect of strategic science”\(^{22}\), the following study is inspired from the synthetic strategic method, which combines the more relevant elements identified by other methods.

First of all, considering how little hindsight the history of space exploration currently affords us, the historical strategic method will not be as useful as it is in land, naval or air strategy. There has never been a battle in space outside of science fiction literature and films. We also note that those films and books convey a number of inaccuracies into popular conscience. Sagas such as Star Wars\(^{23}\) must be spoken out against before we can begin to apply strategic consideration to outer space. History does, however, provide us with examples borrowed from other domains but which can be (carefully) applied in order to illustrate certain arguments.

On a more fundamental level, to begin a dialog about space strategy, we must first establish what this environment, which holds very little in common with our natural habitat, allows and prevents. Even our skies offer a greatly different environment to what we find out in space, although they share a radioelectric transparency over a broad range of frequencies, including the spectrum of visible light. But, of course, there are no clouds in space, other than ones that are very far away and particularly tenuous. The physical laws that apply in this environment are also often very disconcerting. Yet, it is a deciding factor! This is why it is necessary to study and understand these extra-atmospheric physical laws before even starting any strategic considerations. We will start doing this in Chapter 2 and finish in Chapter 3.

The geographic strategic method typically refers to our knowledge of the earth\(^{24}\). It can, nonetheless, be transposed to space, at least for physical geography that distinguishes and delimits large structural elements with their properties: land surface versus seas and oceans, mountains versus plains, etc. This physical geography allows us to highlight natural limits such as coastlines and natural terrain partitions from rivers and mountains, which impact traditional land strategy. One particular limit
is particularly difficult to establish, and that is the split between atmosphere and space. We will discuss this further in Chapter 2.

The realist strategic method will therefore emphasize strategic processes according to available resources. There are two distinct branches: the objective [realist] method will focus on the capacity of the available means; the subjective [realist] method focuses on the way said means can be used which may not correspond to the maximum capacity of said means or even be completely unsuitable\(^\text{25}\). As this is a new domain that can only be reached through technical feat, the objective realist method has a place in space strategy. The subjective realist method, which “aims to determine the opponent’s intentions in order to identify the most likely threat”\(^\text{26}\), poses useful questions allowing the strategist to rank the most credible dangers. Considering that the realist method “emphasizes the primacy of technique”\(^\text{27}\), it is essential when conceiving strategies in an inhospitable environment, without the use of advanced technology.

The scientific or rational strategic method, discussed at the end of the 19th Century by Ecole Polytechnique alumni Auguste-Antoine Grouard, is similar to the deductive method used by empirical sciences. According to this author, it complements the historical method: “The first [the rational method], uses the properties of the available strategic resources and analytical reasoning in order to select the best course of action; the second [the historical method], faces us with past events in order for us to deconstruct them and determine the keys to success and the reasons for failure, in other words, to establish the rules of war. One method uses deduction and empirical science; the other uses inductive reasoning and bases itself upon experience and observation”\(^\text{28}\).

As history currently offers us no past instances to learn from, we must approach space strategy through deductive reasoning. Also, the scientific methods for operational analysis that allow us to create simulation programs to solve operational and tactical problems are generally used in conjuncture with strategic reasoning.

The culturalist method is the polar opposite to the scientific or rational method. It consists of taking into account the culture of strategic actors to better anticipate their reasoning and reactions. It is, therefore, a method that has no absolute aspect, but that is entirely conditional to the situation.

An example to illustrate this: President Obama decided to remove funding for the Constellation program looking to send Americans back to the moon. Officially, this

25 Coutau-Begarie H., Traité de stratégie, op. cit., p. 296.
26 Ibid., p. 303.
27 Ibid., p. 310.
was a financial decision. He is allowed to do this as in 2010 it is no longer considered strategic to send compatriots to the moon. However, during his memorable speech on May 25, 1961, JFK stated his resolve and the strategic necessity of this enterprise\textsuperscript{29}. Strategy is burdened with cultural aspects that one would be wrong to ignore.

Cited only for posterity by strategy historian Hervé Coutau-Bégarie, the \textit{prospective strategic method}\textsuperscript{30} must not be neglected when it comes to space strategy as it is a brand new domain.

This strategic method turned toward the future uses prospecting tools: projection of past tendencies, identifying breaches, imagination, etc. When studying space conflict, since studying past events is of little use, inspiration can be found through prospective thinking.

To conclude on the choice of method, one must learn to take best advantage possible of each different approach by assembling them intelligently within an overall method; the synthetic strategic method seems to be the more suitable. However, in order to account for the interactions between different fields of study, the synthetic recomposition of partial deductions into strategic conclusions must be performed as a systemic approach. This is why the method we will finally be using in this work can be described as \textit{systemic synthesis}.

Let us use an example to illustrate what sort of actions this systemic synthesis can lead us to. Suppose that we seek to oppose a global military force such as the one at the disposal of the United States, which relies heavily on its space power to dominate every strata of war. Suppose that we want to reduce the striking precision that makes their air-raids so effective. Realizing that more and more bombs are guided via GPS\textsuperscript{31}, our most efficient course of action will be to neutralize their NAVSTAR satellite array rather than jamming their signals at a local level. This can be achieved without the need for physical destruction by performing, for instance, a cyber-attack on the control center of the array.

After these semantic considerations, let us raise the tangible problems that are sure to have an impact on any strategy based in space. Three subjects in particular deserve specific attention: the matter of \textit{space debris}, developing \textit{directed energy weapons} and designing a \textit{spaceplane}.

\textsuperscript{29} Speech by President John F. Kennedy at Rice University in Houston, Texas, September 12, 1962. The text for this speech was called \textit{We choose to go to the moon} and appears in Appendix 6.

\textsuperscript{30} COUTAU-BEGARIE H., \textit{Traité de stratégie}, op. cit., p. 300.

\textsuperscript{31} GPS: \textit{Global Positioning System}. The NAVSTAR GPS which contains 24 satellites actually allows both geolocalization and navigational services for mobiles.
1.3. Debris, laser and spaceplane

The first subject to take into consideration is the one of space debris. According to the definition by the CNES, “Space debris is defined as being all objects created by Men, including fragments thereof or parts detached from them, other than a space vehicle that is active or liable to be used in another way, being on orbit”\(^\text{32}\). The official definition is more concise: “residual object resulting from a space expedition, located in orbit”\(^\text{33}\). Note that none of these two definitions include inactive spacecraft and vehicles placed on the exit trajectory of the solar system. These would be man-made objects abandoned in space but simply not in orbit.

The notion of space debris includes any satellite or fragment thereof, which has passed its usability deadline, as well as any launching gear that has not yet come down, and any tools or utensils lost or abandoned during manned flights.

The danger with these objects lies in their kinetic energy, proportional to the square of their own speed that is numerous kilometers per second\(^\text{34}\). The global risk they present increases with their number. Furthermore, certain objects, such as orbital launcher gear that is not flushed, contain **bottom**, which presents a risk of explosion even in the absence of a collision.

Debris are classified according to their size, which determines their destructive capacity. While our extra-atmospheric space was exempt of any artificial objects on the morning of October 4, 1957, NASA estimates that our planets orbit contains approximately:

- 21,000 **large debris** measuring over 10 cm\(^\text{35}\);
- 500,000 **medium debris** measuring between 1 and 10 cm\(^\text{36}\);
- 100 million **small debris** measuring between 1 mm and 1 cm\(^\text{37}\).

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32 Translated from: CNES website relative space debris: https://debris-spatiaux.cnes.fr/fr/node/121.

33 Translation from the official journal of September 22, 2000, this definition can be found on the France Terme website: http://www.culture.fr/franceterme.

34 Orbital speed or initial cosmic speed is of 7.8 km/s: this is the theoretical minimal speed that a launcher must reach to allow it to enter into orbit. The higher the orbit, the lower the speed. For example, at an altitude of 800 km the speed in a circular orbit is of 7.45 km/s, whereas at 36,000 km of a geostationary Earth orbit, it is only of 3.07 km/s.


36 *Ibid*.

37 *Ibid*. 
The CNES sensibly states different numbers, but stays within the same order of magnitude: 16,000 objects larger than 10 cm in diameter, 300,000 between 1 and 10 cm and over 350 million under 1 cm\textsuperscript{38}.

Large debris are considered likely to entirely destroy a craft upon impact. Medium debris can pierce a spacecraft from one end to the other. Small debris are only capable of damaging the surface of a satellite, but present a deadly threat to extra-vehicular activity.

On top of that, the number of debris elements, which is already in the hundreds of millions, is increasing exponentially and therefore self-multiplying mechanically in orbit through multiple collisions: it is estimated that each collision generates on average a hundred new debris elements.

\begin{figure}[h]
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  \includegraphics[width=\textwidth]{image.png}
  \caption{Evolution of objects around the Earth (© CNES)}
\end{figure}

The only reassuring information is that lower debris end up falling back down to earth and disintegrating during re-entry into the atmosphere, except for larger structures of which certain elements may reach the ground. However, this is nowhere near reaching the debris that are currently near geostationary Earth orbit, which, it is estimated, will persist in space for millions of years.

As we understand it, the natural and intentional multiplying of these debris could obstruct the usage of certain areas of space, the same way that military mines prohibit access to vast areas of land and sea, wherever they are buried or anchored. We would need to be able to sweep this debris with, for instance, a sort of “space garbage-truck” to gather the larger ones or some or even a power laser to pulverize the smaller debris.

Hence, the second matter to consider, which happens to be that of directed energy weapons, which can remotely disrupt if not severely damage or even destroy ballistic missiles, satellites and other space objects.

To this day, land, naval or airborne weapons have always delivered projectiles, which act through direct impact or with an explosion close to the target. Only nuclear and thermonuclear bombs produce toxic radiation on top of their destructive force. The principle of all of these ammunitions is essentially the same as for ancient projectile weapons, which shot rocks, arrows, lances, etc. The only difference is that the projectile can now be launched much further (thousands of kilometers in the case of intercontinental military loads) and that it explodes upon arrival. Using missiles against spacecraft is not only conceivable but has been tested by the Soviet Union and the Americans since the 1960s and more recently by the Chinese39. Unfortunately, this relatively simple method presents a major drawback: it produces thousands of new pieces of debris that pose an equal threat to all users of the concerned orbit.

This is why a weapon that can disrupt a satellite from a safe distance without destroying it would be an innovation that makes space battles a real possibility. The Americans have tested the Airborne Laser (ABL), system as part of a program that began in the 1990s. It uses a Chemical Oxygen Iodine Laser (COIL), with a power that ranges in the megawatts. The beam is directed toward a point set by a 1.5-m wide telescope attached to the nose of a Boeing 747-400F jumbo jet. On February 11 2010, during a trial, the system successfully intercepted for the first time a Scud missile headed toward California from an offshore platform40. What this demonstrated against ballistic missiles is entirely applicable to lower orbits up to 1,000 km in altitude. Even

39 On January 11, 2007, a Chinese missile intentionally destroyed one of its old national meteorology satellites, thus generating more than 2,000 new pieces of debris large enough to be catalogued, thus doubling their number at an altitude of 800 km. Source: CNES website: https://debris-spatiaux.cnes.fr/fr/node/122.
more powerful laser systems located on the ground could disrupt satellites located higher than that. It is also conceivable to develop weapons using electromagnetic rays to disable orbital sensors while generating no debris whatsoever.

To summarize, the spread of space debris tends to dangerously impair the access to space by prohibiting the use of certain classes of useful orbits. This adverse effect makes use of anti-satellite weapons with kinetic effects, more and more implausible. On the other hand, developing directed energy weapons allows targeted actions that are compatible with debris generation-free space battles.

That being said, is there not another technical path that could lead to a paradigm shift in the art of space strategy? The third subject to consider is therefore linked to the ever-delayed development of a spaceplane that could open a new and truly aerospatial path.

As will be explained in Chapter 2, there is a difference between the aeronautical environment and space, yet there is no observable frontier between the two. The air, where lift is possible, is the domain of inflatable balloons (lighter than air), which move because of the Archimedes buoyancy force generated by the mass of displaced air. It is also the realm of spacecraft (heavier than air) that fly using the aerodynamic lift that is applied to the wing when it is in motion. Space is an environment where vacuum prevails, there is therefore no possibility of generating lift. Planes follow controlled trajectories through the atmosphere because of their rudders, which affect the direction of the aerodynamic forces. In space, objects follow ballistic paths if not propelled by a rocket engine.

Furthermore, classic planes cannot fly anywhere above a few dozen kilometers in altitude, while satellites cannot be maintained under 200 km in altitude. Between these two heights, there is a fringe of altitudes where objects cannot maintain altitude easily due to physical limitations. Launchers and ballistic missiles pass through it upward at high speed. Re-entry craft pass through it downward at high speed. This particular area creates the real barrier between air and space and is strategically crucial as it separates two distinct environments where the laws that apply are fundamentally different. It is called the aerospace transition zone (ATZ)\(^{41}\). If spaceplanes ever see the light of day, regardless of the difficulty of creating it, its ability to move through that ATZ would bridge these two different environments; space and air. It would give the word “aerospace” its true meaning.

\(^{41}\) In French, the expression zone aérospatiale de transition that was proposed in the previous edition of the book is now validated as official terminology (Journal officiel July 25, 2015). Its definition can be checked on the France Terme website: http://www.culture.fr/franceterme.
To summarize, there are three primary elements to take into account in any considerations pertaining to space strategy: Space debris, spaceplanes and directed energy weapons. There are more that will appear during the study.

1.4. Conclusion

To conclude this chapter dedicated to setting the subject, military pragmatic classification shows that space is a naturally strategic domain.

Table 1.1 recaps the main characteristics of different strategic, operational and tactical levels in terms of dimensions, time, resources affected and decision echelon. Going by this table, it is apparent that space, which encompasses all possible air-land and air-sea stages, possesses intrinsic strategic characteristics: it is global, it is used over long periods of time (average life-span of a satellite is over 10 years), the resources affected in space are those of the country, and lastly the decisions come from the highest politicomilitary levels of command.

Of course, space can be used at the operational and even tactical level, but a fleet of satellites will be necessary in order to offer permanent support to the close quarter forces. For example, the GPS array uses no less than 24 satellites to offer positioning services in all points of the globe. As a result, using resources in favor of tactical operations is not impossible, but certainly expensive.

In summary, we can confidently say that space is a naturally strategic domain. However, it can also be used at an operational or even tactical level, although with a heavy investment cost.

After raising the domain and the methods of strategy, we must now detail the limits of the considered field of applications: extra-atmospheric space.
<table>
<thead>
<tr>
<th>Level</th>
<th>Strategic (physical extent of operations)</th>
<th>Operational (time)</th>
<th>Tactical (resources affected)</th>
<th>Decision-making level of command</th>
</tr>
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<tbody>
<tr>
<td>Physical dimension</td>
<td>Global (long term)</td>
<td>Regional (medium term)</td>
<td>Local (short term)</td>
<td>Politico-military level (President, Head of State, Chief of Defence (CHOD))</td>
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<td>(geographical extent of operations)</td>
<td>(duration of war)</td>
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<td>Operational Theatre level (inter-army theatre command)</td>
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<td>Time</td>
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<td>Military action level (squad leader, battalion leader, company leader or isolated fighter)</td>
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<td>(duration)</td>
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<td>Resources affected</td>
<td>Any resources necessary</td>
<td>Suitable means (compromised with other operational stages)</td>
<td>Reduced resources</td>
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<td>(military resources mobilized)</td>
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Table 1.1. Three levels of military action (© Jean-Luc Lefebvre)