Taking the high ground

Airpower in the Netherlands: a vision of the future 2015–2025

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The Hague Centre for Strategic Studies

HCSS helps governments, non-governmental organizations and the private sector to understand the fast-changing environment and seeks to anticipate the challenges of the future with practical policy solutions and advice.

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High ground offers three strategic assets: greater strength, protection from access, and a wider view.

The advantage of a better view means that higher ground confers a certain offensive power on both attack and defense...

Carl von Clausewitz
On War (Translated by M. Howard, P. Paret)

I realise it is impossible to predict the future. The unpredictability of the future does not, however, relieve us of the obligation to express an expectation, based on the currently available information and understanding, of the possible consequences of this uncertain future.

General P.J.M. van Uhm
Chief of Defence 2008–2012
Military Strategic Vision 2010

Foreword

Taking the high ground

In the centenary of military aviation in the Netherlands, the Royal Netherlands Air Force stands at the threshold of the second century of airpower. This fact is reason not only to reflect on past performance, but also to consider the future of Dutch airpower. Having completed an active period of 20 years in which it has successfully contributed to national and international operations, the Royal Netherlands Air Force has asked The Hague Centre for Strategic Studies to examine the future of Dutch airpower against the current background of various trends and technological developments.

In recent decades, the Dutch air force has developed from a relatively large organization structured for the Cold War into a smaller, more combat-ready expeditionary air force that derives its relevance from the creation of conditions under which national and allied armies, navies, and air forces may execute operations successfully. This has prompted an increasing degree of cooperation between army, naval, and air forces; a cooperation whose complexity is increased by the increasing influence of two new domains: space and cyber space.

The increasing accessibility of space will require the Dutch armed forces to make choices. Moreover, developments in the cyber domain will leave none of the traditional armed forces untouched. In addition, the use of unmanned platforms across the armed forces will increase and, over time, will take over more tasks. This trend will be seen both within the Netherlands and abroad. National and local authorities are making ever more use of defense capabilities, including those of the air force, in order to safeguard the diverse interests of Dutch society.

All this sounds logical enough, but it is by no means the whole story. The emergence of new economic superpowers, in particular China, and the rapid reinforcement of their naval and air forces point to an increasingly assertive attitude. Owing to their similarly rapidly growing need for raw materials and energy and their attitude towards neighbouring countries, the likelihood of an armed conflict in this region is increasing rather than diminishing. China in particular is becoming ever more assertive in clashes with its neighbours over the raw-material-rich archipelagos in the China Sea. In view of our trade with countries in this region, this impacts Dutch national interests directly.

Our postmodern Dutch society pays too little attention to risks of this nature. We would rather make defense cuts to balance our finances than consider the long-term consequences of such economizing. Consequently, we are becoming more vulnerable to developments that threaten our interests.

In order to increase their relevance, the Dutch armed forces must invest in their capabilities in the spectrum of conflict, and critically, not only in the lower part of the spectrum but also in its upper reaches. The scrapping of battle tanks, artillery and antitank weapons means that for their heavy fire power the Dutch armed forces must rely increasingly on the Royal Netherlands Air Force with its fighter aircraft and combat helicopters. In addition, the air force must also remain relevant in the lower part of the spectrum of conflict and must continue to contribute to operations on behalf of national and civil authorities. And all this with a shrinking budget.

This situation will compel the Royal Netherlands Air Force, as a knowledge bearer and exponent of airpower in the Netherlands, to make new choices. In several respects, this must involve 'taking the high ground': the pursuit of superiority in terms of military operations, technology and doctrine. Ultimately, this will be critical to the future of Dutch airpower, military operations and society.

Professor R. de Wijk
Director of *The Hague* Centre for Strategic Studies

1 Introduction

Creating conditions in the past, present and future

In recent decades airpower has developed from being an instrument of the Cold War into a flexible expeditionary military instrument. Airpower creates the conditions under which the army and navy can take action. This role is an essential one. Without aerial observation, air transport, and air support, there can be no deployment on land or at sea. This role imposes on the air weapon a special obligation to engage in ongoing self-development and innovation, for the purposes of both combined operations with the army and navy and its own independent missions.

The development of the armed forces and airpower is influenced by many factors. Coupled with the massive build-up of air and naval forces, increasing disputes concerning scarce raw materials, the persistent threat of international terrorism and piracy, the proliferation risk of nuclear technology and ballistic missiles, and the destablising effect of fragile and failing states, the emergence of new economic and military superpowers is critical to the international security situation. Technological developments in the field of space and cyberspace are expanding the playing field. The emergence of unmanned systems is also influencing how people think about and deploy military capabilities, not only in the military but also in the civil domain. The Kingdom of the Netherlands and its armed forces are not impervious to these trends and developments. In addition, the armed forces, and thus the Royal Netherlands Air Force, are increasingly being called upon to play a role within the Kingdom as a structural security partner in operations undertaken by civil authorities and emergency services. All this is taking place against the background of a future characterized by strong geopolitical dynamics, increasing civic complexity and uncertain security prospects.

These current dynamics present threats as well as opportunities. Although the distinction between interstate and intrastate conflicts is blurring, conflicts of

this nature have decreased in frequency and size in recent years. Having said that, a significant increase was evident in the year 2011, but it would be premature to speak of a break in the trend. What can be said, however, is that the current strategic uncertainty compels caution when extrapolating from the pre-2011 downward trend to a widespread, enduring peace. There are many regional hotspots of instability and the likelihood of armed conflict between major powers has not disappeared; in fact it may even have increased. The array of potential threats is broad, in terms of their nature and size as well as their geographical distribution. To discriminate between these threats, high-quality situational awareness is essential, more so than in the past. Increasingly, political and military decision-makers have a vested interest in gaining reliable access to means of communication and observation, not only in the air, but also in space. A robust capability for air/space-surface observation is vital. The emergence of relatively cheap technology, coupled with the innovative capacity of the Dutch aerospace industry are bringing the development, construction and use of aerospace observation tools within Dutch reach and as such this route should be considered seriously.

The fact that the Dutch army and navy are making increasing use of air support and helicopter transport adds to the need to develop thinking on the use of airpower. The choice made in the Netherlands to reduce ground-based heavy fire support considerably is placing more pressure on light, specialist and air-mobile units, which are more dependent on fire support and tactical transport provided by air forces. The increasing tensions affecting sea areas containing fishing grounds, oil and gas supplies, and scarce raw materials, as well as relentless piracy, will also compel the navy to require more help from aerial or space-based observation tools in their effort to build situational awareness. In view of the threat posed to access of international airspace, space and, in particular, the open sea by the build-up of fleet and air units by emerging superpowers, airpower must be capable of forcing and monitoring this access.[1]

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1   Nathan Freier, *The Emerging Anti-Access/Area-Denial Challenge,* Center for Strategic and International Studies, May 2012. http://csis.org/publication/emerging-anti-accessarea-denial-challenge.

Should it come to a confrontation at sea, the need for fire support in maritime operations, and possibly even strikes against maritime targets, will increase. Of further importance are the trends in national and international cooperation between government(s), research institutes and industry. This area also presents opportunities for Dutch civil and military aviation. Owing to the interests this would serve, this warrants further research.

All this cannot be seen in isolation from the replacement of the F-16 and the acquisition of unmanned aircraft systems. In 2013 the Dutch government will make its final decision about the replacement of the F-16. A decision to purchase a new fighter aircraft will most likely also involve a decision about the numbers to be acquired. It is important to realize that the size of the fighter aircraft force relates directly to the combat power and the sustainability of the Dutch armed forces, their flexibility and speed of deployment. The number of fighter aircraft is one of the factors that determines operational possibilities on land and at sea. While the final choice for a new fighter aircraft has not yet been made, the capacities of the successor to the F-16 and of an unmanned reconnaissance system will undoubtedly redefine the Dutch air force. A mix of unmanned and manned weapon and sensor platforms will be created and this will give a significant boost to both the combat power and the information position of the Dutch armed forces and government. Any addition of an observation tool in space would broaden and increase the availability of information and intelligence even further.

This vision outlines the capabilities with which intended effects can be achieved by the Dutch air weapon both in conflicts and crisis situations, as well as in prevention and de-escalation. These are effects that require both armed and unarmed deployment; effects capable of creating conditions favorable to the realization of the desired solution to a crisis or conflict situation; not only in the air, on the ground and at sea, but also at the various levels of decision-making. The vision focuses on the period 2015 to 2025.

2 Global security trends and technological trends

2.1 Strategic trends
An uncertain and complex future

The security environment is characterized by a movement towards a multipolar system in which several centers of power exert great influence, both individually and in combination, on international politics and economics. Two trends are leading in this respect: the emergence of growth economies, in particular China; and the West's relative decline in power. One consequence of the world-wide financial-economic crisis has been to accelerate this process. In the developing multipolar system, the United States remains the world's dominant military power.[2] But the US is no longer the undisputed superpower and it depends on its cooperation with others to address large international problems. Increasingly, emerging economic superpowers are assuming a presence in diplomatic, cultural and military arenas and are staking out their regions and spheres of influence. They are also organizing themselves in informal clubs of countries in order to counterbalance the clubs of industrialized countries, such as the G8 and the G20. This informalization of global governance is bringing informal circuits into existence alongside the established ones, such as those of the United Nations. This is tending to intensify rather than minimise explicit conflicts of interest.[3] It thereby increases the risk of tensions rising and crises escalating. At the same time, owing to the advance of globalization, international conflicts are increasingly impacting our national security and prosperity.

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2   National Intelligence Council. *Global Trends 2030: Alternative Worlds*, December 2012. http://www.dni.gov/files/documents/GlobalTrends_2030.pdf.

3   Bernhard Rinke, Ulrich Schneckener, en Hillary Crowe (transl). *Information of World Politics? Global Governance by Clubs*, Global Trends 2013, Development and Peace Foundation (SEF), Institute for Development and Peace (INEF), Bonn, 2012. http://www.globale-trends.de/fileadmin/Redaktion/Globale-Trends_2013/gt_2013_English.pdf.

In this period of global shifts in power, new power blocs and new alliances are being formed. Europe's relationship with the United States is undergoing change. The economic crisis and the emergence of Asia are forcing a retrenchment and reorientation of US foreign policy. Increasingly, Europe is taking responsibility for the security and stability of its own region.

Ongoing globalization and accompanying dependencies are also reflected in the increasing prosperity in the growth economies and rise in global population. The world population is rising from 7 to 8 billion, chiefly due to expansion in developing countries where, moreover, urbanization is undergoing explosive growth. At present, urban areas are home to 50% of the population of the developing world.[4] Population growth, in particular in developing regions, is part of a broader demographic trend that is prompting a shift in the composition of the population worldwide. Rich Europe and China are aging, while the African continent and South Asia remain young. Migration and the flow of refugees are on the increase, both 'wanted' and 'unwanted'. The use of new means of communication is responsible for an increasing political awareness. Similarly, ideas and disturbances spread more quickly than they used to. A growing global middle class is increasing pressure on available raw materials. This dynamic is interwoven with the process of climate change. Pressure on energy and raw materials supplies is intensifying international competition for raw materials. This is resulting in price increases and protectionism and it has the power to put relationships between countries on edge.

Already this seems to be fostering military conflicts, such as those in the China Sea over the Senkaku/Diaoyu, Spratly, Paracel and Scarborough islands.[5] Access to raw materials is being used for strategic gain. The most important discoveries of new energy sources, such as shale gas, are being made in the western hemisphere,[6] while Europe and Asia remain dependent on the oil

4   United Nations Department of Economic and Social Affairs; Population Division. *Population Distribution, Urbanization, Internal Migration and Development: An International Perspective*, 2011. http://www.un.org/esa/population/publications/PopDistribUrbanization/ PopulationDistributionUrbanization.pdf.

5   BBC News - *Q&A: South China Sea dispute*, 27 June 2012. http://www.bbc.co.uk/news/world-asia-pacific-13748349.

6   Wendy Lions Sunshine, *Rise of U.S. Shale Gas Production - An Introduction*, 2012. http://energy.about.com/od/drilling/a/Rise-Of-U-S-Shale-Gas-Production-An-Introduction.htm.

and gas reserves found in the Middle East and Russia. As a consequence of the changing balance of power, the international institutional framework of global governance is under pressure; we are in a period in which international agreements and regulations, standards, and institutes in their entirety are growing weak due to the intensification of conflicts of interest. Owing to the emergence of regional superpowers that have adhered to other norms and values, there is much scope for improvement in the protection of fundamental human rights. Multilateral solutions are required to solve complex transnational problems such as climate change and the increasing pressure on raw materials. Where effective supranational structures are lacking, it is debatable whether the necessary cooperation can be realized in the multipolar world.

The increasing fragmentation of states is another noteworthy trend. There is evidence of this in what is known as the 'belt of instability' that runs from Central America and the Caribbean, via West Africa to North Korea. For Dutch security, North Africa, the Sahel and the Middle East are regions requiring particular attention, not only due to their proximity to Europe, but also due to the trade flows that originate in and pass through them.

The combination of pressure on raw material supplies, large groups of unemployed youths and dictatorial regimes has led to instability in the Middle East and North Africa. As this trend is set to continue, political instability will remain an important factor for conflict in this area. In many places in the world, especially in fragile and failing states, the state of human security leaves much to be desired. As a consequence of climate change, the Arctic sea routes will eventually become navigable. It will also become easier to exploit the raw materials present in the Arctic region.[7]

Each year, the planet gains another 120,000 km^2 of desert. Worldwide, 1.5 billion people are dependent on land that is under threat from desertification, as a result of which famine is an ever-present danger. This phenomenon goes hand in hand with sizeable flows of refugees and political instability.[8] Strong population

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7   John Vidal, *Arctic Expert Predicts Final Collapse of Sea Ice Within Four Years*, Environment - Guardian.co.uk, 17 September 2012. http://www.guardian.co.uk/environment/2012/sep/17/ arctic-collapse-sea-ice.

8   United Nations Convention to Combat Desertification (UNCCD), *Desertification*, 24 October 2011. http://www.unccd.int/Lists/SiteDocumentLibrary/Publications/Desertification-EN.pdf.

growth is evident in the coastal areas of developing countries and this is giving rise to new fragilities. In 2015, 1 billion people will be living in slums and will have minimal opportunities to provide themselves with the primary necessities of life.[9] It is estimated that 450 million people have insufficient water.[10] Owing to the growth of the population, the prices of rice, corn, and meat will rise.

Added to this, while for the time being the interaction between (groups of) states remains the dominant force in international relations, non-state actors are also capable of sending shock waves through the global system. Due to increasing economic dependencies, regional militant non-state actors can have a disproportionate effect on the international legal order and stability, and may thus also harm Dutch vital interests.

The net effect of all these developments is that over the next ten years the national and international security situation will be subject to greater uncertainty than has been the case at any time since the end of the Cold War. Fundamental uncertainty in the security environment is a given, and as such is the starting point for security policy.

2.2 Trends in conflict
Future conflicts cannot be predicted
Since the end of the Cold War, the number of armed conflicts has declined. Thus it is striking that in 2011 the number of conflicts around the world increased.[11] It is too early to speak of a change but, as stated above, it is not too early to point to a greater uncertainty as to where and how threats become manifest and whom they impact.

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9   United Nations Department of Economic and Social Affairs; Population Division, 2011.

10   UK MOD, Development, Concepts and Doctrine Centre, *DCDC Global Strategic Trends Programme 2007-2036*, January 2007. http://www.cuttingthroughthematrix.com/articles/strat_trends_23jan07.pdf.

11   Peter Wallensteen et al. *The Number of Armed Conflicts Increased Strongly in 2011* - Uppsala University, 13 July 2012. http://www.uu.se/en/news/news-document/?id=1724&typ=pm&area=2&lang=en.

An important fact is that for decades now the number of intrastate conflicts has been many times greater than the number of interstate conflicts.[12] While this trend seems set to continue, the value of extrapolated trends at this juncture, with fundamental power shifts and uncertainty the order of the day, is extremely limited. Under the influence of globalization, intrastate conflicts that involve failing state authority or territorial claims have increasingly serious consequences for Dutch national economic security. After all, any disruption of the financial market or free trade, anywhere in the world, impacts the Dutch economy since it thrives on international relations.
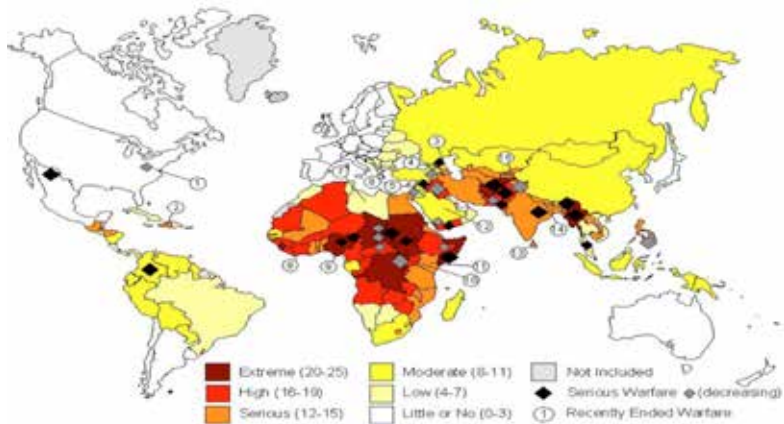
STATE FRAGILITY AND WARFARE IN THE GLOBAL SYSTEM, MID-2011

The above figure[13] shows the distribution of current conflicts; the numbers indicate the 15 conflicts that ended most recently. The large number of conflicts terminated in the recent period also means an increase in the number of unstable states in which social systems must be rebuilt. The humanitarian situation in such places is often poor. One of the greatest challenges in these states is posed by the large numbers of well-armed and trained militias that control parts of the state in the prevailing power vacuum or that choose organized crime as an alternative. As in the case of the Somali pirates, the effects of this are felt regionally if not globally.

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12   Monty G. Marshal, and Benjamin R. Cole, *Global Report 2011: Conflict, Governance and State Fragility,* Vienna (VA), 1 December 2011. http://www.systemicpeace.org/GlobalReport2011.pdf.
13   Monty G. Marshal, and Benjamin R. Cole, ibid.

Conflicts involving various types of parties—a combination of state and non-state actors—are the norm. While states themselves make use of non-state actors, they may also find themselves increasingly opposing non-state actors. These hybrid conflicts present new challenges for the armed forces. In addition, asymmetric operations need to be taken into account. In such cases the enemy would exploit Dutch or allied vulnerabilities in various domains. Take, for example, the use of economic weapons, the blending of civil and military domains, the use of cyber resources targeting civil infrastructure, or the manipulation of perception and public opinion. Naturally, the Netherlands and its allies could employ similar asymmetric methods of operation, provided such action were in accordance with international and humanitarian law.

2.3 Trends in technological developments
Innovation critical, but western lead diminishing

In the technological arena, three revolutions are occurring simultaneously. The best-known of these, the Information and Communication Technology (ICT) revolution, has radically changed our lives already. Moreover, changes in the ICT sector seem to be gaining rather than losing pace. Facilitated by network-level activity, we are seeing unprecedented possibilities for rapidly generating large quantities of information and studying its connections and relationships (*data mining, big data*).[14] In addition, digitization is facilitating networked military operations, shorter decision-making cycles, greater precision and larger stand-off capacity. The information revolution has also prompted the development of an independent domain for national and military security: the cyber domain.

With the expansion of the use of ICT and our corresponding dependence on it, it is becoming increasingly important that we protect this capacity. The cyber attack on Estonia in 2007 drove home the message that the internet sites of government, banks, the media, political parties, and companies were insufficiently protected.[15] Besides defensive measures taken to protect one's own interests, the cyber domain also offers increasing possibilities for launching attacks. In 2010 in Iran, for example, the Stuxnet computer worm was disseminated with the aim of disabling

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14 Varun Dutt, *Strategic Data Mining Is One of the Biggest Secrets Behind Corporate Success-*Mydigitalfc.com, 8 January 2013. http://www.mydigitalfc.com/knowledge/strategic-data-mining-one-biggest-secrets-behind-corporate-success-556.

15 Russia Accused of Unleashing Cyberwar to Disable Estonia, World News - *The Guardian,* 17 May 2007. http://www.guardian.co.uk/world/2007/may/17/topstories3.russia.

a number of essential systems in an uranium-enrichment factory.[16] The cyber domain is developing into an independent environment in which defensive and offensive military operations can be conducted.

The ICT revolution is linked to the revolutions in bio- and nanotechnology. Individually and in combination, these are exerting great influence on defense capabilities. *Nanotechnology* is enabling the development of new materials capable of making many products smaller, faster, stronger, lighter, cheaper and smarter. [17] Effects that in the industrial era could only be achieved with large-scale operations and mass production, will be achieved in future with smart clusters of smaller things. This means a radical change in our lives and work. Many experts expect *biotechnology* to be responsible for considerable progress in medical healthcare, and that it can even significantly extend our lifespan. In the field of food production, too, biotechnology is creating new prospects. These revolutions will have consequences for our supplies of energy, food and raw materials and for healthcare. Equally, they will have implications for military operations.[18]

In the field of robotics, several major steps have already been taken. In the coming years, unmanned technologies will mature in the sense that they will achieve widespread use and operate with greater autonomy. Most states are now using unmanned systems. It is not inconceivable that in time armed unmanned systems will be used against each other.

In a marked contrast to the past, these developments are not driven per se by governments, but by market players who are operating at an ever more global level and with greater integration. Many of these technological developments are also creating opportunities for airpower. Closer cooperation with industry is necessary to realize these opportunities, and to control the availability of these developments to our enemies. Driven by market forces, the research budgets of market leaders have increased hugely, and this has accelerated the pace of innovation. Whereas

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16 Stuxnet Was Work of U.S. and Israeli Experts, Officials Say - *The Washington Post*, 2 June 2012. http://www.washingtonpost.com/world/national-security/stuxnet-was-work-of-us-and-israeli-experts-officials-say/2012/06/01/gJQAlnEy6U_story.html.

17 National Nanotechnology Initiative. *Nano.gov*, 12 January 2013. http://www.nano.gov

18 Guo Ji-wei, en Xue-sen Yang. Ultramicro, Nonlethal, and Reversible: Looking Ahead to Military Biotechnology. *Military Review*, 2005. http://usacac.leavenworth.army.mil/CAC/milreview/download/English/JulAug05/yang.pdf.

progress used to be measured in decades or years, the measure is now months—
and the pace is constantly quickening.

Under the influence of technological possibilities, new systems are highly
multifunctionally employable. The price we pay for this multifunctionality is
increasing complexity, which raises both the purchase price and maintenance costs.
Weapon systems are a case in point. As their technical complexity has increased,
so has their price. RAND has calculated that given the current trend in system costs
and inflation, in 2054 the entire US defense budget would be required to buy a single
platform.[19] This will never happen in practice but the rising costs of technology
continue to be an important point requiring attention. This drawback is balanced
to some extent by the ever-greater multifunctionality of the new systems, which
is being achieved through the optimum integration of weapon and and sensor
functions.

Nonetheless, new ways of reducing the total cost of having a weapon system at
one's disposal must be explored. For example, it might be possible to develop a
smaller number of multifunctional platforms or, at the other extreme, to create
a greater number of differing, complementary platforms with which a form of
modular multifunctionality. Developments in the field of unmanned aviation
make this reorientation not only expedient, but also necessary. Furthermore,
more use will be made of high-fidelity simulators, which when networked offer
high-quality individual and mission training. This will reduce the number
of actual flying hours needed. It also reduces the total cost of using a system.
The strong dependence on digital resources and the fact that many networks
are connected also brings new vulnerabilities. A focussed cyber attack on the
Netherlands could have an immense impact on the functioning of our society.
Infrastructure and weapons systems may be damaged to such an extent
that their effectiveness is immediately diminished. In view of the extensive
connectivity within the digital domain, protection will be integrated at the
national and international level. Wherever potential enemies make use of
digital applications, they too will have similar vulnerabilities. The use of cyber
resources to exploit these vulnerabilities generates an offensive capability, the
implications of whose substantial potential effects cannot yet be envisaged.

19   Obaid Younossi, Mark V. Arena, Robert S. Leonard, Charles Robert Roll Jr, Arvind Jain, and
     Jerry M. Sollinger. *Is Weapon System Cost Growth Increasing? A Quantitative Assessment of
     Completed and Ongoing Programs*, 2007. http://www.rand.org/content/dam/rand/pubs/
     monographs/2007/RAND_MG588.pdf.

The possibility of disrupting systems or disabling them, whether or not temporarily and while incurring only a minimal likelihood of collateral damage, will change the deployment of airpower. Also, airpower will be impacted by developments in the fields of precision weapons, less lethal and non-lethal weapons. The small-diameter bomb represents the first step along this route. This weapon is able by virtue of its great accuracy to achieve the same effect as a traditional bomb but with a smaller explosive charge, and its use involves a significantly lower likelihood of collateral damage and collateral victims.[20] Modern technology can be disseminated more quickly than ever before. This is a consequence of technological developments working in combination with the increased global interdependence that is a byproduct of the digital and communication revolutions. Whereas for decades the West was assured of a technological lead, this can no longer be taken for granted. Emerging economies are working hard to catch up.

2.4 Political trends
Coordinated policy and deployment as principle
The active protection and, if necessary, defense of Dutch interests is a political matter. The Netherlands is one of the few countries to have included the promotion of the international legal order in its Constitution.[21] This means not only that the Netherlands attaches great importance to the promotion and protection of human rights around the world, but also that the country considers a stable international legal order to be a prerequisite for the conduct of trade worldwide. This supposes a proactive foreign policy. In fact, two instruments exist with which international influence can be exerted: economic power (including foreign trade and development cooperation) and military power. A third instrument, diplomacy, is only credible when economic and military power are held in reserve as a means of exerting pressure or in preparation for use. The Dutch Advisory Council on International Affairs (AIV) states: 'After all, the political exercise of power is neither credible nor effective if it is not backed up by military power'.[22] In other words, the effectiveness of *soft power* is determined

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20 GBU-39 Small Diameter Bomb / Small Smart Bomb. GlobalSecurity.org, 7 July 2011. http://www.globalsecurity.org/military/systems/munitions/sdb.htm.

21 Grondwet voor het Koninkrijk der Nederlanden (Constitution for the Kingdom of the Netherlands), article 97.

22 Adviesraad Internationale Vraagstukken (Advisory Council on International Affairs), *Open letter to a new Dutch government: the armed forces at risk*, Advisory Letter nr. 22, September 2012. http://www.aiv-advies.nl/ContentSuite/template/aiv/adv/collection.asp?id=2372&language=UK.

to a significant degree by the possession and, when necessary, the willingness to use *hard power*. In view of this, it is not surprising that despite the increased focus on the national tasks of the Dutch Ministry of Defense, the principal part of armed forces investments goes towards people and resources that can be deployed abroad. The Netherlands attaches great importance to the use of the 'development cooperation' instrument in helping to prevent the impoverishment of countries and regions as this could create a breeding ground for conflicts. If the Netherlands should however become involved in a conflict or should intervene, it would pursue what is known as a *comprehensive approach*, in other words, an approach in which the coordinated deployment of various instruments, including the armed forces, is intended to lead to a structural solution to the conflict. The use of the armed forces is thus primarily a question of creating the conditions for the effective use of other instruments of foreign policy.

For the Netherlands, the coordinated deployment of various instruments of power in an effort to prevent instability, crisis and conflicts will be just as important as the use of these same instruments of power to end conflicts or to stabilize former conflict zones.

3 Consequences for the aerospace domains

Future operations beyond national tasks will be expeditionary in nature, conducted on the fringes of Europe or farther afield. Operations will vary in duration and will involve various threat levels and complicating factors such as the need to take action in coastal waters and urban areas, network environments and cyber warfare. All this will take place in a joint/combined/ inter-agency environment. The most important developments for the aerospace domains are stated below, together with their implications for airpower.

3.1 Air
Unmistakable success factor

Considerable adaptive capability is required to respond quickly to threats, conflicts, and disasters, because the issue of how and where the next deployment will occur is characterized by uncertainty. By its very nature, airpower is well placed to facilitate. Its short response time affords political and military decision makers the necessary time to weigh up their deployment options. The speed with which deployment can be realized serves to increase diplomatic pressure on the parties involved at an early stage and contributes to de-escalation. Rapid deployment may be limited to the air force, but may also occur in combination with, for example, special operations units of the army or marines, which by means of strategic and tactical transport can be flown in with a very short response time.

Decision making in crises requires rapid insight into the strategic and operational situation. Aerial observation is essential to this insight since it forms an essential part of Intelligence, Surveillance and Reconnaissance (ISR) activities. Aerial observation may be conducted covertly in a non-permissive air situation by using stealth or in a permissive air situation by using the freedom of action acquired in the skies. This aerial freedom of action enables the sustained observation of each location and, if necessary, the attacking of each target. Escalation dominance can be achieved effectively from the air, thereby

reducing the need for ground-based fire support. The smaller footprint ensures that deployment is also highly efficient.

The limited capacity for sustainability of the reduced Dutch armed forces makes sustained operations involving large units not an obvious choice. In view of the size of the armed forces, combined with their high levels of training and equipment, it is expedient that smaller, more specialized units should be deployed. The Special Operations Task Group (SOTG) concept developed by NATO points this development in the right direction.[23] For the purposes of firepower and mobility, the use of 'special units' and task groups, as well as air-mobile or amphibian units, requires a larger-scale deployment and thorough integration of airpower.

With their amphibian capability, naval forces are capable of supporting land operations from the maritime environment. From a support base at sea, amphibian or air-mobile units can be moved and deployed by helicopter in relative safety and a land operation can be supported logistically. In such a scenario, sufficient tactical air transport is required to create the necessary flexibility. A further dependence on air support is created by the fact that the units being deployed are relatively lightly armed. Both air transport and air support must be made available 24 hours a day, irrespective of weather conditions. But the freedom of action this creates is not a matter of course. Technological developments are enabling ever more countries to set up an integrated air defense system consisting of fighter aircraft and sophisticated (mobile) surface-to-air missiles. Complemented with portable air defense systems that are increasingly commonplace, these systems increase the challenge of maintaining freedom of action in the air. If this freedom of action must be secured by force, that force is exerted not only in the air and from the ground but also, increasingly, in the space and cyber domains.

Operations conducted over the past 20 years have shown that fighter aircraft continue to form the backbone of air operations. While it is true that unmanned aircraft are deployed increasingly in armed missions, the multifunctionality of the modern fourth- and fifth-generation fighter aircraft is as yet a bridge too far for unmanned air systems. For the time being, it would appear that unmanned

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23   NATO MC 0437/2, Special Operations Policy.

THE MULTIFUNCTIONAL F-16 FIGHTER

aircraft can take over some of the tasks of manned aircraft but that fighter aircraft will remain dominant due to their versatile deployment capability. In addition, the emergence of unmanned systems has caused a paradox in military aviation. On the one hand, their rapid development is prompting a call to entrust more types of mission to these systems, while on the other hand the use of armed unmanned systems against human targets is generating increasing criticism. The coming years will give rise to ethical and legal discussions about the employment of unmanned armed systems. Moreover, while there are as yet no signs that the development of unmanned systems has reached its limits, unmanned systems do have technological limitations. The lack of datalink space in the electromagnetic spectrum is one of the problems yet to be resolved. In the meantime, the technological and operational development of unmanned systems is prompting the redefinition of the balance between manned and unmanned systems. Miniaturization, increasing autonomy and legal and ethical considerations will all influence the outcome.

In recent years the airspace has become busier and for the time being this trend looks set to continue. In addition to the increasing number of civil aircraft movements each year, we are seeing the exponential growth of civil and military flights using unmanned systems. As a result, maintaining control of the airspace presents an ever-increasing challenge. Another problem caused by the increase in (unmanned) systems in the airspace is the limited availability of the bandwidth required to manage and exchange real-time images and information.

3.2 Space
Necessary and attainable

Expeditionary operations rely heavily on navigation, observation and communication resources installed in space. Dependence on resources in space is growing steadily. Increasingly, their guaranteed availability as a form of support is a precondition for military operations. However, the guaranteed availability of space resources in the field of communication is increasingly problematic due to the shortage of bandwidth capacity.

The intelligence chain, the ability to exercise command and control, and the necessary reach-back capability, all depend on the availabilty of guaranteed bandwidth between the operational theater and the national home base. For the Dutch armed forces this bandwidth is supplied by MILSATCOM. In about 2030 the capacity of the current contracts will be fully utilized. The Dutch MOD will need to take action nationally, bilaterally, or multilaterally to ensure the availability of sufficient bandwidth.

Technical developments are enabling more countries and also commercial organizations to launch and run satellites with which the whole world can be observed. This observation is persistent and (semi-)permanent and the image resolution of the observation systems is sufficient for military applications, which makes them an effective and efficient tool for accumulating global intelligence. Ownership of such capability affords the desired independent intelligence position and enables covert observation, without the need to make one's political or military intentions known. This makes a space-based observation capability extremely well-suited to supporting political and military decision-making in the period prior to committing capabilities to a crisis situation or conflict. In addition, such a system can provide a sustained contribution to situational awareness in the Netherlands, and this can be used to support civil authorities and emergency services.

Conversely, the increasing use of satellites also gives rise to dependence, which creates vulnerability. Satellites are vulnerable to solar activity, space debris, disruption by other satellites and, due to to the presence of computer systems on board and in the ground control stations, to computer viruses. Because of the large quantity of communication signals going to and from these satellites, their primary source of threat is the cyber domain. For this reason, the security of these signals and the networks containing the satellites is and will continue to be an important area requiring attention.

SATELLITE OBSERVATION CREATES NEW POSSIBILITIES FOR ISR

The increasing use of resources installed in space and our dependence on them makes profound knowledge about the availability of the various space systems a neccessity. The orbit in which a satellite flies determines when any given part of the earth can be observed. Operating a satellite involves knowing the locations and orbits of other satellites and of space debris. In addition, the 'weather' in space (solar winds, etc.) will also influence the performance of space capabilities. A thorough picture of the situation in space, Space Situational Awareness (SSA), is necessary to safeguard the operational deployment of this type of system. Incidentally, this is true not only of the Netherlands' own space systems, but also for those of other countries, and commercial systems whose continued operation is valuable to Dutch society.[24] Finally, an SSA capability also contributes to the detection and early warning necessary to execute missile defense operations.

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24 See Dr. M.G. Mennen & Analistennetwerk Nationale Veiligheid. *Nationale Risicobeoordeling 2011* (National Risk Review 2011). http://www.rijksoverheid.nl/bestanden/documenten-en-publicaties/rapporten/2012/08/15/nationale-risicobeoordeling-2011/nationale-risicobeoordeling-2011v2.pdf.

4   Roles for air & space power

Several effects that contribute to the achievement of strategic goals can be achieved from the air and space. Some effects have direct influence on strategic aims, such as the disabling of communication and command structures; others will contribute to tactical objectives, such as fire support when in combat with enemy units on ground or sea.

Characteristic of air & space power capabilities is their employment throughout the preparation, execution, and completion of an operational mission, forming a deployment chain. During the preparation phase a political and military decision will be taken, based in part on intelligence received from the chain, after which the first units will be transported by strategic air transport to the deployment area. Once these units have arrived, the first missions will be flown immediately in order to establish air superiority in the deployment area. This will create a relatively safe environment in which tactical movements can take place. Air superiority will be safeguarded throughout the mission, the flow of intelligence will be maintained, the enemy's strategic and operational targets will be attacked and aerial protection will be provided by means of fire support or visible presence.

Eventually, once the mission has been completed, the capabilities that have been flown in will leave the theater in reverse order. From the moment the deployment decision is taken, the deployment must be supported by a command and control system that guarantees effective and efficient use and safe return. The chain is effective only if all of its parts function and their mutual connectivity is guaranteed.

4.1 Freedom of action in air and space
Essential condition

Having control of the airspace in order to be able to guarantee freedom of action in the air and to deny the enemy this freedom is the most important condition enabling military operations on land, on sea, and in the air. Depending on the situation, control of the airspace may be won through a battle for air superiority. In some cases there is no aerial opposition, so that control of the airspace need only be maintained. Control of the airspace is not an intrinsic aim but rather part of an operations plan to achieve desired effects. It is the point of departure for all other forms of military operations. Only once the required level of control has been attained can an expeditionary unit move (strategically) and can tactical units move freely (whether or not temporarily) in the operational theater in order to achieve operational aims. Leaving control of the airspace in part or wholly to the enemy creates an inherent threat to friendly units and this will limit the achievement of the desired (strategic) effect. In the coming decades, technological developments will cause the fundamental value of airspace control to increase, and not only during times of crisis or war.

Freedom of action in the air and space also means that friendly air and space systems can be deployed without hindrance. While freedom of action is normally a given in peacetime, its active maintenance is nonetheless necessary. For example, the Dutch sector of NATO airspace is controlled and secured through the use of radar systems and fighter aircraft. Similarly, actions are taken to secure space infrastructure.

In a crisis or war situation freedom of action is not a matter of course. In a situation like this, air superiotity will be pursued that is appropriate to the desired extent of freedom of action. With a mix of aerial weapons systems and ground-based resources a local, theater-wide, temporary or permanent air superiotity can be achieved. Through the suppression or disabling of the enemy's integrated air defense and offensive capabilities, friendly aircraft, ground troops and ships can move unrestricted in the theater, thus ensuring operational flexibility.

In view of the investments being made worldwide in offensive air systems and the proliferation of modern and mobile air defense systems, there is a strong likelihood that it will be necessary to call upon a fifth-generation fighter aircraft to create air superiotity in the initial phase of a conflict. In 2025,

Russia, India and China will also have a fifth-generation fighter aircraft. While a direct confrontation with these countries does not seem likely, their export policies would suggest that the proliferation of fifth generation fighter aircraft to other countries is plausible.

AMBITION	FIGHTER AIRCRAFT	ATTACK HELICOPTER	BOMBER	STRATEGIC TRANSPORT	TACTICAL TRANSPORT	TRANSPORT-HELICOPTER	UAV	SURFACE-AIR DEFENSE
BRAZIL	0	+	0	0	+	+	+	+
CHINA	+	+	+	+	+	+	+	++
EUROPE	0	0	0	+	+	+	+	0
INDIA	+	0	0	0	+	+	0	0
RUSSIA	+	0	+	0	0	0	+	+
US	+	0	+	0	0	0	++	0

SUPERPOWER AMBITIONS FOR THE BUILD-UP OF AIR FORCES[25]

Developments in the air are taking place alongside the evolution of maritime and ground-based air defense systems. New radar techniques are emerging, such as phased array, and interception ranges are ever increasing. Here too, proliferation is increasing the level of risk.

25 Various sources: *Military Balance 2010; Military Balance 2012;* US Department of Defense, *The National Military Strategy of the US,* 2011; US Department of Defense, *Future Unmanned Aircraft Systems Training, Operations, and Sustainability,* 2012; European Defence Agency, *Air Operations Analysis,* 2012; US Department of Defense, *Military and Security Developments Involving the People's Republic of China,* 2011; Halloran, Richard, *Revolution for China's Air Force,* Air Force Magazine, 2012; People's Republic of China, *National Defense White Paper,* 2010; Ministry of Defense, Brazil, *National Strategy of Defense,* 2008.

RANGE S-300 AIR DEFENSE SYSTEMS VENEZUELA

Freedom of action in space can be seen as an extension of freedom of action in the air. This involves the armed forces having guaranteed access to resources in space and, if possible, the power to deny any potential enemy this access. For many years now, much of our communication, information gathering, localization and weapons guidance has involved satellites. Observation, navigation and communication satellites play an essential role in our societies, economies and the political-military sphere. Yet they are vulnerable to disruptive signals, cyber attacks and electronic espionage. If their use is to be guaranteed, these space resources must be protected. Their security is an issue that is not restricted to space itself. The physical security of satellite ground stations and communication hubs, as well as protection against cyber attacks, are important elements in maintaining freedom of action in space. In addition, it also helps to have a certain degree of redundancy in the capabilities deployed in space.

Technological and cyber developments afford state and non-state actors alike opportunities to influence space capabilities. It is therefore advisable that priority be given to ensuring that the control signals going to the satellite and the data generated by the satellite are well protected. At the same time, the cyber domain creates scope for disrupting the enemy's space capabilities, temporarily or permanently.

This scope is being explored within the Dutch national cyber strategy. In view of the various aspects that play a role in space, on the ground and in the cyber domain with regard to the security of space resources, the creation and enforcement of freedom of action in space is a task not only for the air force but for the armed forces as a whole.

The monitoring and protection of the freedom of action of the air force and the other components of the armed forces is an ongoing process. It occurs in peacetime and can be intensified during deployment throughout the entire deployment chain.

4.2 Intelligence and building situational awareness
ISR: a renewed primary task

The ability to provide a wider view, gained by virtue of elevation above the battlefield, is the historical reason why building situational awareness has been largely the responsibility of the air force. Like maintaining freedom of action, this is a role that is already being fulfilled when no crisis or conflict is afoot and it continues throughout the entire deployment chain. Besides aerial observation, observation from space is gaining importance.

In every part of the armed forces, and for political and military decision-makers and planners alike, the need for accurate and up-to-date intelligence is increasing. The nature and extent of the dependence on intelligence varies in each domain. Owing to the considerable range of air systems and their rapid speed of deployment, the air force is highly dependent on rapidly available, up-to-date and accurate intelligence. On the other hand, these characteristics make the aerospace domains highly suitable for the gathering of intelligence useful to army and naval forces. Thus ISR is an essential task for the armed forces and, in view of the urgency of airpower's need and its characteristics, a primary task for the air force.

Observation from space is the most persistent form of observation and as such it is the starting point for building strategic and operational situational awareness. Technological and commercial developments are creating new possibilities for smaller countries to carry out their own observations from space. The commercial availability of multispectral sensors with sufficient resolution is increasing. Satellites with these capabilities are, however, large, expensive to

develop, launch and operate, and are thus limited to countries with a relatively high defense budget. The burgeoning availability of nanosatellites (1–10 kg) with one specific sensor is changing this sitution. And that's not all.

Dutch development of Synthetic Aperture Radar (SAR) technology and message interception technology known as Signal Intelligence (SIGINT) is sufficiently advanced that these systems can be used in space. These technologies offer high-quality information, but require a larger microsatellite (10–100 kg). Using one or several microsatellites strengthens the Dutch national intelligence position and reduces dependence on other parties, either commercial or international. Observations made in this way are global, neither hindered by airspace restrictions, nor limited to periods of crisis or wartime. In view of this, the information gained is also useful to other Dutch government bodies and emergency services. Satellite observation also enables covert observation, which raises the possibility of anticipating conflict situations unnoticed.

The intensive use of space necessitates a good understanding of this domain. The many satellites circling the earth as well as space debris pose risks for space systems. Besides the physical objects in space, solar activity ('space weather') is another factor that influences the efficacy of space systems. This activity can cause the temporary loss or impairment of certain capabilities. If space situational awareness is to be acquired and maintained effectively, an organizational division must be charged with these tasks.

The development of unmanned aviation continues. The flight endurance and range of unmanned systems continue to increase and the resolution of the sensors continues to improve. Whereas a satellite passes a particular region daily, an unmanned system offers sustained, uninterrupted surveilliance of a smaller area. An unmanned reconnaissance plane can expand the situational awareness gained with satellites by charting movements and events (*pattern of life*) in the area of interest or by identifying targets. This information is relevant at every level (strategic, operational and tactical) and is no longer generated separately at each level. Micro- and mini-UAVs are an important development. These are small to very small unmanned air systems. They may be used in swarms or individually for tactical purposes, for example in urban areas or even indoors. The use of systems like this is chiefly a matter for smaller groups of ground units operating in the relevant environment.

PHOTOGRAPH: GENERAL ATOMICS

UNMANNED AIRCRAFT OFFER A WIDE RANGE OF OBSERVATION POSSIBILITIES

As stated earlier, control of the airspace is an important condition for the deployment of larger, unmanned systems. In a non-permissive environment, an unmanned reconnaissance plane cannot yet produce the required intelligence without risking loss or failure. In such situations, the intelligence need must be met by other, more robust systems carrying self-protection, such as fighter aircraft or armed helicopters. By releasing the information gathered by these platforms, much of the need can be met until sufficient air superiority has been won and an unmanned reconnaissance plane can be deployed. The extent to which this limitation will still prevail around 2025 is difficult to predict.

The data that is increasingly being generated by the intelligence chain must be disseminated and analyzed. The space-borne capabilities, unmanned and manned systems, and all the other sensors in and above the operational theater supply the available information to the intelligence chain via datalink. The large quantity of data has prompted the use of new analysis methods, such as automatic change detection and data mining (in which links between data are sought). Moreover, thanks to new network techniques, analysis can now be conducted outside the

area of operations, for example at an analysis centre in the Netherlands. This permanent connection with the home country (*reach-back*) enables multi-source analysis, which in turn creates synergy. Normal working conditions, far away from the deployment and in relative calm, foster quality of the analysis and enable harmonization with organizations such as the military and civil intelligence & security services (MIVD and AIVD). Once the analysis is complete, operational commanders can access the results via the network.

A robust Dutch air-to-surface ISR capability meets more than just the national requirement. It is common knowledge that other countries, in particular European NATO countries, have a substantial shortage of ISR resources, which makes them too dependent on US support during operations. As the US increases its focus on Asia, the necessity grows for Europe to become self-sufficient in these capacities. A Dutch air-to-surface ISR capability could contribute to closing the much-discussed capabilities gap.[26]

4.3 Mobility
'Get there the firstest with the mostest'[27]

In any military deployment, it is advantageous to have rapid, flexible mobility options. Global deployability requires strategic mobility. In the chain of deployment-related activities, strategic mobility is usually an issue from the start of the deployment until its end. This mobility may be delivered by ship, but particularly when rapid mobility is essential, delivery by air is preferable. In general, the private sector can meet this need. Viewed from this perspective, it is worthwhile considering the strategic transport requirement not only from an investment perspective, but also from a commercial point of view, in the sense that if the necessary service provision is well defined, commercial operators can respond accordingly. At present, certain locations and destinations are not accessible to civil aircraft, due either to the threat level or the relatively primitive conditions (e.g., unpaved runways). In any event, extensive international cooperation seems to be a good way of guaranteeing the temporary availability

26   Jorge Benitez. *2012 and NATO's unresolved capabilities gap,* Atlantic Council, January, 2012. http://www.acus.org/natosource/2012-and-natos-unresolved-capabilities-gap.

27   Motto attributed to Nathan Bedford Forest, cavalry commander, Confederate States of America, 1861-1865, Wikisource, http://en.wikisource.org/wiki/Interview_with_Nathan_Bedford_Forrest.

of an affordable hybrid[28] air transport capability. The European Air Transport Center and NATO's Heavy Airlift Wing are good examples of international cooperation in the field of strategic mobility; various countries pool, jointly manage, and deploy their capabilities or participate in a joint fleet comprising one type of aircraft. These are various forms of *pooling*. An expansion of strategic mobility with more participating countries, aircraft and specialisms, such as air tanker capability, is needed to compensate for the shortages evident within NATO and the EU.

AIR TANKER CAPABILITY, SUCH AS THE KDC 10, IS VITAL

Another option is to enter into a lease construction with a civilian company that has strategic or hybrid capability with military features. This is referred to as *sourcing* strategic air transport.

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28 Transport aircraft developed for strategic and tactical airlift missions, such as the C-17 and the A-400M, are sometimes referred to as 'hybrid' or *'stratac'*.

As the costs of owning (and operating) this capability are so high, this option and the cooperation option warrant serious consideration. Accordingly, developments in this area should be followed closely.

Tactical mobility, with aircraft and helicopters, is increasingly necessary in military operations and it plays a major role throughout the entire deployment chain. Conflicts are characterized by a diffuse operational theater in which movement by road and sea is not always possible or carries exceptional risk. Movement by air offers protection and gives the tactical commander the necessary flexibility. The shift within naval and army operations to more specialized missions, such as air maneuver, special reconnaissance missions, the evacuation of civilians from crisis regions, and action against pirates on board hijacked ships, requires capabilities whose deployability is guaranteed, day and night, irrespective of the weather.

Cooperation under difficult conditions requires optimum integration between the various units involved. Standardization, interoperability and joint initiatives in the areas of training, mission preparation, procedures and communication are essential.

THE C-130 HERCULES OFFERS TACTICAL MOBILITY

Increasingly, too, tactical mobility gained with aircraft and helicopters is determining the nature of logistical movements in the theater. The trend for more frequently employing small, specialist, light and air-mobile infantry groups is increasing demand for specialized tactical air transport.

LIGHT INFANTRY DEPENDENT ON TACTICAL TRANSPORT HELICOPTERS, SUCH AS THE CHINOOK

Take-off and landing at locations with a high threat level involve some of the riskiest moments in any tactical air movement. In view of the high degree of specialism involved, the risky deployment conditions and the adaptations to aircraft, helicopters and the training programs they necessitate, such capabilities are less well suited to sourcing.

4.4 Offensive action
The Dutch armed forces' heavy combat power

The character of airpower is inherently offensive, whether it is acting in a defensive or an attacking role. While this seems to emphasize airpower's kinetic effects, airpower can also be called upon to provide non-kinetic effects. One of these is reconnasissance, as described earlier; another is to provide a 'show of force'—flying noisily over an enemy ground unit to act as a deterrent. The non-kinetic effects of airpower exist by virtue of its kinetic effects; in other words soft power derives its value from credible hard power.

The ability to destroy targets anywhere in the world, very rapidly and with minimal warning, is one of the characteristics of airpower. Airpower's speed, range and firepower force an enemy to consider carefully the consequences of his actions. The early positioning of units close to an emerging threat can have

HEAVY COMBAT POWER FROM THE SKY

a de-escalating effect and, if necessary, intervention can be rapid and proportional, involving minimal risk. There are various reasons for disabling targets by means of precision attacks. Tactically, friendly ground units can be protected by neutralizing or destroying hostile units in their immediate vicinity, while deep strikes aimed at logistic and training centres reduce the enemy's operational sustainability. Attacks on the enemy's war industry or communication hubs often serve a strategic purpose and are intended to make it impossible to start or continue a war. In view of the speed with which and the range over which airpower can operate, it is not difficult to combine the various targets at various levels, and such action gives the operational commander maximum flexibility.

In many cases, the most effective method is to destroy targets from the air. The optimum deployment of airpower for the purpose of optimizing the ground force enables the rapid movement of ground units in smaller, more flexible groups, which in turn reduces their safety risk. As smaller units carry lighter armoury, aerial firepower is increasingly critical, whether it is used in an attacking sense or in a protective, defensive sense.

With various emerging economies expanding and modernizing their fleets, the threat at sea is growing.[29] Consequently, freedom of movement at sea can no longer be assumed, and the distances over which ships can be attacked are increasing due to technological developments. This is giving rise to a greater need for air support in protecting maritime units. In particular, the disabling of maritime targets at greater distances is a task requiring greater attention of the air force. In this context, the *Anti-Access/Area-Denial* concept is worthy of serious consideration.

NH-90, THE LONG ARM OF A FRIGATE

The Netherlands has a maritime expeditionary capability that enables amphibian deployments.[30] Amphibian operations allow for only limited deployment of heavy weapons. This is one factor that increases the need for air support at the boundary between the maritime and land domains. The attack helicopter adapted for maritime operations may operate from the ship and, as a form of maneuver capability, can provide immediate air support to amphibian and ground units in the landing zone.

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29   *De Zee: Speeltuin van de supermachten*, *Over de maritieme strategie van supermachten* (The Sea: Playground of Superpowers), The Hague Centre for Strategic Studies No 13/03/12, The Hague 2012.

30   Leidraad Amfibisch Optreden (Guidelines Amphibian Operations), Royal Netherlands Navy, Den Helder 2010.

APACHE, ESSENTIAL FIREPOWER

In order to guarantee the necessary operational and tactical flexibility, the attack role is fulfilled by a mix of fighter aircraft, attack helicopters, and unmanned aircraft. Depending on the situation, the assignment, the required endurance, distance, available time, visibility, and risk, a particular ratio in the mix of systems is chosen for deployment, or a choice is made between the various systems. The simultaneous deployment of different systems has a synergetic effect, but is possible only if intersystem connectivity is guaranteed. Any mix of air systems gives rise to a mix of armament. Fighter aircraft, attack helicopters and UAVs already use the same munitions to some extent. The arrival of *directed-energy* weapons represents a further step towards a common weapons package, so that the choice to deploy a certain mix will depend more on the characteristics of the platforms than on the weapons package. Whether *non-lethal* weapons will become part of the future weapons iventory remains to be seen.[31] In any event, developments in weapons technology should be followed.

31   Menno Steketee, Uitschakelen zonder te doden (Disable without killing), *NRC Handelsblad*, 26 January 2013.

4.5 Command and Control
Centralized planning, decentralized execution

Command and Control (C2) is not a role found only in the air force. It is a role that is also present in the other domains and which is vital throughout the entire chain of deployment. As compared to the other domains, however, C2 is structured and executed significantly differently in the air domain.

As 'centralized planning, decentralized execution' is still the adage that applies to air operations, it is critical to the structuring and execution of the *Air C2* functionality. Air and space capabilities are scarce. In addition, these capabilities are in high demand throughout the operational theater. Decentralized planning and control of these capabilities would create suboptimization and would make it more difficult to concentrate air forces against enemy centres of gravity. Centralized planning and control is a prerequisite for the optimum use of the speed and range of air and space capabilities. In addition, theater-wide operations require that the necessary flexibility be incorporated into the command and control system. Mission command *(Auftragstaktik)* is essential in creating the required flexibility. This manner of C2 ensures that execution is decentralized and it is precisely this decentralized execution that is required for the final harmonization with the various entities at the tactical level, which is necessary to mission success. To enable the required decentralized execution, the C2 system should not only gather information for decision-making in the staff divisions, but should also provide the operational weapons systems with the right information at the right time and in the right way, so that the various users can take the right decisions during deployment. To enable this, there should be a controlled *information push* towards the air systems.

To enable the optimum flow of information to and from the weapons systems, a dynamic ad-hoc network should be set up. This network uses all the available communication resources, such as UHF, GSM, SATCOM and Wi-Fi. The network automatically chooses the best connection using IP-based techniques. This creates a robust mesh network that is relatively impervious to disruption or interference and in which each weapon system forms an ad-hoc hub.

AIR C2 PROVIDES INFORMATION PUSH

As well as this amalgamation of communication resources in an operational network, a connection between this network and the Netherlands is also created. Such a *reach-back* capability makes it possible to provide logistical facilities from the Netherlands and this serves to reduce the operational logistics footprint required in the operational theater.

As a rule, airpower is deployed within a coalition framework and planning is carried out at an international headquarters. Through the involvement of its own personnel in the planning process, a coalition partner has a certain degree of control and influence over the execution of the missions allocated to him within the operation. On such an occasion, the Dutch air force could supply personnel to staff the international headquarters. By designating personnel for operational planning functions on a structural basis within the Dutch peacetime organization, while providing the necessary education and training, the air force will be able to adequately fulfil key planning functions within any operational headquarters. This increases the professional standard and the experience gained can be fed back into the domestic organization to facilitate the accumulation of knowledge and expertise. In the case of a national crisis situation, this air operations planning and control capability can serve as part of a national joint staff.

The NATO Air Command and Control System (ACCS) remains an important starting point for the operational control of air operations. The replacement of the radars of the Dutch Air Operations Control Station (AOCS) puts the air force in a position not only to greatly improve the airspace surveillance task and, as stated earlier, to conduct limited space surveillance, but also to observe and track ballistic missiles. Support of expeditionary operations by means of a command and control capability is being further developed within the context of NATO. Military and civil air traffic security tasks will be performed jointly by Netherlands Air Traffic Control (LVNL) and Eurocontrol.

4.6 Air Operations Authority
All airpower knowledge in one hand

Development of airpower knowledge in the Netherlands should be institutionalized at both the strategic and operational level. As the *Air Operations Authority,* the Commander of the Royal Netherlands Air Force is pre-eminently equipped to fulfil this task. Through its wide range of past operations, the Dutch air force has acquired substantial tactical experience. In addition, education about air operations has enabled the air force to progress at various levels, but strategic and operational thinking about airpower lacks structure and a firm anchorage. Over the longer term, this may hamper the development that is necessary in thought and action. The responsibility of the Air Operations Authority to gather and safeguard knowledge concerning operations of all elements of Dutch airpower would place this task in one hand. In view of this, it would be natural for the Air Operations Authority to assume responsibility for the development and safeguarding of knowledge and expertise concerning the various types of unmanned aircraft within the armed forces. This would be irrespective of which component of the armed forces deploys these systems; the choice is based rather on the domain in which these systems operate. Owing to the fact that the military use of space, in terms of both doctrine and military operations, is an extension of air operations, this aspect too should be represented by the Air Operations Authority. This would create a single integrated product: *air & space power*.

The defence of airspace is performed by several weapons and sensor systems, from the ground and in the air. Only through their optimum integration within an Air Command and Control System (Air C2) can these systems respond properly and effectively as a single entity. This response would involve deploying the right resources efficiently against the prevailing threat. Owing to this necessary integration, the integration of air and missile defense cannot be viewed

independently from air operations and for this reason the accumulation of related knowledge would also fall within the responsibility of the Air Operations Authority.

As Air Operations Authority, the Commander of the Royal Netherlands Air Force plays a coordinating, monitoring and driving role in the deployment of all Dutch systems in the air and space. This finds expression not only in the accumulation and safeguarding of knowledge, but also in the formulation of doctrine in the field of air & space power and in weapons system management[32] for all air systems of the Dutch armed forces.

In order that the Authority's role can be properly fulfilled, the aerospace domains should be properly described and the tactical and technical procedures should be harmonized between the various weapons systems and components of the armed forces. Moreover, the prompting and encouragement of strategic and operational consideration of air & space power should become a permanent task of the proposed *Air and Space Operations Authority*. The *Air & Space Warfare Center* of the Air Force Command would in many respects embody the role of the Air and Space Operations Authority.

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32 Weapons system management involves the integrated management of all relevant processes with the aim of achieving the required employability throughout the life cycle of weapons systems at the lowest possible life-cycle cost and within the framework of operational safety (airworthiness, seaworthiness, etc.). Ministerie van Defensie, *Concept Aanwijzing SG: Wapensysteemmanagement*, The Hague, October 2012.

5   Cooperation

5.1 International cooperation
European within an Atlantic perspective

It is highly preferable that Dutch military units be deployed in a coalition context. In view of recent positive experiences, it is probable that ad-hoc coalitions will be formed between NATO or EU countries, complemented with likeminded national partners such as Australia or Sweden.

In the coming decades, the United States will be focused more on Asia and less on Europe. As a result Europe will bear more responsibility for its own security. Investment in expensive military capabilities whose availability will no longer be guaranteed by the US by 2025 will necessitate European cooperation.

Therefore, the trend for greater European cooperation within and beyond NATO is irreversible. International cooperation in executing military tasks and deploying capabilities has increased. While key Dutch military capabilities must be maintained in order that national interests can be protected and national tasks can be executed, far-reaching international cooperation is offering ever more possibilities and oppportunities. With increasing frequency, organizations such as the EDA or NATO are developing initiatives that lead in time to a reduction of the costs of sustaining deployments while raising effectiveness and efficiency. The drawback of these organizations, however, is that the multitude of participating countries and (industrial) interests ensures that investment projects are slow to complete and regularly incur inflated costs. Smaller cooperative alliances with likeminded countries are less susceptible to this problem. The initiatives developed by the Royal Netherlands Air Force in this area, such as the *European Air Transport Command* (EATC), the *Multinational Fighter Program F-16* (MNFP) and the *Heavy Airlift Wing* (HAW), are very successful and can be expanded with initiatives in the areas of aerial refuelling, observation from space, unmanned observation systems and training programmes.

The key word in these international initiatives is 'connectivity'. Whether at international or at national levels, connectivity, compatibility and interchangeability with (international) partners must be ensured to facilitate joint operations. Connectivity must however be seen independently of a pre-established coalition.

The same applies to intelligence. At present information gained through our own operations is Dutch national property and is shared only out of operational necessity; often in exchange for information that we have been unable to acquire through our own observations. Owing to the large datastream that is expected, the system will develop on a need-to-share basis. Within a coalition, everything will be made available on a shared network for immediate use and for analysis. An international ISR initiative such as the *Alliance Ground Surveillance* (AGS) run by NATO could fulfil a flagship role in this regard.

There is, however, a limit to international cooperation, and the dependencies it involves. The retention of the Netherlands' own military capabilities remains necessary to protect national interests and execute national tasks.

5.2 Structural cooperation between the Royal Netherlands Air Force, research institutes and industry
The 'golden triangle' of the aerospace industry cluster
The Royal Netherlands Air Force applies a highly sophisticated standard in terms of its technology. This standard should be guaranteed by strengthening cooperation between research and education institutes, such as TNO, NLR, TU Delft, TU Twente and various other aircraft engineering schools, the cluster of aerospace industry, and the air force itself. Similar to the 'golden triangle' of the naval industrial cluster, the golden triangle of the Royal Netherlands Air Force serves many and varied interests. Firstly, the interest of security and freedom of action in the air and in space and thus on land and at sea, by means of sophisticated, decisive airpower; secondly, the economic interest of a thriving aerospace industry that provides jobs and export products; thirdly, the innovation that is created by R&D, which strengthens the competitive position of the Dutch aerospace industry and the technological edge enjoyed by the air force, which in turn serve both the economic interest and the security interest; and fourthly, the timely and sufficient availability of technically schooled aerospace personnel who enter the employment market once they have served

out their military contracts and who gravitate primarily to the national aerospace industry. It is worth exploring this in more detail.

5.3 Interdepartmental cooperation
Structural partner and supplier

Conflicts are often complex and sustained. As such, they require the coordinated deployment of all international and national resources, economic, political and military. In its mature form, the *Comprehensive Approach* (CA) realizes a more balanced participation by the various departments involved and forms the basis for deployment. Within this cooperative partnership, the armed forces, and hence the air force, are responsible for building the necessary information position and for releasing that information to the other departments. This involves the sharing of acquired data in an integrated information network and joint performance of analyses.

This interdepartmental cooperation also has added value at the domestic level. It is customary for the armed forces to lend support to the civil authorities; military resources are employed under civil authority. This also applies to the capabilities of the air force. In part, this involves military specialists with skills, equipment and command structures for which no civilian alternative exists. Examples are the employment of helicopters in fighting forest fires and medical evacuations, search and rescue at sea, and the airlifting of patients from the Wadden Islands.

SEARCH & RESCUE HAS BOTH MILITARY AND CIVIL USES

Military observation and analysis can also generate an information source at the national level. This can enable, by way of example, the judicial authorities to act more rapidly and in a more focused manner. In addition, sustained aerial observation can, for example, provide the legal process with critical evidence regarding incidents that occur during mass gatherings or sporting competitions. In 2025 the Dutch armed forces, and hence its air force, will be a structural security partner of the Dutch civil authorities. This relationship will extend beyond making specialist personnel and equipment available, as well as exchanging information, to the acquisition and commercial operation of systems. Within government several initiatives for centralizing services are currently in development. Extending this line of thought to, for example, all helicopter services in the Netherlands raises the possibility of centralizing the maintenance of these services and their deployment for national purposes. A *National Helicopter Command* that coordinates all requests for support and that manages deployment, while also performing integrated weapons system management, would operate more efficiently and effectively than three separate organizations, each meeting its own needs. The same reasoning applies to unmanned aircraft. At present the Dutch MOD is the only authority with a substantial capability of unmanned reconnaissance planes, but among other departments the need for this capability is growing. A new national organization, similar to the one for helicopters, would be valuable not only to the MOD, but also to civil authorities and emergency services, in terms of both efficiency and effectiveness.

6 Taking the high ground: an ambition for the air force

The formulation of a vision of the future in times of fundamental uncertainty presents a special challenge. That the Royal Netherlands Air Force should consider it necessary to cast a glance at this uncertain future with the assistance of the The Hague Centre for Strategic Studies (HCSS) shows a certain amount of courage and determination; qualities the modern air force shares with the first aviation pioneers a little over a century ago. The emergence of airpower at that time heralded the transformation of military operations. And this transformation is a continuous process. The air force continues to develop and in the future must be prepared to transform itself. To ensure this capability, the situations described below should be secured.

Complementary mix essential

With the fifth-generation fighter aircraft, the attack helicopter and the MALE UAV, the Dutch air force possesses a flexible mix of weapons systems with which it can achieve success in a multitude of scenarios, in both reconnaissance tasks and in armed missions, kinetic and non-kinetic. With this mix of complementary air systems, the air force is able to provide heavy combat power required to support ground and naval units, and the rapid tactical and semipermanent operational observation capabilities for the Dutch armed forces.

No combat power without mobility

Strategic air transport has been incorporated in international cooperation structures similar to the European Air Transport Centre or the NATO Heavy Airlift Wing. For exceptional transports, use is made of private companies. Tactical air transport specializes in the in-theater conveyance of people and equipment under conditions of limited threat and difficult climatic and geographical conditions. Tactical transport helicopters are equipped to conduct air-mobile and amphibian operations and, increasingly, to conduct special operations. Tanker capacity is organized internationally with likeminded partner countries.

Situational awareness for the entire government

Owing to the relative freedom of action in the air and in space, and the inherent wider view, observation resources in the air and space fulfil an important task in the intelligence chain. With the increasing demand in political, military and civil areas for observation resources, this task is developing into a renewed non-kinetic main task of the air force. In view of the expertise present in the air force regarding airspace management, air-to-surface observation, and the deployment of air systems, there is a role here for the Royal Netherlands Air Force as an innovation leader. Moreover, the RNLAF can meet the information requirement present within political, administrative and military decision-making processes. Internationally, this in turn is helping to close the capabilities gap between the US and Europe.

Space, the ultimate high ground

The rapid technological development of observation resources in space is leading to ever-smaller, cheaper applications. The industrial capacity in the field of Dutch aerospace is enabling the development, construction and deployment of a dual-use satellite capability, especially when international cooperation with a likeminded partner is involved. In this way, the existing mix of systems in the field of observation from the third dimension can be expanded with a satellite. Here, too, there is a role for the Royal Netherlands Air Force as an innovation leader and user.

A single Air & Space Operations Authority

The Commander of the Royal Netherlands Air Force is the Air & Space Operations Authority. Owing to the fact that, with regard to both doctrine and military operations, the military use of space is an extension of air operations, this aspect of activities should also be the responsibility of the Air & Space Operations Authority. This arrangement brings together in one entity all of the following: responsibility for knowledge management; development of procedures; doctrine formulation and the dissemination of information across the domains of Air and Space; and integrated weapons system management for all the armed forces' aerial systems. The *Air & Space Warfare Center* of the Air Force Command fulfils the role of the Air & Space Operations Authority.

No airpower without knowledge & experience

In order to gather knowledge on a structural basis and to develop procedures, the national and international staff positions, which plan and execute deployment operations, must be systematically assigned to Dutch air force personnel trained and qualified for this purpose. This enables the tracking and incorporation

of international experience and enables the MOD to exercise influence on the decision-making process and the execution of operational missions. In addition, this will give rise to not only a planning and management capability, but also to a knowledge base that benefits the build-up of knowledge and experience and thus ensures the quality of the end product: *air & space power*.

A dynamic ad-hoc network

A defense-wide study should be conducted of the technological and operational feasibility of a robust mesh, *IP-based*, *dynamic ad-hoc network* in which each weapon system forms an ad-hoc hub and that is relatively impervious to disruption and interference. The network should be equipped with a reach-back capability. Owing to the considerable importance to airpower operations within the joint environment, the Air & Space Operations Authority should take the initiative for development of this capacity.

Innovation leader *and* launching customer

The agreements made between the MOD, the research institutes NLR and TNO, and involved elements of the Dutch aerospace industry regarding the development and production of the F-35 serve as an example for a more structural form of cooperation between the government, the research institutes, and the entire aerospace sector of Dutch industry. In view of the knowledge, experience and highly innovative nature of the Dutch aerospace industry, opportunities present themselves for achieving a permanent structure, in which the MOD and the air force operate as innovation leaders, development partners and launching customers. This is particularly true in the field of sophisticated observation systems, unmanned systems, and satellites.

Taking the high ground: a permanent process

The Chinese warlord Sun Tzu and the German military strategist Carl von Clausewitz both devoted considerable attention to the advantage of gaining elevation above the battle field: of taking the high ground. This was, naturally, the aim of the earliest aviation pioneers. They wished to conquer the high ground in the technological sense. Early on, the military realized that this brought tactical and ultimately strategic use of the high ground within reach. With the help of airpower, the military expanded the high ground where it was needed, with the aim of gaining a better view of enemy movements and the ability to better anticipate enemy intentions. The classical task of airpower—observation—was established.

Over the almost 100 years during which Dutch airpower has developed, the men and women of the various organizational divisions comprising the air weapon have shown how important it is for the armed forces to be able to use the tactical and strategic advantages of possessing or controlling the high ground.

But Clausewitz recognized that possession of the high ground confers an advantage that is only temporary. If the enemy is likewise situated on high ground, the advantage is lost. This means that the quest for a better high-ground position must be continuous if the advantage over the enemy is to be maintained. The constant quest for the best strategic, operational and tactical position above the battle field is a characteristic of airpower. This is certainly also true in terms of technology and doctrine.

This, in a nutshell, is the continuous challenge facing the Royal Netherlands Air Force, as the exponent and knowledge bearer of Dutch airpower. The Dutch armed forces cannot afford to assume that they will always possess and retain the high ground. The high-ground position must be actively pursued. For the air force, this means that *taking the high ground* is a permanent process, in the sense of both technology and military operations.

The most important thing is to have a flexible approach.... The truth is no one knows exactly what air fighting will be like in the future. We can't say anything will stay as it is, but we also can't be certain the future will conform to particular theories, which so often, between the wars, have proved wrong.

Brigadier General Robin Olds, USAF