

Anticipating and Innovating in a Changing World

Strategy, Knowledge and Innovation Agenda 2011-2015

Netherlands Ministry of Defence

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Foreword by the Minister of Defence



In the coming years, the Defence organisation will have to operate with substantially fewer resources. The Defence organisation's financial situation demands a raft of painful cutbacks, as set out in my Letter to Parliament (TK 32 733, no. 1, 8 April 2011).

A modern and affluent country such as the Netherlands should have capable armed forces. Armed forces that offer protection to its population and, in cooperation with NATO allies and EU partners, safeguard our vital interests in an unsettled world. Armed forces that promote the international rule of law in word and deed and, together with our diplomats, development workers, police forces and judiciaries, continue to build peace and stability. Armed forces that help combat organised crime, piracy and terrorism and assist civil authorities in the Netherlands with their expertise and unique capabilities in a variety of ways.

Precisely now that the Defence organisation has to downsize across the whole of its organisation in a fast-changing world, it is important to create space for new ideas and initiatives. The investments mentioned in the aforementioned Letter to Parliament serve to emphasise this importance. The Defence organisation must not retreat into a foxhole. It must actively and continuously survey its subject area, change its position in a timely manner and take action when and where necessary. The Defence organisation must continue to meet a dynamic environment in which it operates confidently and with an open mind. It must create sufficient room for knowledge and innovation. This will not only contribute to the effectiveness of the armed forces and their innovative capability. It will also improve the structural affordability of the organisation. I would like to quote Alexander Rinnooy Kan, the eminent Dutch mathematician and business leader: "He who thinks that knowledge is expensive, does not know the cost of ignorance."

This Strategy, Knowledge and Innovation Agenda (SKIA) follows up the intentions enumerated in the Letter to Parliament by setting out strategy development in the area of management and administration within the Defence organisation, by providing direction for defence-specific knowledge development and by stimulating innovation by and for the Defence organisation. The knowledge priorities and innovation goals stated in the SKIA are closely related to future investments and the priorities set out in the Letter to Parliament. They are also part of my vision for a military organisation which excels by the quality and the innovative character of its contributions to managing complex and dynamic conflicts, where opponents utilise regular and irregular methods of combat. The innovative ability of the Defence organisation will not only be determined by new technological solutions or large-scale materiel projects.

This ability is also present among Defence personnel themselves. They know what works – and what doesn't work. They must therefore be given room to bring inventive solutions to the table and apply these on the workforce; innovation from the bottom up, so to speak. This is another way that the Netherlands Defence organisation can make a real difference in the world.

There is no doubt that, as a consequence of the cutbacks, there are difficult times ahead for Defence. The measures set out in the Letter to Parliament make that abundantly clear. They will also inevitably restrict the implementation of recommendations set out in this SKIA. At the same time, the Government faces the challenge of defining a new beginning of versatile armed forces focused on renewal. With their sights set on 2020. The Strategy, Knowledge and Innovation Agenda will make its contribution to meeting that challenge.

J.S.J. Hillen (*drs.*)

Netherlands Minister of Defence

Management Summary

What is the Strategy, Knowledge and Innovation Agenda (SKIA) about?

The Strategy, Knowledge and Innovation Agenda (SKIA) is a follow-up document to the Government's Letter to Parliament concerning the future of the armed forces (Parliamentary Document 32 733, no. 1, 8 April 2011). The agenda follows up the intentions set out in the aforementioned letter by:

- Supporting the **development of strategy** in the framework of the Defence organisation's policy, planning and budget procedure, thereby making use of the experiences gained during the interdepartmental Future Policy Survey;
- Providing direction to **defence-specific knowledge development** in support of the priorities set out in the Letter to Parliament. The agenda also meets the House of Representatives' request for an integral vision on security and the Research and Development cluster and follows up the recommendations made in the Inspector-General of the Armed Forces' annual report of 2009 (Parliamentary Document no. 32 123-X, no. 139);
- Stimulating **innovation** by and for the Defence organisation by making possible the introduction of new ways of working, new processes and new technologies. The SKIA also addresses the Defence organisation's contributions to the Government's policy regarding the commercial sector, as set out in the so-called 'Commercial Sector Letter' drawn up by the Minister of Economic Affairs, Agriculture and Innovation (Parliamentary Document 32 637, 4 February 2011).

Why is the SKIA important?

The strengthening of the Defence organisation's strategic function is important in view of the uncertainty surrounding our future security and the constant and unmistakable changes in the world around us. The Defence organisation must be prepared for foreseen and unforeseen developments and events that influence the interests of the Kingdom and the international rule of law. The strategic function's objective is to ensure that the right choices are made, and continue to be made, in an ever-changing global environment. A well-oiled strategic process is indispensable for the modern and professional organisation that the Defence organisation intends to be.

The SKIA is also important as, in the Government's view, the Netherlands armed forces' added value lies in the quality and innovative character of its military contributions, particularly in conflict situations involving opponents using asymmetric tactics. In the coming years, the Defence organisation will be transformed into a capable and effective organisation with considerably smaller overheads. To support this ambition, the Defence organisation must create room for the introduction of new ideas, technologies and processes in the coming years. The SKIA will assist in making this ambition reality.

What will the Defence organisation do differently as a result of the SKIA?

Strategy development

1. In cooperation with the Ministry of Foreign Affairs, the Defence organisation will establish a **strategic monitor**, which will chart both the security-political implications and the consequences for the Defence organisation of (possible) developments on the world stage. The strategic monitor will, among other things, deliver input for the policy, planning and budget process of the Defence organisation. It will also be linked to the National Risk Assessment of the National Security Programme in order to assist in charting

international threats to national security (in accordance with the letter of the Minister of Security and Justice regarding national security, 22 February 2011). The Military Intelligence and Security Service, the diplomatic missions and knowledge institutions, such as the Netherlands Institute of International Relations Clingendael and the Netherlands Organisation for Applied Scientific Research (TNO, Dutch abbreviation) will also be involved in the strategic monitor.

2. From the point of view of strengthening the direction of policy development within the Defence organisation, **policy surveys** will be carried out more often, with the intention of charting possible paths of action at an early stage but avoiding a weighty bureaucratic process. The civil and political leadership of the Defence organisation will exchange views more frequently with external experts regarding topics of strategic importance. In relation to this point, the Defence organisation's so-called 'chamber of knowledge' will be reorganised.
3. In order to maintain a clear perspective during the implementation phase of the strategic objectives stated in the Letter to Parliament, and to adjust where required, the Central Staff will utilise a **strategic map**, as other large organisations do. Good experiences that can be used to build on have already been gained in various parts of the Defence organisation by using this aid.

Knowledge

4. In accordance with the priorities stated in the Letter to Parliament and on the basis of an internal assessment of knowledge requirements, the Defence organisation recognises the following **knowledge priorities** for the development of (applied) scientific knowledge during this term of government:
 - military operations in a complex and dynamic environment;
 - new technologies for defence purposes;
 - cyber defence and cyber operations;
 - the military use of space.

These knowledge priorities will shape the Defence organisation's research and development plan, which is to be drawn up annually. The plan will determine the research programmes that the public knowledge infrastructure (particularly the Netherlands Organisation for Applied Scientific Research and the major technological institutes) will carry out on behalf of the Defence organisation under programme funding. The Netherlands Defence Academy (NLDA) and the Netherlands Institute of International Relations Clingendael will also be explicitly asked to devote attention to the Defence knowledge priorities in their research programmes.

5. **Knowledge management** within the Defence organisation will receive more structural attention and will be more heavily supervised. Together with its strategic partners, the Defence organisation will develop initiatives to improve the application of knowledge within the organisation. Knowledge management remains a responsibility of Defence personnel in positions of leadership, and they must specifically focus on this subject in their plans of action and receive support from experts. Operational knowledge within the Defence organisation will be concentrated per domain and supervision thereof strengthened; operational knowledge development will remain embedded at a relatively low level in the organisation. Policy responsibility for knowledge management will rest with the Defence organisation's Principal Directorate of Policy, which, in 2011, will develop a departmental vision on knowledge management and a matching plan of action. This will ensure implementation of the recommendations made in the Inspector-General of the armed forces' annual report for 2009.

Innovation

6. As an extension of the vision for the armed forces set out in the Letter to Parliament, the SKIA provides an elaboration of the following Defence **innovation goals**:
 - Information-driven operations in networks;
 - effective influencing of operations;

- energy-efficient armed forces;
- an innovative and flexible organisation.

These innovation goals reveal the particular areas the Defence organisation is striving to renew. They form, both for the Defence organisation itself and Defence-related institutes and companies, inspiring and concrete objectives to aim for in the coming years. During those years, various activities and projects will be carried out in order to achieve these objectives.

7. The Defence organisation is in a good position to contribute to **increasing the competitive strength of the Dutch commercial sector**. With reference to the Government's 'Commercial Sector Letter', the Defence organisation will in the coming years play an active role in supporting the high-tech (including security) and water (including maritime construction) economic top-level sectors and clusters such as 'Maintenance Valley' (part of the chemicals top-level sector). Dutch defence-related industry comprises approximately 300 companies that deliver products to both military and civil customers. Their high-quality technological and innovative character gives them relatively large added value and prestige. The presence of a strong and healthy defence-related industry in the Netherlands is important to an armed forces focused on renewal. The Defence organisation will continue vigorously with the implementation of the Defence Industry Strategy.

Funding

In view of the Defence organisation's financial situation, a sense of realism is required regarding the implementation of the recommendations made in the SKIA. As a consequence of the cutbacks, it is inevitable that both scientific and professional expertise will be lost, even though specific attention will be given to the retention or transfer of expertise during the reorganisation process. In the light of the objectives set out in the Letter to Parliament, the Defence organisation will endeavour, in spite of the broad range of cutbacks, to achieve a stable financial footing in order to develop and sustain a defence-specific knowledge base. The Letter to Parliament therefore contains no further cuts to the Defence budgets allocated to knowledge and technological development, which, incidentally, also partially meets the Ten Broeke motion (Parliamentary document 32 500-X, no. 58). As a result of the Ten Broeke amendment, a one-off sum of € 6 million has been added to the 2011 Defence budget for projects to be carried out by the Netherlands Organisation for Applied Scientific Research. Despite the Defence organisation's attempts, the cutbacks to government organisations and Defence will not leave the defence-specific knowledge base of the Defence organisation's strategic partners untouched. In order to restrict the consequences of the cutbacks for the defence-specific knowledge base as much as possible, the Defence organisation will, in consultation with its strategic partners and other ministries, monitor and map out any possible effects.

Introduction

This Strategy, Knowledge and Innovation Agenda (SKIA) is a follow-up document to the Government's Letter to Parliament regarding the future of the armed forces ("Defence after the credit crunch: a smaller force in a troubled world", 8 April 2011) and follows up on the important aspects set out in the letter. The SKIA focuses on the following goals:

- * **the strengthening of the strategic function in support of the Defence organisation's policy, planning and budget procedure.** Strategy development and the ability to apply and retain strategic focus during the implementation phase are of real importance in realising the vision of the armed forces described in the Letter to Parliament. Strategy development is about, among other things, being prepared for foreseen and unforeseen developments and events that could influence the interests of the Kingdom and the international rule of law and that relate to the armed forces;
- * **Providing direction to knowledge development for the Defence organisation and improving the application of knowledge within the organisation.** This involves, among other things, achieving the strategic objectives set out in the Letter to Parliament through the development and application of the knowledge required to achieve these objectives (by following a set of knowledge priorities). It also involves meeting the request for an integral view on security and the Research and Development cluster made during the general consultations of 3 February 2010 and following up the recommendations made in the Inspector-General of the Armed Forces' annual report of 2009 (Parliamentary Document no. 32 123-X, no. 139);
- * **Stimulating innovation by and for the Defence organisation.** This involves, among other things, achieving the strategic objectives set out in the Letter to Parliament through the introduction of new ways of working, new processes and new technologies by following a set of innovation goals. While the strategic objectives clarify *what* the Defence organisation wishes to achieve in the coming years, the innovation goals focus on *how* these strategic objectives can be brought into reach. The SKIA also addresses the Defence organisation's contributions to the Government's commercial sector policy, as set out in the 'Commercial Sector Letter' drawn up by the Minister of Economic Affairs, Agriculture and Innovation (Parliamentary Document 32 637, 4 February 2011).

The SKIA replaces the Defence organisation's Strategic Knowledge Agenda (SKA) (November 2008, Parliamentary Document 31700-X, no. 60).

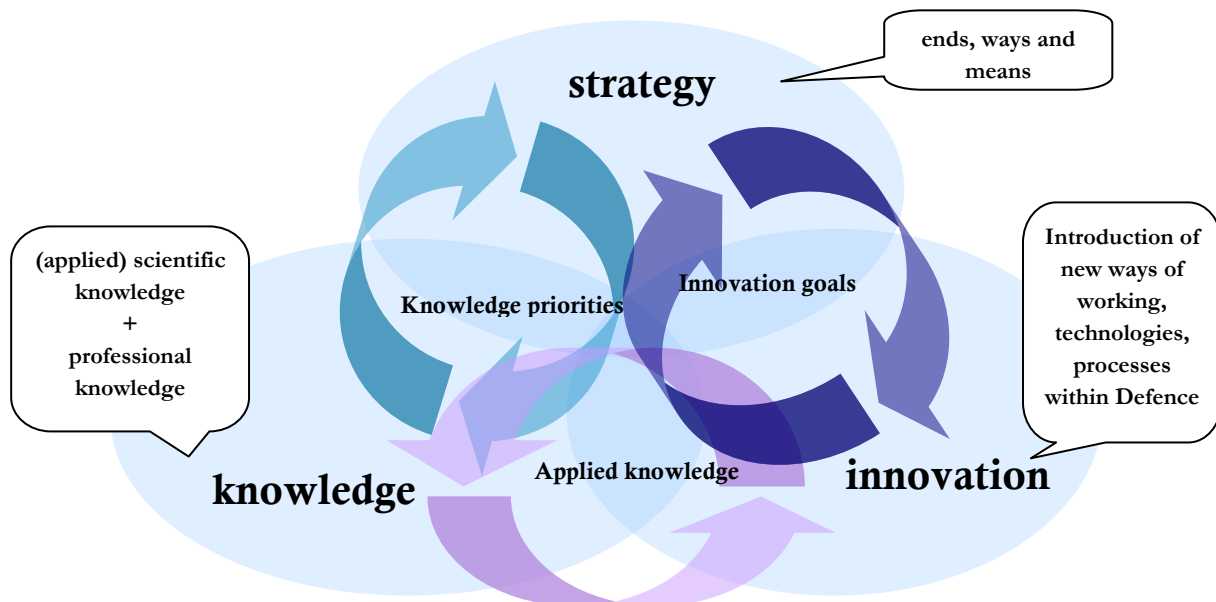
Strategy, knowledge and innovation

The SKIA brings together strategy development, knowledge and innovation in one coherent approach. On the one hand, the SKIA recognises the distinction between these terms and, on the other hand, presupposes that they are so closely related that they can be approached as one whole.

The term **strategy** alludes to the set of main objectives of the organisation, the way the Defence organisation intends to achieve these objectives and the resulting allocation of assets and resources ('ends, ways and means'). The Defence organisation's objectives and the measures to be taken are set out in the Letter to Parliament. The SKIA provides a guideline for the set-up of the Defence organisation's strategic function to support the implementation of the measures set out in the Letter to Parliament and Defence's policy, planning and budget procedure on the principle that strategy development is a dynamic process. **Chapter 1** is devoted to the 'new style' strategic function.

The term **knowledge** encompasses both scientific knowledge and professional knowledge. Scientific knowledge is based on research conducted following scientific criteria. Applied science focuses on solving a specific problem or developing a product, service or technology by utilising scientific knowledge. Setting knowledge priorities addresses the question as to in which areas the Defence organisation will require (applied) scientific knowledge in the coming years: what does the Defence organisation need to know more about? Professional knowledge ('know-how') is knowledge required for competently carrying out the tasks related to a military or civilian position within the Defence organisation. Professional knowledge is tested in practical day-to-day situations and is often based on experience, skills, lessons learned, job-specific courses and applied scientific knowledge. **Chapter 2** explains how the Defence organisation deals with knowledge as a factor of production.

Innovation encompasses the introduction of new ideas, technologies, materiel, services and processes. The innovation section of the SKIA deals primarily with innovation by and for the Defence organisation. The innovation goals set out in the SKIA clarify the areas in which the Defence organisation is seeking renewal. These innovation goals are, naturally, an extension of the strategic objectives set out in the Letter to Parliament. In addition to innovation *by* and *for* the Defence organisation, Defence is in a good position to contribute to the broader innovation agenda in the Netherlands and to the commercial sector policy of the Government. **Chapter 3** focuses on these two dimensions of innovation.



There is a close **relationship** between strategy, knowledge and innovation. Knowledge is required for both determining and implementing strategy. Knowledge priorities are derived from the strategic objectives set by the political leadership of the country. Innovation lies more in the domain of the application of knowledge, but can only be pushed through in combination with processes, management, new attitudes and new skills. Innovation goals are also an extension of the strategic objectives of the organisation, as set out in the Letter to Parliament. Knowledge and innovation serve both the development and implementation of strategy determined, or yet to be determined, by the political leadership. This is also valid for the strategy section of the SKIA.

Finally, **Chapter 4** deals with the following subjects: culture, organisation, management and funding.

1 Strategy Development within the Defence Organisation

1.1 Set-up of the Strategy Function

A well-oiled strategic process is indispensable to the modern and professional organisation the Defence organisation wishes to be. The Defence organisation's strategic function is important in view of the uncertainty surrounding our future security and the changeability of our environment, as many recent analyses show. The Defence organisation must be prepared for foreseen and unforeseen developments and events that influence the interests of the Kingdom and the international rule of law. The strategic function's objective is to ensure that the right choices are made, and continue to be made, in an ever-changing environment.

The Defence organisation's strategic function is shaped in close relationship with the Policy, Planning and Budget (PPB) procedure, which is at the core of the Defence organisation's operations. The strategic function comprises four sub-processes: learning, thinking, decision-making and acting. Strategic 'learning' and 'thinking' are important for the Defence organisation's anticipatory ability. On this point, use can be made of the experiences gained during the Future Policy Survey. Apart from 'knowing', the Defence organisation's anticipatory ability encompasses the 'ability to act' in response to – the expected – developments in the security environment.¹ In addition to a knowledge component, the anticipatory ability also contains an organisational component, with flexibility, adaptability and resilience as key terms. Thus, the anticipatory ability is dependent on both the Defence organisation's decisions (strategic 'decision-making') and its implementation (strategic 'acting'). The activities and instruments set out below are used in these sub-processes.

Strategic management				
	Learning	Thinking	Decision-making	Acting
Goal	Know the world. Know yourself. Know your job.	Perspectives on how to act	Do the right thing.	Do things in the right way.
Activities & instruments	Strategic intelligence Future surveys Strategic monitor Comparative studies (benchmarks) Evaluations (lessons identified)	Policy surveys (incl. military-strategic vision) and studies Zero-based decision support tool SWOT analyses Chamber of knowledge meetings Advisory Council for International Affairs	Four-yearly and annual PPB-cycle (vision, plan, budget)	Strategic map Communication Cooperation Innovation (incl. lessons learned) Control Directing effort

¹ The Defence organisation commissioned the The Hague Centre for Strategic Studies (HCSS) to examine ways of strengthening the anticipatory ability, including an examination of other countries' efforts in this area (HCSS, *Anticipatie* (HCSS, no. 5, 2010)). The results of this study will be used for the strengthening of strategic management within the Defence organisation.

1.2 Strategic Learning

One of the objectives of strategic learning is to permanently enhance situational awareness and the orientation towards the future. Sound strategic intelligence and a relevant knowledge base are indispensable for achieving this objective. In order to improve the Defence organisation's future orientation, a future policy survey has been incorporated into the Policy, Planning and Budgeting Procedure and into the organisation's 'normal' way of working. In the coming years, the Defence organisation will naturally make use of the experience gained during the interdepartmental Future Policy Survey. The report regarding future policy drawn up by the Scientific Council for Government Policy (WRR, Dutch abbreviation) entitled '*Uit Zicht*' [Out of Sight] also contains useful recommendations that will be put into practice.

In order to chart the implications of – possible – developments in the world for the security interests of the Kingdom and the international rule of law systematically and in a timely manner, the Defence organisation and the Ministry of Foreign Affairs will collaborate in setting up a strategic monitor. In the context of this monitor, regular reports will be made to the minister and civilian and military top-levels regarding:

- * the driving forces – i.e. chiefly autonomous and external developments – that influence the security interests of the Kingdom, the international rule of law and the armed forces;
- * the actors influencing the security interests of the Kingdom, the international rule of law and the armed forces;
- * possible scenarios and strategic shocks.

Possible implications at the strategic level will be explicitly mapped out, both for the demand placed on the armed forces (demand side) and for the armed forces as an organisation (supply side).

The reports from the strategic monitor will serve as, among other things, input for the Defence organisation's Policy, Planning and Budget cycle. The strategic monitor will also be linked to the National Risk Assessment, related to the National Security Programme, which addresses the explicit resolve to focus more attention on international threats to national security (see the letter drawn up by the Minister of Security and Justice regarding national security, 22 February 2011). Agreements have been made in this area with the Ministry of Security and Justice.

Internal and external knowledge institutes will be engaged to make contributions to the strategic monitor. The Netherlands Institute for International Relations Clingendael will focus on the demands that may be placed on the armed forces in future (demand side), while the Netherlands Organisation for Applied Scientific Research (TNO) will focus on the implications for the armed forces as an organisation (supply side). The Military Intelligence and Security Service and, in consultation with the Ministry of Foreign Affairs, the network of diplomatic missions will make a contribution to the strategic monitor.

In addition to improvement of the situational awareness and future orientation capabilities, self-knowledge ('know yourself') and professional knowledge ('know your profession') are important. The Defence organisation is a large organisation incorporating a wide range of disciplines with great diversity among its personnel. Decisions regarding the armed forces must be based on a clear picture of the characteristics and of the strong and weak points of the Defence organisation. What are we good at? What are our weak points? Comparative studies (benchmarks) and evaluations (lessons identified) also contribute to policy development within the Defence organisation.

1.3 Strategic Thinking

This part of the strategic management process is aimed at lending support to the Defence leadership in the development of new directions in strategic thinking and policy options. Once again, the experiences gained in

the Future Policy Survey project could prove their use here, particularly the strategic functions and the zero-based decision support tool developed by the Defence Staff. Apart from conducting policy surveys, the Defence organisation's civil and military leadership will more regularly exchange views with external experts on subjects of strategic importance. The 'chamber of knowledge' will be reorganised for that purpose. To assist in giving direction to the development of the armed forces from a military-operational perspective, the Chief of Defence will draw up an up-to-date military-strategic vision at regular intervals. For strategic policy advice, the Defence organisation can, in consultation with the Ministry of Foreign Affairs, call on the assistance of the Advisory Council on International Affairs (AIV, Dutch abbreviation). The Ministers of Foreign Affairs and Defence draw up the Council's work programme annually, which is then submitted to the Ministers Council for approval. The Defence organisation also makes use of the advice issued by the Scientific Council for Government Policy, an independent government advisory body, which advises on cross-sector issues that are important to society at large. The advice issued by the Scientific Council for Government Policy is long-term advice and is embedded in scientific research.

1.4 Strategic Decision-making and Action

In the coming years, much will change in the Defence organisation as a consequence of the Letter to Parliament. The implementation phase will not be a static affair involving a single-tiered plan aimed at achieving 'the' objective of 'the' organisation. That would presuppose that the environment the Defence organisation operates in is not subject to change. The international security situation is currently characterised by change. Under these circumstances, strategy development is a dynamic process. The four-yearly and annual cycle of the Policy, Planning and Budget procedure allows for the regular updating and testing of the strategy development process. The ability to constantly focus and re-focus the strategic objectives of the Defence organisation is also essential for the implementation phase. In order to maintain a clear perspective during the implementation phase of the strategic objectives stated in the Letter to Parliament, and to adjust where required, the Central Staff will utilise a **strategic map**, as other large organisations do. A strategic map formulates in a concise and practical way the organisation's most important objectives and also charts the subjects the performance of the Defence organisation will be assessed on. It also clarifies who is responsible for what in achieving the objectives set and helps to bring focus and coherence to the processes and activities of the Defence organisation. The process of establishing and drawing up the strategic map is at least as important as the map itself. Good experiences that can be used to build on have already been gained in various parts of the Defence organisation by using this aid.

2 Knowledge Agenda

2.1 Knowledge: a factor of increasing importance

A high-quality knowledge base over a broad area is of real importance to the Defence organisation. First of all, a high-quality knowledge base is indispensable for assuring the most efficient and effective execution of defence tasks and for creating conditions for military operations that are acceptable to society at large. It is also important for the instruction, training and safe deployment of Defence personnel. That knowledge institutes can make valuable contributions right up into the area of operations can be seen from the deployment of employees from the Netherlands Organisation for Applied Scientific Research (TNO, Dutch abbreviation) to the ISAF operation in Afghanistan; moreover, the Dutch Aviation and Aerospace Laboratory (NLR, Dutch abbreviation) was also engaged to make a contribution to the same operation. With the Defence organisation in its role as *smart customer*, *smart specifier* or *smart developer*, a broad knowledge base is also required for the procurement of military materiel and for the innovative ability of the Defence organisation. Finally, the knowledge base also contributes to strategy development at the Defence organisation, as described in Chapter One.

The importance of the defence-specific knowledge base is, moreover, emphasised by the following factors:

- * the increased degree of uncertainty regarding the future security situation and the future demands to be made on the armed forces. In order to respond rapidly and effectively to changing circumstances and/or a changing demand for the services of the armed forces, a sufficiently broad knowledge base is indispensable to the Defence organisation;
- * the increasing complexity and the dynamic character of present day operations. Knowledge and the application of knowledge in a short innovation cycle have become a necessity. The application of knowledge in the operational domain demands that knowledge institutes are familiar with the aforementioned domain and, further, requires close cooperation with the knowledge institutes themselves, even right into the area of operations. A good example of this point is cooperation regarding the rapid development of a solution to the threat of roadside bombs in Afghanistan;
- * the growing complexity of weapon systems as a consequence of technological developments;
- * the increasingly stringent demands made by society at large regarding armed forces operations. These include terms of employment, environmental requirements, the prevention of (noise) pollution, the protection of Dutch military personnel and the prevention of civilian casualties and collateral damage during operations. In view of these demands, the required military deployability can only be maintained with the assistance of (applied) scientific knowledge;
- * the importance of controlling costs in areas of investment and operational management of the armed forces. The relatively rapid increase of real costs regarding military materiel forms a substantial risk for the Defence organisation's operational management process. For a number of years, the organisation has also suffered increasing pressure on running costs. In the coming years, keeping control of investment and operational management costs will be a major challenge for the Defence organisation. The knowledge base can make an essential contribution to meeting this challenge.

What does knowledge deliver to the Defence organisation?

A random selection:

- * the development of a simulator for training Royal Netherlands Army Forward Air Controllers in realistic conditions. Now, fewer F-16 flying hours per pilot during training are required, which results in fewer flying hours of F-16 aircraft.
- * the development of a low-frequency active sonar (LFAS) for Royal Netherlands Navy M-frigates. The sonar is required for underwater imaging in coastal waters. Improved performance makes savings possible.
- * the extension of the operational service life of the Lynx helicopters through the introduction of a specific user-registration system (AIDA).
- * the development of an advanced video-monitoring system (three times more accurate than normal vision) to aid in refuelling combat aircraft while in flight. Improved performance has made savings possible.
- * the development of a self-protection system (AMASE) against IR-guided missiles for the Apache helicopters, making the Apache the best-protected helicopter against missiles in the world.
- * the development of smart manning concepts and smart organisation of operational areas and rooms. The savings achieved in personnel costs are considerable; related to this point are the scaled-down recruitment drive, lower personnel costs in the area of operational deployment and reduced training and instruction costs.
- * an extension of the life-cycle of ammunition and missiles. In addition to improved safety, major savings have been achieved by less replacement of parts and a reduction of disposal costs.

2.2 The Knowledge Base relevant to the Defence Organisation

In the context of the Future Policy Survey and in close consultation with the knowledge institutes and Defence requirement setters, the method of classification within the Defence organisation's knowledge base – the so-called taxonomy – has been updated. It now comprises nine main knowledge areas, sub-divided into forty areas of expertise important to the Defence organisation. This new classification of knowledge and expertise areas offers a stable and transparent basis for knowledge management. The new method of classification is in line with NATO and the European Defence Agency (EDA), which facilitates cooperation with these organisations. The classification should not be seen as being rigid: there is a great deal of interconnectivity between knowledge and expertise areas, and intersections of these areas present interesting challenges and possibilities for application. Research with a multi-disciplinary character is therefore important.

Knowledge of **technological developments** remains a highly determining factor in the effectiveness of military operations. The armed forces must continuously be aware of their technological requirements. In future, the Defence organisation must have the ability to assess which technologies are sufficiently viable, robust and affordable to be suitable for use as a military application. Effectively identifying, monitoring and evaluating relevant technological developments requires a strong knowledge position with a network of national and international experts. A sound technological knowledge base is also indispensable for the procurement, maintenance and deployment of military materiel. As a rule, the Defence organisation purchases off-the-shelf products. These may be civil products (commercial off-the-shelf – COTS) or military products (military off-the-shelf – MOTS). As set out in the Letter to Parliament, the Defence organisation will only be involved by exception as *smart specifier* and *developer* in the development of defence materiel. This means that the armed

forces' innovative ability will mainly focus on using and combining off-the-shelf materiel as intelligently as possible (smart user) and introducing new technologies into its organisation as quickly as possible (early adopter).

Apart from technological developments, developments in the area of the physical and social sciences are highly important to the Defence organisation. After all, the functioning of the armed forces is to a large degree dependent on the human factor. This is more about scientific research than research and development. Improving the performance and resilience of individual soldiers can significantly contribute to the effectiveness of the armed forces. The prevention of permanent physical or mental damage as a result of deployment and optimal care and aftercare of military personnel are of great importance.

2.3 Knowledge priorities: what does Defence want to know more about?

In the coming years, Defence will require the development of (applied) scientific knowledge in a wide area. In order to meet the objectives set out in the Letter to Parliament and ensure an effective use of Defence resources, it is nevertheless necessary to set a number of priorities. The SKIA is based on the knowledge requirement of the Defence organisation, although there is room enough for knowledge institutes to develop their own initiatives ('Knowledge as Capability'). Offering 'free' space for knowledge development strengthens the anticipatory ability regarding new technological and scientific breakthroughs, with possible implications for defence operations. This is in the interest of the Defence organisation.

The following three criteria must have been met before Defence will invest in the development of knowledge:

1. the development of or retention of knowledge is necessary to support policy objectives as set out in the Letter to Parliament or determined by the Minister of Defence (policy relevance). This also includes knowledge development required for projects that are part of the Defence organisation's investment programme. If necessary, knowledge development also supports innovation goals mentioned in the Letter to Parliament and further detailed in the SKIA.
2. the Defence organisation has a specific requirement for knowledge and there is a concrete vision of the application of the knowledge to be developed or retained (utilisation). The ambition level of the Defence organisation is an important parameter for the depth of the knowledge requirement: does Defence wish to be a smart customer, a smart specifier or a smart developer?
3. the knowledge is so specific to defence that it will not become available or will not be viable without Defence investment (*uniqueness*). This might also involve knowledge required for applying civil technology to the military domain.

In addition to the three abovementioned criteria, and with international cooperation in mind, the further development of a strong knowledge position can be desirable. 'Excellent' knowledge can then be exchanged internationally against knowledge that the Defence organisation requires but has insufficiently available or not at all ('quid pro quo'). This form of international cooperation, where countries focus on specific areas of knowledge, could offer possibilities for a more efficient effort in the field of science and technology. See paragraph 2.3.7 on international cooperation.

Although the Defence requirement is (and will remain) leading, the Defence organisation will, in accordance with the Defence Industry Strategy and where possible, take into account the innovation goals of the Ministry of Economy, Agriculture and Innovation and the strong points of the Netherlands' defence-related industry (particularly the prioritised areas of technology). For more information, see paragraph 3.3 on the Defence contribution to broader innovation goals.

On the basis of the Letter to Parliament and an internal assessment of knowledge requirements, the Defence organisation recognises four priorities for the development of scientific knowledge during this term of government.

Defence Knowledge Priorities
Military operations in a complex and dynamic environment
New technologies for defence purposes
Cyber defence and cyber operations
Military use of space

The knowledge priorities will shape the Defence organisation's research and development plan, which is to be drawn up annually. The plan will determine the research programmes that the public knowledge infrastructure (particularly the Netherlands Organisation for Applied Scientific Research (TNO) and the large technological institutes) will carry out on behalf of the Defence organisation under programme funding. The Netherlands Defence Academy and the Netherlands Institute of International Relations Clingendael will also be explicitly asked to devote attention to the Defence knowledge priorities in their research programmes.

In 2010, the Defence organisation recalibrated the knowledge portfolio in the 'Defence Knowledge Portfolio reassessment' report (TK 27 830, no. 71). The results of this recalibration indicate the range of the defence-specific knowledge base and have been implemented at the Netherlands Organisation for Applied Scientific Research. On the basis of the Letter to Parliament, the SKIA clarifies which priorities will be emphasised in the coming years.

2.3.1 Military operations in a complex and dynamic environment

<p><i>Connection to Letter to Parliament:</i> Armed forces focused on renewal (investment in unmanned aerial systems, resources for operating in networks, protection against improvised explosive devices, psychological operations).</p> <p><i>Connection to innovation goals:</i> Operating in information-driven networks Effective influencing of operations</p>
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In the coming years, the added value of the Netherlands armed forces will lie in the quality and innovative character of military contributions in complex and dynamic conflicts involving opponents using asymmetric tactics. The distinction made between operations in the lower part of the spectrum of force and those in the higher part, as set out in the 1993 Defence Priorities Review, has gradually lost its meaning. In any military operation, low intensity force and high intensity force may occur in quick succession, depending on the nature of the conflict. Not only NATO and EU-led operations, but also UN-led operations are becoming more complex. The original UN peace operations, where compliance with interstate cease-fires was monitored using a minimum of force, have increasingly been replaced by so-called 'multidimensional' peace operations, involving a heavily armed force with a broad mandate carrying out a wide range of tasks in complex interstate conflict situations.

Non-conventional opponents are usually paramilitary groups or armed civilians, who compensate for their relatively weak military position by using unorthodox methods of combat and who take no account of the requirements of military necessity and proportionality. To compensate for their weak military position, they use asymmetric methods, often using criminal activities to safeguard their (financial) interests.

States also use non-conventional methods of combat, sometimes in concert with non-state parties. The reverse situation is also possible, i.e. where non-state actors have conventional military resources at their disposal, helping them to offer substantial resistance to armed forces based on the western model. The Taliban in Afghanistan and Hezbollah in Lebanon are typical examples. Future military operations will therefore have to take account of both conventional military opposition and non-conventional tactics. This 'hybrid' form of warfare is characterised by great complexity and changeability. The distinction between combatants and non-combatants becomes blurred, particularly on land and at sea, and there is also no clearly demarcated area of operations to be controlled. Non-conventional methods of combat have a much wider geographical range which may reach the "homefront" and infiltrate the information and communication domains (and, among other things, attempt to erode the support base for the operation).

The combination of own intentions and those of the opponent, as well as the nature of operations, determines the type of conflict that the armed forces are to operate in. Although account must be taken of variable levels of force and adversaries employing both conventional and non-conventional methods of combat, the distinction between state and non-state actors remains relevant. Generally, states have more possibilities at their disposal to offer resistance than do non-state actors. In contrast to non-state actors, states often have – sometimes advanced – weapon systems such as fighter aircraft, helicopters, armoured vehicles and ships at their disposal. Moreover, political leaders of states can take centralised decisions, such as ending a war, whereas non-conventional combatants are often not centrally led and also have an interest in keeping a conflict going as long as possible.

Present day security problems are, and future security problems will be, complex. The causes are diverse with in almost all cases economic, ideological and cultural dimensions. Such complex problems require an integrated solution and an integrated approach. Cooperation with national and international, governmental and non-governmental organisations is expected to increase. Strategy development, in which all power factors are considered in concert and whereby the strategy is carried out in an integrated way, is the defining characteristic of future military deployment. In an integrated approach, many non-military factors and actors influence the deployment of military potential and, vice versa, military deployment influences non-military domains such as government, economy and general society at large.

Military operations in a complex and dynamic environment

The knowledge requirement related to this priority particularly focus on:

a. The human factor in military operations. The human factor is the decisive factor in many military operations. In every type of conflict (regular, irregular or hybrid), military personnel must often operate under great pressure in complex conditions. Research must particularly focus on the improvement of physical and mental resilience and resistance, dealing with performance-restricting conditions and the relationship between man and machine (including ethical aspects). Knowledge of the possible effects of new technologies on the general health of military personnel, as the users of these new technologies, is also required.

b. Military operations in heavily populated areas and 'ungoverned spaces'. Increasing urbanisation in combination with demographic concentrations in coastal areas and the phenomenon of "ungoverned spaces" where organised crime dominates, effects the way operations are carried out

on land (in large urban areas where lawlessness holds sway), from the air (above these areas) and from the sea. Research should focus on how the armed forces can operate as effectively as possible in such environments and what requirements platforms, weapon systems and command and control must meet to be able to do so. In order to achieve optimal preparation for current and future operations, the modelling and simulation of conflicts is important (complex adaptive systems).

c. Protection. Protection is about measures and means focused on preventing or minimising threats against our civilians, military personnel, platforms and compounds emanating from regular and irregular opponents and (local) conditions. This is about a cohesive system of protective measures against a range of threats (roadside bombs, mortars, etc.). Research should focus on not only physical protective measures, but also on mental and conceptual components. Protection against chemical, biological, radiological and nuclear threats demands specific knowledge that must be maintained at a sufficient level, preferably in concert with civil partners in the security domain.

d. Military operations in networks. The network-centric approach sets new requirements for conceptual and doctrinal aspects of military operations. Reconnaissance, assessment and the gathering of intelligence through a range of sensors at all decision-making levels is a precondition for military deployment. The possibilities and demand for reconnaissance will increase in the coming decades. The knowledge requirement will focus on decision-making concepts (C2) and security concepts, but also unmanned aerial vehicles, network-enabled operations via datalinks and the military use of space.

e. Effective cooperation with civil partners. Both at home and abroad, the work areas of the armed forces and civil organisations have, to a considerable degree, grown closer together. Military operations are mostly part of a much broader, integrated approach (often known as the '3D' approach). The armed forces are also called upon at home to lend support to civil organisations.

f. Effective influencing of operations. In addition to technological superiority, the effectiveness of military operations is determined by knowledge in the field of the physical and social sciences, such as the social, cultural and psychological dimensions of conflict or conflict prevention. Research must focus on the effects of so-called 'non-kinetic' capabilities, such as intelligence operations, psychological operations and strategic communication. Attention must also be given to measuring the effectiveness of military operations (operational assessment).

2.3.2 New Technologies for Defence Purposes

Connection to Letter to Parliament:

Armed forces focused on renewal

(investment in unmanned aircraft systems, resources for operating in networks, protection against improvised explosives, defence against ballistic missiles).

Connection to innovation goals:

Operating in information-driven networks

Effective influencing of operations

An energy-efficient armed forces

An innovative and flexible organisation

For an innovative armed forces, making use of – and being prepared for – new technological developments is of great importance. Technological progress is rapid, with civil technologies increasingly being applied to the military field. The Defence organisation must therefore continually monitor and assess new technological developments for the opportunities they offer and the threats they pose.

The most important developments for the Defence organisation can be expected in the area of aerospace technology, biotechnology, nanotechnology, information and simulation technology, advanced materials and cognitive sciences. The convergence of and interaction among formerly separate fields of research and innovation may lead to qualitatively new technological opportunities with potentially revolutionary implications. The trend of increasing use of civil technologies for military application (“spin-in”) is expected to continue.

Dependence on technology also harbours a risk, however. Dependence on technological infrastructure, such as electricity networks and information and communication systems, has made societies vulnerable. Failure of these facilities or damage to databases can lead to far-reaching social and economic consequences. Dependence of the military on technical infrastructure and cyber communication is also a point of vulnerability. Moreover, knowledge in the area of weapons technology has become more accessible to more parties as a result of the information revolution and the growing overlap between civil and military technologies. Small states, groups, or even individuals, can gain access to effective means of force of great destructive power, which may be possible to use from long range. For all these reasons, it is important to monitor developments in the aforementioned fields of scientific research, in order for the Defence organisation to be fully prepared for new and unexpected applications of new technology.

New Technologies for Defence purposes

The knowledge requirements related to this priority particularly focus on:

a. Ground-breaking technologies. In the coming decades, technological breakthroughs are expected following the convergence of the fields of biotechnology, nanotechnology and cognitive sciences. The integration of the exact sciences with the social, and particularly human- oriented scientific fields, make new military applications possible. Bio and nanotechnology will bring new possibilities in the areas of miniaturisation and robotisation within our reach. In combination with information technology and cognitive science, these areas of development have the potential to produce micro-systems which contain, for example, a variety of mechanical, electrical, chemical, optical and even intelligence-based characteristics. The possibilities for application of these new technologies are groundbreaking and will inevitably be accompanied by discussions regarding ethical

and moral issues and possible risks to general health and the environment.

b. System development. In view of the increasing scale in which civil technologies are applied in the military domain, military superiority will in future be increasingly determined by the innovative ability to combine new possibilities for application in functionally integrated systems. System integration will, in other words, in future be more significant than specific military-technological developments and will involve an expansion of systems' limits.

c. Network-enabled capabilities. Thanks to the rapid developments in the sphere of information technology in both the civil and military domains and of command, control, communications, computer, and intelligence (C4I) systems, the integration of military capabilities in information networks will gain further ground. By linking all sensors in an area of operations, a shared and complete situational picture can be created. Moreover, by integrating decision-making and weapon systems in the network, the precision of weapons deployment and response times can be improved. Operational information provision and command and control must, under all circumstances, continue to function and be resistant to countermeasures from the opponent.

d. Training and simulation. In addition to training and instruction, simulation can be used for mission preparation, doctrine development and as a field method for establishing the optimal course of action in certain military situations. In the field of civil technology, the development of gaming software is important. The introduction of simulation equipment is intended to achieve savings.

e. Remote operations. Various technological developments offer possibilities for operating from long range. In combination with developments regarding platforms and weapon systems, these developments could lead to a reduction of the operational and logistic footprint in the area of operation. Maintenance can increasingly be supported by intelligent technological aids capable of diagnosing the cause of failure and carrying out repairs (remote diagnostics). These developments bring a further reduction of the logistic footprint of deployed military units into reach.

f. Miniaturisation, unmanned aircraft systems and robotisation. In addition to logistic advantages, miniaturisation in operational terms offers possibilities for making use of unmanned or robot systems for carrying out labour-intensive, routine or dangerous tasks. Robots can be deployed under conditions and in environments deemed to be too risky for military personnel. It is already possible to deploy unmanned armed aircraft and to control them from a great distance from the area of operations. On land, robot vehicles are used for conducting tactical reconnaissance tasks and for disarming, for example, explosives and roadside bombs. Finally, unmanned platforms have also entered the maritime theatre, both above and below the water surface. Currently, intelligence, surveillance and reconnaissance are the most important areas of application of unmanned systems. More applications in the areas of public safety and police and firefighting tasks will also appear. Challenges to researchers lie in the areas of navigation, energy supply and swarming. In future, fully autonomous systems with artificial intelligence are expected to be sent to the area of operations. Of course, this development will be accompanied by a discussion on the ethical acceptability of the automation of lethal force. Research will have to be conducted into the optimal balance and the interplay between autonomous, unmanned and manned systems in an operational environment.

2.3.3 Cyber Defence and Cyber Operations

Connection to the Letter to Parliament:

Armed forces focused on renewal (investment in cyber capabilities)

Connection to innovation goals:

Operating in information-driven networks

Effective influencing of operations

Owing to the rapid development of information and communication technology, Dutch society and its armed forces have become increasingly dependent on unobstructed use of the digital domain. Failure of digital networks and management systems and damage to and manipulation of databases can have serious consequences. Modern and open societies such as the Netherlands are exposed to the risk of damage being done to industrial and/or security interests through violation of sensitive digital information sources or databases. Military dependence on digital communication and information technology is also a point of vulnerability.

In the past ten years, government organisations have come to the realisation that deliberate IT disruptions stemming from crime, terrorism, sabotage and conflicts represent a threat to national security and the effectiveness of national military operations. The Netherlands, just as most other countries, therefore has cyber security high on the agenda. This priority for digital security is also partly due to an awareness that future conflicts will hold both conventional and non-conventional threats, including large-scale cyber attacks. Fear of this threat is further reinforced by other countries investing in capabilities aimed at disrupting vital systems on a large scale in other countries. An effective plan of action against suspected abuse of the digital domain requires reliable and up-to-date knowledge of vulnerabilities and risks and the ability to take proactive or reactive action within an adequate legal framework.

Next to land, sea, air and space, the digital domain is now considered as the 'fifth dimension' wherein military operations could take place. Just as in the other dimensions, armed forces may undertake both offensive and defensive operations. The digital domain, however, is not demarcated by borders and the direction from which the disruption comes says virtually nothing about its true origin. The fifth dimension also lacks usable definitions of acceptable and unacceptable actions to help determine the nature, the proportionality, the moment and the legitimacy of one's own operations.

Carrying out cyber operations requires a great deal of knowledge. Defence against such operations may require even more knowledge and further developed capabilities, as protective software must be capable of disabling attacking software. This does not automatically mean that the knowledge required for a defensive capability can also be used for offensive purposes. Offensive activities require specific knowledge of the systems to be attacked and also of systems that are not to be harmed by the attack. Cyber operations also raise new conceptual questions. Can a cyber attack be deterred or can retaliation take place? The fact that it is often not clear who exactly is behind a cyber attack serves to further complicate the legal aspect of this issue.

To be able to continue to guarantee the deployability of the armed forces, the Defence organisation will, in the coming years, have to significantly strengthen its cyber defence capability.

In order to guarantee the deployability of the Netherlands armed forces and improve their effectiveness under these circumstances, the Defence organisation will in the coming years strengthen its cyber defence capability and develop the capability of carrying out cyber operations of its own. The strengthening of this capability

encompasses, among other things, the establishment of a Defence Cyber Centre of Expertise. This cyber centre of expertise will focus explicitly on the exchange of knowledge between the civil and military domains and will work closely with the National Cyber Security Centre, which is currently also being established. From a military point of view, more insight is required into cyber operations, both as part of offensive operations and in response to an attack.

Cyber Defence and Cyber Operations
<i>The knowledge requirements related to this priority particularly focus on:</i>
What are the long-term consequences of the increasing importance of cyberspace for the armed forces operations? How does the digital domain relate to the other four dimensions in which the armed forces operate? What consequences do the increasing dependence on IT and the development of specific cyber resources have for the integrated operations of the armed forces?
What are the vulnerabilities of sensor, weapon and command and control systems and how should these be dealt with?
How can the sustainability of the armed forces be guaranteed with the increase of possibilities for linking networks and network-enabled capabilities?
As yet, little is known regarding the nature of cyber conflicts. How are they initiated, how do they develop (escalation) and what are the legal grounds for response?
What possibilities are there for improving the active defence of networks and systems by, among other things, monitoring data traffic, analysing threats, etc.? How can active defence contribute to the strengthening of the possibilities of attribution? What are the possible legal restrictions connected to this?
What measures can be taken to improve the decision-making procedure in order to respond to attacks or threats in a timely manner? How can the primacy of the political leadership be safeguarded if an immediate decision has to be taken regarding a response to an attack?
How can NATO's common defence principle be maintained in the digital domain if member states do not declare or share their offensive cyber capabilities? How can a common cyber capability be developed?
In the digital domain, the boundaries between crime, espionage and armed conflict blur. How should the government approach the matter of retaining the operational capability of the organisations involved on the grounds of legal powers?

2.3.4 Military Use of Space

Connection to Letter to Parliament:

Armed forces focused on renewal (investment in military satellite communication)

Connection to innovation goals:

Operating in information-driven networks

Possibilities for the military use of space are developing rapidly. In global terms, there are a wide range of space research programmes focused on increasing general knowledge in the area and both civil and military application possibilities. A limited number of countries have a national space programme for the development and deployment of space resources under own control. The United States is by far the largest player in space, while China is currently the fastest developing country in space. No European country is as yet capable of independently building and maintaining a complete space infrastructure, although European cooperation is taking place in order to gain autonomous European access to space by developing booster rockets and satellites for, for example, observation and navigation.

The availability of new technological space applications is expected to continue to grow rapidly. There is a trend towards smaller systems with better performance in terms of accuracy, timeliness and data capacity for a lower price. For years now, costs for the procurement and operation of space systems has been following a downward spiral, which, for many countries, brings a national space programme in reach. On the other hand, this also means that there will be increasing pressure on the use of the radio spectrum.

Dependency on the (military) use of space is expected to rise further in the coming decades. Situational awareness of commanders of operations at all levels, for example, is mainly achieved by observation via satellite systems. It is already the case that many control, command and communication systems, unmanned aerial vehicles, precision weapons and logistics tracking systems would not be able to operate without space applications. Many of these applications are based on civil technologies and services. In military terms, use can also be made of civil space services for communication, navigation and Earth observation. Common civil-military use of space assets (dual use) prevents duplication of (development) work. This civilian 'spin in' also makes it possible for military applications to be developed rapidly and to become affordable for a growing group of countries. The possibility of an arms race in space in the next few decades cannot be discounted entirely, notwithstanding a series of UN resolutions and treaties intended to control that development. Space-based weapons could include weapon systems that can be deployed *from* space as well as those that are deployed from the atmosphere *into* space. Some countries are already investing in programmes to develop weapon systems capable of threatening or disabling the space assets of other countries.

The increased dependence on space applications makes not only military operations, but also economic and social intercourse increasingly vulnerable to deliberate or accidental disruptions of the technological infrastructure and data communication. In addition to the protection of space assets from military threats, armed forces must also take additional measures to ensure the availability of civilian technologies and commercial services under all circumstances.

Expertise within the NLD Defence organisation with respect to space systems and related possibilities is fragmented and limited primarily to 'own systems'. Improvements are required in the area of knowledge-building and the ability to anticipate new technological developments and application possibilities. There is a

requirement for integrated planning, central coordination and policy development. The Defence organisation has recently undertaken to improve cooperation with other ministries and with both civilian and military partners.

One interesting recent development is the American programme entitled Operationally Responsive Space (ORS). This programme is aimed at supplying made-to-measure military space capability to Joint Force Commanders in an operationally relevant timeline for the replacement of lost capability, for the strengthening of existing capability or to make available missing functionalities. The idea is to enable the assembly of satellites, to be used during an ongoing military operation, within a very short timeframe (days to weeks) through the 'plug and play' modular approach. The programme involves relatively cheap, easy-to-launch, disposable capabilities. In addition, the aim is also to develop, test and assess new technologies and to research the possibilities of their application in concert with military allies. Civil partners can also be involved, leading to lower costs, an expansion of the technological knowledge base and overall harmonisation and flexibility. Defence is involved in the drawing up of a Memorandum of Understanding that will serve as a framework for international information exchange in this area.

The knowledge required by the Defence organisation is at the conceptual level and will be used in support of Defence as a 'smart buyer' in future requirement setting.

Military use of space
<i>The knowledge requirements related to this priority particularly focus on:</i>
a. Application of enabling technologies and new concepts. The possible breakthroughs in enabling technologies and system development will bring a broad range of new applications related to the military field, and that can also be used in space, into reach. In this context, the developments in the area of sensors and information technology are particularly interesting. New concepts could relate to the use of space capabilities as part of a larger command and control network, to communications and intelligence, to system development as well as to the construction of satellites.
b. Protection. Protection concerns the measures and means aimed at preventing or minimising threats from opponents or 'space environmental' conditions (space junk, space weather) to military space capabilities. The space capabilities to be protected are defined as assets or systems operating in space, ground stations and supporting infrastructure and specific parts of the radio spectrum (threat of disruption or manipulation of data traffic). Enhancing the overview of the assets placed in space and the relevant environmental factors ('Space Situational Awareness') are also part of protection. This is about implementing a cohesive system of protective measures for civil and military space infrastructure. In addition to physical protective measures, research should also focus on conceptual and doctrinal measures.
c. Security aspects of the civil use of space. The use of civil space applications is expected to soar. In addition to satellite navigation systems (GNSS), this also involves large civil Earth observation programmes such as Global Monitoring for Environment and Security (GMES). Open data policy may, through abuse of high resolution images and positioning and time information, cause new threats to vital societal infrastructure. Positioning information of military units and operational patterns may possibly become easy to trace. Insight into risks must be improved, as must the prevention of abuse of commercial or freely available data. Armed forces may have to take additional measures to guarantee the availability of vital or strategic infrastructure (power supply, financial transactions, telecommunications) under all circumstances. In view of the supporting role that the Defence organisation plays in the context of the third core task, this will have to take place in close cooperation with civil partners.

d. Independence of space systems. In addition to knowledge regarding the optimal use of the possibilities for the use of space and the protection of space assets, we intend to carry out research into ways of reducing dependence on space systems. Military deployments must be guaranteed under all circumstances, including when space systems are unavailable for use. Conceptual and doctrinal measures may be required.

e. Feasibility and affordability of space assets. Applications for use in space are becoming cheaper, which may make them more attractive to the Defence organisation to take into use, to get involved in the development of civil capabilities in the area or to recruit and develop in-house capabilities. The feasibility of the recruitment and development of, for example, own satellite communication or intelligence capabilities can be assessed as a result of possible international cooperation in this area. This cooperation could take place within NATO, the EU or at the bilateral or multilateral levels.

2.4 Knowledge Infrastructure

This section maps out the knowledge infrastructure required for the Defence organisation's task execution and sets out Defence's vision regarding its knowledge infrastructure for the coming years. The knowledge fostered and being developed within this knowledge infrastructure is of great importance to Defence. In accordance with the pledge made by the then State Secretary for Defence during the General Consultations of 3 February 2010, the following paragraphs do not only deal with the relationship between the Defence organisation and the Netherlands Organisation of Applied Scientific Research, but also sketches an integral picture of the defence-specific infrastructure.

Defence requires scientific advice in a large number of areas of expertise. Part of the required knowledge is non-defence-specific and available in the market. In those cases, the Defence organisation meets its requirements by inviting competition among market parties. Some of these areas of expertise are, however, so defence-specific that the Defence organisation has to ensure availability of the required knowledge under its own management. In these cases, Defence invests in the build-up and sustainment of an area of expertise in a knowledge institute embedded in the public infrastructure. For these 'defence-only' areas, Defence determines the level of ambition of knowledge development and bears financial responsibility. In these areas of expertise, the knowledge institute is the Defence organisation's supplier of knowledge and is, where possible, permitted to market the knowledge developed in these areas in order to reduce its own dependence on Defence investment.

The knowledge infrastructure important to the Defence organisation comprises an internal and external component.

The **internal knowledge infrastructure** comprises:

- a. Organisational elements and networks within the Defence organisation that focus on the development and retention of area-specific expertise and that provide linkage between (operational) knowledge development and analysis within Defence and (external) scientific research;
- b. The Netherlands Defence Academy (NLDA);
- c. the Military Intelligence and Security Service.

The **external knowledge infrastructure** is highly diverse and involves both national and international knowledge institutes:

- d. organisations and institutes that develop defence-specific (applied) scientific knowledge and with which the Defence organisation, along with other ministries (particularly the Ministry of Economy, Agriculture and Innovation, the Ministry of Foreign Affairs and the Ministry of Security and Justice), maintain a financial and administrative relationship. These institutes and organisations are the Netherlands Organisation of Applied Scientific Research (TNO), the National Aerospace Laboratory (NLR), the Maritime Research Institute of the Netherlands (known as Marin) and the Netherlands Institute of International Relations Clingendael. These organisations act as the Defence organisation's strategic partners;
- e. other organisations and institutes in the (semi-) public infrastructure, such as planning offices, institutes affiliated with the Royal Netherlands Academy of Science (KNAW) and the Netherlands Organisation for Scientific Research (NOW), the Scientific Council for Government Policy (WRR), top technological institutes (TTIs), the National Institute for Public Health and the Environment (RIVM) and the Netherlands Forensic institute (NFI);
- f. the public universities;
- g. international cooperative arrangements in the area of science and technology, including the NATO Research & Technology Organisation (RTO), the NATO Undersea Research Centre (NURC), the NATO Consultation, Command & Control Agency (NC3A), the European Defence Agency (EDA) and bilateral, trilateral and multinational cooperative partnerships. Use is also made of international centres of expertise, particularly within NATO. For example, the Netherlands Defence organisation maintains structural relations with the Allied Command Transformation (ACT) and the Joint Analyses and Lessons Learned Centre (JALCC) in Lisbon. Moreover, Defence make use of or participates in centres of excellence.

Of course, market parties have knowledge available to them that may be relevant to the Defence organisation and can be sourced on a case-by-case basis. Furthermore, particularly defence-related industries have defence-specific knowledge available to them, although its continuity is not guaranteed in advance. The relations between the Defence organisation and defence-related industries are dealt with in paragraph 3.3. External consultancy bureaus may also have defence-specific knowledge available to them, but they will not be considered here.

In the coming years, Defence policy will focus on retaining and further developing the internal and external defence-specific knowledge base and on making more effective use of the available scientific knowledge for an efficient and effective execution of Defence tasks. In the light of the cutbacks being made within the organisation, it is now more than ever necessary to make the best possible use of scientific knowledge. In accordance with the Government's 'Commercial Sector Letter', the commercial sector will become more closely involved, with Defence the requirement remaining leading.

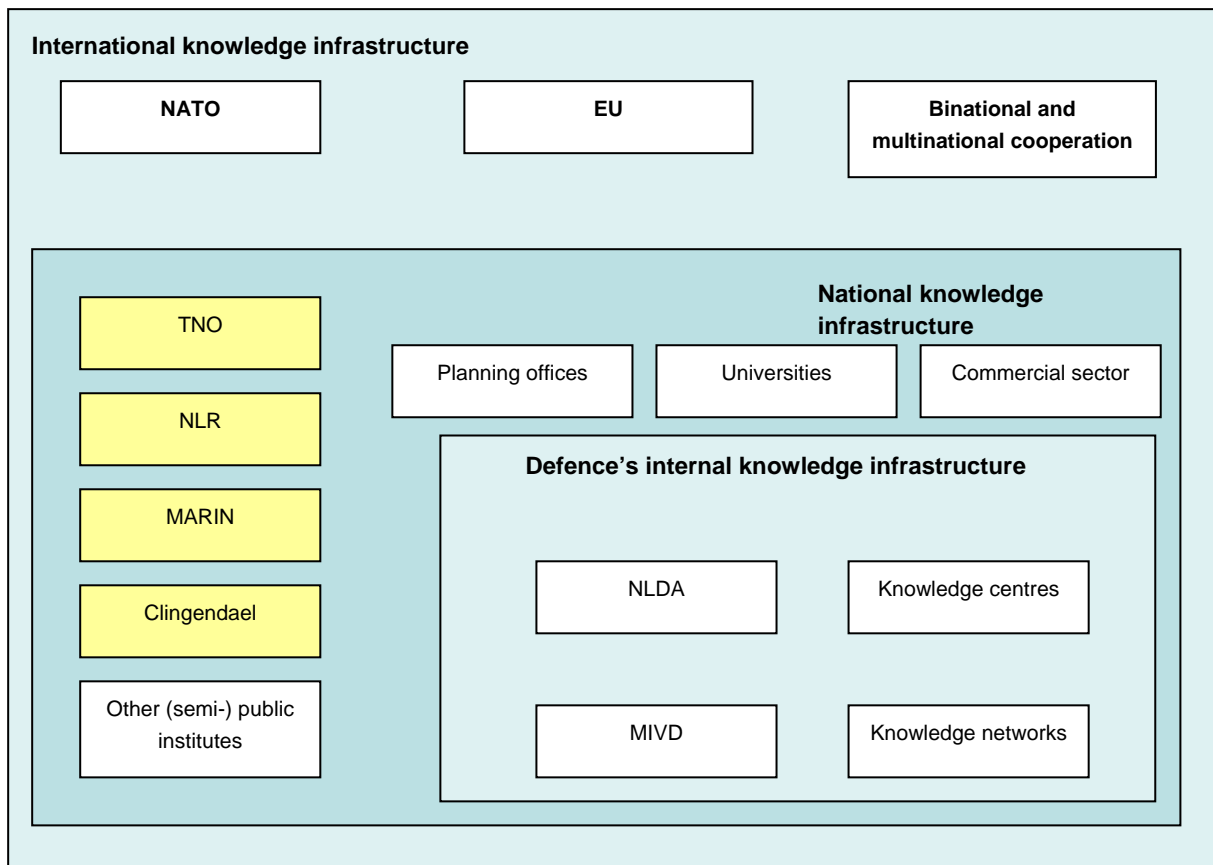


Diagram of the Defence organisation's knowledge infrastructure (strategic partners marked)

With regard to the knowledge infrastructure, the Defence organisation will:

- * reorganise its internal knowledge infrastructure, with, on the one hand, operational knowledge being grouped per domain and supervision thereof strengthened and, on the other hand, operational knowledge development remaining embedded at a relatively low level in the organisation (section 2.4.1);
- * make more intensive use of the Netherlands Defence Academy (see section 2.4.2);
- * further develop its relations with its strategic partners and, in cooperation with the same, improve the application and the overall impact of (applied) scientific knowledge within the Defence organisation (section 2.4.4);
- * strengthen its ties with universities and other (semi-) public institutes in the Netherlands, insofar as these have defence-specific knowledge available to them which Defence's strategic partners are not able to provide either in sufficient measure or not at all (section 2.4.5);
- * strengthen interdepartmental cooperation in developing or sustaining a knowledge base vital for both civilian and military purposes (section 2.4.6);
- * strengthen international cooperation in the area of research and development by, among other things, examining the possibilities of a cooperational model involving complementary research programmes (section 2.4.7).

2.4.1 Professional knowledge within the Defence organisation

Defence personnel have a great deal of professional knowledge that is brought together in centres of expertise and knowledge networks which can be very diverse in nature. By linking operational knowledge development and scientific research and embedding operational knowledge development at a relatively low level in the

organisation, Defence remains capable of responding rapidly and effectively to changes in the operational domain ('short innovation cycle') and has safeguarded the requirement for scientific knowledge in support of its operations. Within the operational commands, operational knowledge is grouped per domain (land, sea, air). Non-operational knowledge is also vital for task execution and support of the armed forces and is brought together in centres of expertise. For weapon systems management, for example, a great deal of knowledge is required and housed within the Defence Materiel Organisation/Directorate of Weapon Systems, where it is integrated with knowledge provided by knowledge institutes, knowledge networks, centres of expertise, defence-related industries and organisations such as NATO and EDA. The various knowledge networks that are active within the Defence organisation remain important for determining the value, the interconnectivity and the desired depth and range of scientific research to be undertaken. They are an important sounding board for questions, problems, initiatives and plans within their respective fields.

2.4.2 Netherlands Defence Academy (NLDA)

The NLDA provides military-academic education within the Defence organisation. In accordance with the Letter to Parliament, the number of courses given at the NLDA will be reduced to three bachelor courses, the number of profiles and minors will be restricted to a minimum, and parts of courses will be taken at civil universities. As part of and as a contribution to academic education, the NLDA will also carry out independent scientific research. The Government has already decided to establish an NLDA Academic Education and Research Foundation (Dutch abbreviation: SWOON), which will allow accreditation of NLDA courses in the Dutch system of higher education and academic research. As explained in the letter of 28 January 2010 regarding the reassessment of the Defence knowledge portfolio (Parliamentary Document 27 830, no. 71), Defence will make more use of the studies being carried out by the NLDA. The Defence organisation intends to involve the NLDA more intensively in policy-making and learning lessons from past operations (lessons learned). In order to align the NLDA's research programme more closely than previously with policy priorities and knowledge requirements, discussions on the aforementioned will be held with the NLDA on a six-monthly basis, starting this year. The NLDA is working closely with researchers from civil universities and with the Netherlands Organisation for Applied Scientific Research (TNO) and the National Aerospace Laboratory (NLR) via a common research assistants training programme. Cooperation with universities is also put into practice by appointing professors to lecture at both the NLDA and at civil universities.

2.4.3 Military Intelligence and Security Service

The Military Intelligence and Security Service (MIVD) examines factors that influence the interests of the Kingdom and the international rule of law and involve, or could involve, the armed forces. The MIVD employs personnel with various backgrounds, where specific military knowledge and academic knowledge complement each other. The MIVD focuses on global security developments and on themes such as military-technological developments and the proliferation of weapons of mass destruction (threat analyses). In addition to other intelligence services, the MIVD maintains close contact with knowledge institutes both within and outside the Defence organisation and within the academic community.

2.4.4 Strategic partners

Defence has outsourced its scientific and technological expertise for defence-specific knowledge areas to strategic partners. On account of the close strategic relations, these partners are very familiar with the operations, processes, doctrines and assets of the Defence organisation. This 'knowledge of the domain' represents a great deal of added value in terms of knowledge support. In contrast to many other NATO member states, the Netherlands Defence organisation has thus outsourced a large part of its scientific knowledge base to organisations and institutes outside the armed forces, making Defence dependent on these institutes for support in the area of scientific knowledge. In addition to generating knowledge for the Defence organisation,

its strategic partners also have facilities for developing and testing new concepts and capabilities (Concept Development & Experimentation). CD&E can incorporate knowledge gained from operations into technology assessment and development and help to gain insight into the operational user value of new technologies. Strategic knowledge partners are also vital to the Defence organisation for international cooperation, where they represent Defence abroad. These are reasons for Defence, along with other ministries (particularly the Ministry of Economy, Agriculture and Innovation, the Ministry of Foreign Affairs and the Ministry of Security and Justice), to maintain a financial and administrative relationship with these institutes. For many years, the Defence organisation has maintained a strategic partnership with the Netherlands Organisation of Applied Scientific Research (TNO), the National Aerospace Laboratory (NLR), the Maritime Research Institute of the Netherlands (Marin) and the Institute of International Relations Clingendael.

2.4.4.1 Netherlands Organisation of Applied Scientific Research (TNO)

For over 75 years, TNO has been and will remain a strategic partner of the Defence organisation. The special relationship between TNO and Defence is laid down in the TNO Act, which established a Defence Research Council (RDO). The secretarial role of TNO has been transferred from the Ministry of Education, Culture and Science to the Ministry of Economic Affairs, Agriculture and Innovation. This means that the latter has replaced the former in the Defence Research Council (RDO).

TNO supports the Defence organisation in the area of 'hard' defence technologies, such as weapons and munitions, the protection of military personnel, platforms and sensors and in the area of human factors. TNO also founded the The Hague Centre of Strategic Studies (HCSS), which carries out research relevant to Defence in the areas of peace and security. The centre, however, falls outside the funding range used by the Government for financing TNO programmes.

As already announced, as from 2010 the Defence organisation will make less funding available from its central budgets for research and development (R&D) purposes. This measure has hit the TNO research programme particularly hard. In consultation with TNO, the Defence Research Council (RDO) reached an agreement regarding the implementation of the Defence knowledge portfolio review (Parliamentary Document 27 830, no. 79).

2.4.4.2 National Aerospace Laboratory (NLR)

The NLR is the most important Dutch knowledge provider for both civil and military aerospace activities. The objective is to develop high-quality aerospace technology and to thereby strengthen the innovative and competitive capabilities of the Government and the commercial sector in the Netherlands. NLR is Defence's knowledge provider for aviation-related technological support and use of aviation assets.

The Defence organisation, and particularly the Royal Netherlands Air Force and the Defence Materiel Organisation, are dependent on NLR for a large part of their technical knowledge of aviation assets. The military aviation organisation makes intensive use of NLR support in the requirements setting process, during procurement and introduction, during exercises, operational deployments, training and maintenance processes. The secretarial role has been transferred from the former Ministry of Transport, Public Works and Water Management to the Ministry of Economic Affairs, Agriculture and Innovation.

2.4.4.3 Maritime Research Institute of the Netherlands (Marin)

The Marin is a globally authoritative institute on the behaviour of ships at sea and much more. The Marin is important to the Defence organisation on account of its hydrodynamic and nautical knowledge, required for assessment of ship design. Marin has specific knowledge on the effects of the shape of ships' hulls and the effects of propulsion on the handling behaviour, manoeuvrability and underwater signatures of a ship. In

addition, another of Marin's important specialisms is expertise on the behaviour and deployability of ships in high seas. Finally, Marin's nautical knowledge and simulators can be used for simulating and optimising operations at sea in advance. These three aspects are vital for the effective functioning of ships.

2.4.4.4 Netherlands Institute for International Relations 'Clingendael'

The Netherlands Institute for International Relations "Clingendael" has been an important knowledge provider to the ministries of Foreign Affairs and Defence since its establishment in 1983. Clingendael is a knowledge institute specialising in international issues. It carries out studies into topical international issues and provides training courses on the same. The ministries of Foreign Affairs and Defence contribute a basic subsidy to the institute, based on the Clingendael multi-year plan. In the coming years, the Defence organisation will strengthen its consultation with Clingendael. The Defence organisation's contribution to Clingendael's basic subsidy is not part of central funding for Defence R&D.

2.4.5 Universities

Currently, universities take part in research programmes conducted by the strategic partners and by the NLDA. The Defence organisation intends to intensify its relations with universities. They are able to offer relevant knowledge to Defence, although continuity of knowledge support is a point requiring attention.

2.4.6 Interdepartmental Cooperation

The Defence organisation is striving to achieve far-reaching interdepartmental cooperation for the development and sustainment of knowledge relevant to Defence and other ministries. This will prevent duplication of efforts and promote more effective and efficient use of financial resources. Interdepartmental cooperation could take place in the areas of research on chemical, biological, radiological and nuclear threats (CBRN), the military use of space, cyber security (in the framework of the National Cyber Security Strategy) and network-enabled operations. Closer cooperation is taking place with the Ministry of Foreign Affairs for directing the knowledge base in the area of foreign and politico-security issues by setting up a joint research programme at the Netherlands Institute of International Relations 'Clingendael'.

2.4.7 International Cooperation

For the Netherlands and many other NATO and EU member states, international cooperation in the area of research and development is a cornerstone of the national knowledge and innovation strategy. The most important drivers for cooperation are gaining access to knowledge and to – often expensive – research facilities. International cooperation improves the quality of academic advice and the effectiveness and efficiency of national knowledge investment.

For decades, the Defence organisation and the Netherlands' defence-related industries have been working intensively with other countries in the area of R&D. Moreover, the Netherlands Defence organisation is an active advocate of more intensive international cooperation. The current forms of international R&D cooperation are focused on retaining or strengthening the respective participants' national knowledge bases as far as possible. This is known as the so-called "synergy model"; by working with other countries in a specific area of expertise, more knowledge will become available for national purposes without the necessity of making significant extra investment. International R&D cooperation based on this model is well developed in NATO, the European Defence Agency (EDA) and in the context of multinational or bilateral R&D cooperative arrangements.

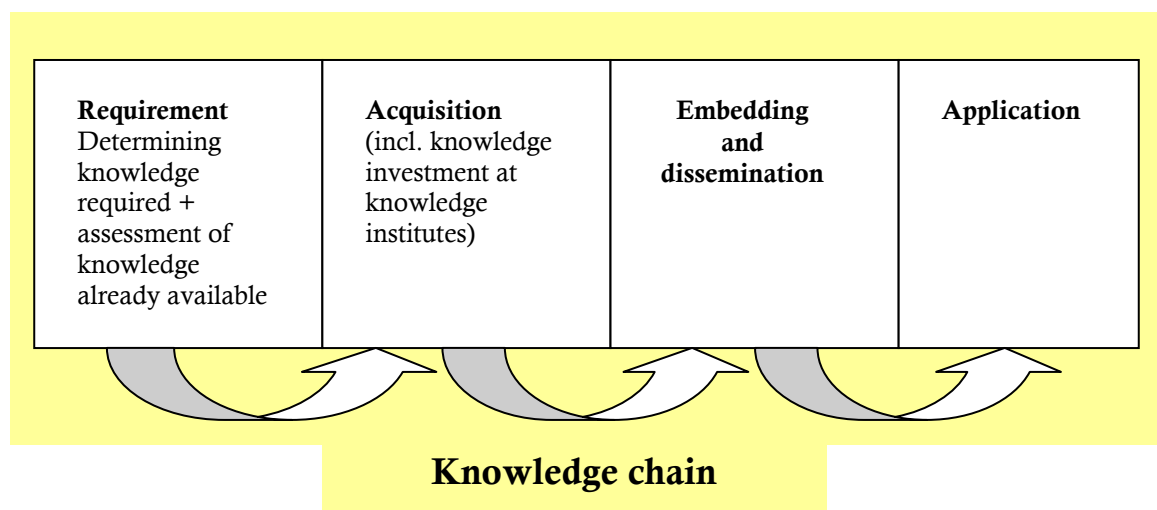
Following an initiative launched by the Netherlands, a number of countries – in addition to the Netherlands itself, Australia, Canada, Germany, Norway and Belgium are the countries certainly taking part – have, since 2009, been studying the possibilities for a new multinational or bilateral cooperation model based on the

principle of 'strategic mutual assistance in research and technology' (SMART). The SMART model entails various countries making complementary investments in an area of knowledge development and making arrangements for granting unrestricted access to each other's databases. In the SMART model, there is collective management of the knowledge areas to be developed. This requires collective research planning, a collective build-up and maintenance of international knowledge bases and so-called portfolio management. It is the endeavour to structure and manage the international knowledge bases such that knowledge shortfalls are avoided and complementarity and synergy are enhanced. In order to develop this form of cooperation, the Defence organisation has organised three international meetings in the last three years. This concept can only work if the Netherlands continues to share knowledge of the same quality with other countries; in this, *quid pro quo* is the operative principle.

2.5 Knowledge Management – on the agenda!

Knowledge management encompasses the management and internalisation of knowledge in the organisation and involves all leadership and management tasks relating to knowledge as a production factor, extending throughout the whole knowledge chain, from setting the requirements to the application of knowledge. The objective of knowledge management is to chart the knowledge requirement, to develop and use the knowledge of personnel to an optimal level, and to make knowledge accessible, easier to share and easier to retain (e.g. in the case of employees leaving the organisation). Knowledge is context-related, dynamic and person-related. An organisation does not actually of itself have knowledge available, but employs personnel with knowledge. Knowledge management is therefore primarily the responsibility of all employees in leadership positions within the Defence organisation.

Defence's knowledge chain comprises four sub-processes: determining the knowledge requirement; acquisition of the knowledge required; embedding and dissemination of the acquired knowledge; and the application of knowledge. It is important to retain the distinction between knowledge development and knowledge application, although this distinction must not be at the expense of Defence's flexibility in meeting its knowledge requirement. In the knowledge development phase, there is extremely close cooperation with the knowledge users, which in practice means that knowledge development and use of knowledge go hand in hand.



There are reasons for giving more structural attention to knowledge management within the Defence organisation and strengthening it. There are also measures required for retaining and applying acquired

knowledge to an optimal level. Especially the relationship between scientific knowledge and professional knowledge and the application of knowledge in Defence policy and Defence innovation must be strengthened.

The 2009 annual report of the Inspector-General of the Armed Forces (IGK) also stated that knowledge management within the Defence organisation could be improved. The IGK remarked that the Defence organisation in fact has a great deal of knowledge within its ranks and that useful initiatives have been taken in Defence elements to professionalise knowledge management. Knowledge is produced over a wide range of subjects within the organisation. Nevertheless, the IGK determined that the management, embedding and transfer of knowledge leaves much to be desired and that an overarching policy for knowledge management is lacking. The production, retention and transfer of knowledge relevant to the organisation demands more focused attention and direction. Moreover, the IGK considered it desirable that a number of important preconditions for knowledge management be more fully met, among them increased attention for personnel policy. The Defence organisation endorses the findings and recommendations of the IGK and will take steps in improving knowledge management. These will be discussed in Chapter Four of this document.

3 Innovation Agenda

3.1 Innovation: the key to a modern and affordable Defence organisation

Innovation – or renewal – is about introducing new ideas, technologies, services and processes. This part of the SKIA mainly discusses stimulating innovation *by* and *for* the Defence organisation. The Netherlands armed forces is one of the most innovative armed forces in Europe. In practice, the relatively small size of the Netherlands Defence organisation necessitates finding innovative solutions. Moreover, the Netherlands armed forces puts the emphasis on quality. It is not about having ‘a lot’ of everything, but about having the smartest and most effective methods of operation available, by means of different combinations of the deployment of materiel and personnel. Finally, the current cutbacks demand that the Defence organisation act even more innovatively in order to achieve the desired operational effects.

3.2 Innovation goals

The Letter to Parliament clarifies the direction in which the Defence organisation intends to develop in the coming years. Further to the Letter, the innovation goals set out below reveal the areas where the Defence organisation, together with defence-related knowledge institutes and companies, will endeavour to innovate. In the implementation phase of each innovation goal, concrete steps will be set and “pioneers” will be identified within the organisation. In order to achieve these innovation goals, in the coming years various activities and projects will be carried out. Many ongoing activities are already contributing to realising these goals. In that respect, setting innovation goals helps to improve the coordination of activities. However, where necessary, new activities will be undertaken.

3.2.1 Operating in information-driven networks

This innovation goal focuses on the optimisation of military operations in the era of information technology. By making more intensive use of networks and information technology, the effectiveness and efficiency of military operations can be further improved. Furthermore, as a consequence of the increasing complexity of military operations, ever more stringent demands are made of the interoperability of resources. Relevant information must be available on time and ready to share, thereby improving situational awareness and decision-making. Network-enabled and information-driven operations also offer opportunities in the area of security and surveillance, by, among other things, the introduction of new security and surveillance concepts. This could involve *inter alia* buildings, embassies in fragile states or mission compounds. The growing migration pressure on the European Union also places high demands on border control. New technological possibilities offer opportunities to make border control more information and risk-driven, thereby making it more effective.

The Defence organisation is already carrying out various activities in the context of this innovation goal. These entail the improvement of cooperative arrangements and processes, information supply and management, and information and communication technology in the context of national and international cooperation. The implementation of the Network and Information Infrastructure (NII) vision is also part of this innovation goal. Furthermore, a Concept Development and Experimentation pathway has been initiated for the gradual development of various information systems for support of the command, control and information process (such as MAJICC, Purple Nectar, I-bridge and the Passenger Information Unit), for the “Security and Surveillance 2020” concept and the development and implementation of the new border control concept.

3.2.2 Effective influencing of operations

This innovation goal is focused on strengthening the armed forces' possibilities of exercising influence during operations without the application of force. The application of military force is, and remains, a core competence of the armed forces. Deployment of the armed forces is often primarily not for using force to achieve the objective, but to influence the behaviour of other parties. The application of military force can sometimes even be counterproductive. Nowadays, military operations are often part of a broad and coordinated approach. Gaining the support of the population and paramilitary and civil actors in the area of operations is essential. At the same time, account must be taken of adversaries influencing public opinion on missions through their own operations and modern means of communication. Perceptions are an important factor in military operations, requiring attention both from within and outside the area of operations.

In the context of this innovation goal, and on the basis of the Letter to Parliament, investments are being made in so-called psychological operations. Information operations are also an important element of operations that will receive more attention.

3.2.3 Energy-efficient Armed Forces

With this innovation goal, the Defence organisation will endeavour to substantially reduce its dependence on fossil fuels by using alternative energy sources. This will be applied to both weapon systems and infrastructure in the Netherlands and in mission areas. Measures aimed at reducing energy use are desirable for operational reasons and also contribute to reducing costs. As weapon systems have a long life-cycle, Defence must now already start to address where fuel will come from and how it will be paid for in twenty years time. Consequently, a Defence-wide vision on energy including all aspects (availability, consumption, cost savings, efficiency and sustainability) will be drawn up for all domains (infrastructure, materiel, operations). Defence will also align itself to cross-government initiatives in the area.

Alternative energy sources. The decreasing availability of crude oil is forcing the Defence organisation to think about energy-saving measures, alternative energy sources and the associated use of new technologies. Alternative fuels and new technologies are not expected to be able to compensate for the decreasing availability of crude oil in the coming decades. Air systems consume most fuel by far and are wholly dependent on liquid fuels. The aviation industry and air forces therefore take full part in research into alternative fuels. In this context, the Defence organisation carries out the following activities:

- research into the application of absorption cooling as a cooling system for use on military compounds;
- research into the feasibility of a sky-sail on one of the new patrol vessels for supporting propulsion by wind power;
- innovation by autonomous energy generation. In this regard, the 'Distributed Generation' concept offers opportunities. The 'man-for-man' generation of energy is of prime interest to the Defence organisation. Defence is also experimenting with its own wind farm in Coevorden, in the north of the Netherlands;
- innovation technology and the development of alternative fuels. Military aviation has a strong partner in the commercial aviation sector as regards cooperation;
- the use of bio-fuels for military applications, in particular for aircraft.

Energy-saving systems. Saving energy is also of great importance for keeping down operating costs, both in the Netherlands and in mission areas. A large quantity of fuel and a big logistic effort is required for maintaining stock levels. About € 160 million (approximately 2 percent) of the Defence budget is spent on procurement of energy. The actual costs are higher, as fuel used for weapon systems (65% of total energy consumption) has to be stored, treated, transported, distributed and protected. The availability of fossil fuels will, in the coming

years, decrease, leading to price increases. Eventually, these price increases will not only hinder military operations, but in certain cases even make them impossible.

Traditional weapon systems often have high energy consumption. Therefore other, more energy-effective weapon systems will have to replace them. It is essential that the right choices are now made regarding the procurement of new materiel, investment in research and development, and in searching for relevant industrial partners for purposes of cooperation. In this context, the Defence organisation carries out *inter alia* the following activities:

- reduction of number of land and air systems, leading to a reduction in fuel consumption;
- application of techniques used in the car industry to small ships;
- application of techniques from stationary energy generation or nuclear energy are possible energy-reducing options for bigger ships;
- the combination of high-impulse systems and electric propulsion, characteristic for weapon systems, can be optimised. A smart configuration of that combination could reduce total energy consumption;
- research whether optimisation of the basic design parameters of future weapon systems is possible for achieving the desired (weapon) effect with the use of as little fuel as possible;
- their armour makes land systems heavy, which makes movement or transport energy-intensive. The race between weapon and armour will be won by weapons unless other concepts, lighter materials and more efficient energy and traction systems can offer the same or better protection to the occupants of the systems against lower fuel consumption.

3.2.4 An innovative and flexible organisation

The Defence organisation will also introduce new ideas, technologies and processes into operational management. For example, Defence will, in the coming years, push forward the principle of network-enabled cooperation (otherwise known as the "new ways of working" programme within Defence). Personnel are central to this principle. Members of personnel can, within certain parameters, determine *how* they work, *where* they work, *when* they work, *with what* they work and *with whom* they work. The Defence organisation has set itself the long-term objective of providing all of its personnel members with a digital environment that allows them to carry out their work at their work location (any place) at any time with authorised safe and secure access to correct, full and up-to-date information required for task execution. Information can be provided to personnel in a form tailored to user circumstances, up-to-date cooperative groups (on the basis of digital identity) and, moreover, independent of the equipment at the disposal of members of personnel (any device). This must result in improved cooperation, higher productivity, improved operational management, rising job satisfaction and a good position in the labour market. One important step in achieving this is provision of seamless and safe interconnectivity of information and communication systems. Moreover, managing of information instead of managing by structure will become the most important instrument for managing the Defence organisation. Another good way of stimulating innovation in an incremental and cost-effective way is through application of the Concept, Development and Experimentation method, as used in NATO circles.

3.3 The Defence Contribution to a Broader Innovation Agenda in the Netherlands

On the basis of the coalition agreement, the Government is adopting a focused policy aimed at enhancement of innovation and entrepreneurship. The objective of this policy is to strengthen the competitiveness of the Dutch commercial sector in a challenging and rapidly changing international economic environment. The government will give particular attention to strengthening the main nine economic sectors set out in the coalition agreement. The government also intends to facilitate to a maximum degree the area-specific clusters of

companies. Cooperation between the commercial sector, knowledge institutes and government organisations will also be stimulated. The aforementioned policy has been clearly set out in the 'Commercial Sector Letter' as drawn up by the Minister of Economic Affairs, Agriculture and Innovation (Parliamentary Document 32 637, no. 1).

The Defence organisation is in a good position to contribute to this cross-government approach to strengthening the competitiveness of the Dutch commercial sector and is actively involved in setting out the Government's new commercial sector policy. The added value of our defence effort for the Dutch economy is considerable, involving not only the salaries of Defence personnel, purchases of user items, consumer goods and services at (local) suppliers, but also high-quality investment in Dutch companies and knowledge institutes and compensation orders for foreign contracts. Although the operational requirement of the armed forces regarding procurement decisions is, and remains, leading, the Defence organisation promotes the innovative capability and the competitive strength of the Dutch economy and industry in a variety of ways. To that end, in conjunction with the Ministry of Economic Affairs and in close consultation with the commercial sector and knowledge institutes, the Defence organisation drew up the Defence Industry Strategy (DIS) in 2007 (Parliamentary Document 31 125, no. 1). At that time, the DIS was the answer to the motion tabled by Kortenhorst and Herben (Parliamentary Document 30 800 X no. 32), who had called for the integration of the Ministry of Defence's technology policy and the Ministry of Economic Affairs' innovation policy. The Defence organisation also contributes to promoting export by participating in trendsetting international defence fairs, where it shows what the Netherlands is capable of as an industrialised country. Finally, Defence is also an important driver of knowledge acquisition in the Netherlands. Cooperation between the commercial sector, knowledge institutes and government organisations in the area of defence has, as of old, been highly developed. A substantial part of the knowledge infrastructure in the Netherlands focuses on defence research, particularly TNO, large technological institutes such as NLR and Marin, the Delft and Twente universities of technology and the Institute of International Relations Clingendael (see section 2.4 on the Defence organisation's knowledge infrastructure).

From the point of view of the Commercial Sector Letter, the Defence will, in the coming years, play a particularly active role in a number of the principal economic sectors. These will include the high tech sector (which will include security), the water sector (which will include maritime construction) and the creative sector (in connection with serious gaming and simulation) and clusters such as Maintenance Valley. Dutch defence-related industry comprises about 300 companies, the majority of which supply products to both military and civilian customers. Although these enterprises represent a relatively small share of the Dutch economy (0.5 percent), their high-quality technological and innovative character lends them significant added value and prestige. Dutch defence-related industry is, for example, research and development intensive (over twenty percent of personnel are involved in research and development) in comparison with many other industrial sectors. The presence of a vibrant and innovative defence-related industry in the Netherlands is therefore important for both the Defence organisation and the Dutch economy in general.

In order to help achieve the objectives set out in the Commercial Sector Letter, the Defence organisation will forcefully address the implementation of the measures set out in the DIS in the coming years, as the DIS contains an integral vision for Dutch defence-related industry and the role of the Government therein. It identifies six areas of technology to be prioritised on the basis of the Defence requirement, the strong points of Dutch industry and opportunities on the international market (both the defence market and the civilian market). This involves the following areas of technology:

1. Command, Control, Communications, Computers and Intelligence;
2. Sensor systems;

3. Integrated platform design – development and manufacture;
4. Electronics and mechatronics;
5. Advanced materials;
6. Simulation, training and artificial environments

The Defence organisation utilises the following instruments in strengthening the competitive position and the innovative ability of Dutch defence-related industry and promoting participation in international networks (supply chains) for the development, production and sustainment of defence materiel. The efforts mentioned below do not change the fact that the Defence requirement is leading for the Defence organisation and that Dutch defence-related industries are themselves responsible for their positioning in the national and international market:

- Information will be exchanged in a structured manner between the Ministry of Defence, the Ministry of Economic Affairs, Agriculture and Innovation and Dutch defence-related industry regarding the (future) requirement of Defence and the possibilities of Dutch industry meeting this requirement;
- the relationship with industry in the area of sustainment will be intensified. For strategic reasons, Defence will have part of the maintenance activities carried out by its own sustainment agencies. As set out in the Letter to Parliament, support from industry in the area of maintenance is both possible and necessary. Innovative projects, such as public-private cooperation in the maintenance of F-100 engines for F-16s (Parliamentary Document 25 820, no. 19, 7 December 2010), stimulate cooperation with market parties and the development of Maintenance Valley;
- the possibilities for the Defence organisation to act as launching customer will be extended. The term launching customer means that the Government, as the important first customer, plays a stimulating role in the application of new technologies and in the development of innovative products. As the launching customer, the Government – and Defence in particular – can, among other things, further strengthen the DIS prioritised areas of technology and further enhance confidence in Dutch products. This will create a base for further production and sales on both national and international defence and security markets. As small and medium-sized companies' development of innovative military products that meet Defence's operational requirement sometimes only progresses with difficulty, the Defence organisation has established a funding instrument in order to finance viable projects at an early stage, with a view to later procurement contracts (see Letter to Parliament, 18 November 2010). Defence has a budget available of a total of € 5 million for the 2010-2012 period. By establishing this funding instrument, the Defence organisation has responded to the motion tabled by Eijssink, Knops and Voordewind (Parliamentary Document 32 123 X, no. 76);
- where possible, the Defence organisation promotes the involvement of Dutch defence-related industries in international materiel projects and production networks. In addition, the Defence organisation intends, in accordance with the Defence Letter to Parliament, to join the "Letter of Intent" (LOI) cooperation framework of six European countries.
- The Defence organisation stimulates the commercial sector and knowledge institutes in developing innovative solutions for Defence requirements. The 'Defence Innovation Competition' (DIC) is one of the initiatives undertaken by the organisation in this area. The DIC challenges particularly small and medium-sized companies to come up with innovative solutions for specific defence issues. In addition to the DIC, the Defence organisation, together with TNO, NLR, Marin and the commercial sector, also organises an

annual 'Innovation Game', in which ideas are developed for new technological innovations in the armed forces.

4 Culture, Organisation, Management and Funding

4.1 Culture, organisation, management

More important than the SKIA as such are its effects on personnel and organisation. Attention is required for culture, organisation, management and funding for achieving the objectives set out in the Letter to Parliament and the SKIA. No new bureaucracy, but reinforcing a culture to which curiosity, transparency and room for innovative thinking and innovative actions are central. People are key to innovation at the Defence organisation. An enterprising organisational culture is crucial for the innovative ability of Defence: room for enterprise, experiments and unorthodox thinking. The Defence organisation wishes to strengthen a culture that promotes innovative behaviour. Transparency, representation, looking forward to the future, knowledge sharing, organising with flexibility, a flowering of talent and a certain tolerance towards risk taking are essential in this. Without attention to culture, organisation, management and funding, a broad range of opportunities will be wasted.

With regard to organisation and management, the Defence organisation will take the following steps:

1. **knowledge management at the level of an organisational element explicitly remains the responsibility of senior managers.** They are also responsible for giving specific attention to the retention or transfer of knowledge in the event of reorganisations. Precisely in view of the expected reductions in personnel and organisational changes within the Defence organisation in the coming years, knowledge management is of great importance. It is nevertheless unavoidable that both scientific knowledge and job-specific knowledge will be lost as a result of the cutbacks;
2. **as a consequence of the reorganisation of the Central Staff as described in the Letter to Parliament, the Principal Directorate of Policy (*Hoofddirectie Beleid* or HDB) will bear responsibility for the Defence organisation's knowledge and innovation policy.** The HDB is also responsible for the strategic function within the Defence organisation and for policy-driven management of the knowledge and innovation agenda. The Defence Research & Development organisation will be incorporated into the HDB;
3. **in response to the recommendations of the Inspector-General of the Armed Forces, responsibility for policy regarding knowledge management will also be borne by the HDB.** In this capacity, the HDB will ensure the implementation of a departmental vision on knowledge management within the Defence organisation, as well as an accompanying plan of action. This vision will be available by the end of 2011 and must contain easy-to-use pointers and tools for senior managers. In this vision, attention will be given to *inter alia* the Inspector-General of the Armed Forces' recommendations regarding the Defence organisation's personnel policy. The departmental vision must set conditions for treating knowledge with the respect it deserves. This involves recognition of knowledge management as an integral part of operational management, investing in a culture which values knowledge, and the use of IT resources that support the development, sharing, application and retention of knowledge;
4. **In cooperation with internal and external knowledge institutes, the Defence organisation will develop initiatives to promote the application of the available scientific knowledge**

within the organisation. Internal and external knowledge institutes will be involved more in the application of knowledge within the Defence organisation. Where possible, (outsourcing) procedures will be simplified to ensure flexibility in outsourcing to the said institutes. The Defence organisation will also work together with its knowledge partners on a revised vision for increasing the impact and application of knowledge investment programmes. This new approach has the intention of developing intensive cooperation between the Defence organisation and other parties regarding knowledge and increasing the use of the knowledge available, thereby increasing the total innovative ability of our armed forces. At the core of this new vision is a common mindset characterised by closer cooperation during research, clearly defined concrete challenges, flexibility, involvement and a safe environment in which to innovate;

5. **the knowledge infrastructure in the operational domain will be reconfigured.** By embedding operational knowledge development at a relatively low level in the organisation, Defence remains capable of responding to changes in the operational domain rapidly and effectively ('short innovation cycle'). However, the supervision of operational knowledge development will be reinforced, with the Defence Staff being responsible for this supervision. This will allow improved Defence-wide use of knowledge networks and also avoid or eliminate duplication of effort. The (operational) knowledge will be concentrated per domain (land, sea, air) or area of expertise (such as occupational health and safety and healthcare; medical training) at the Defence elements. Initiatives will be developed to improve linkage between operational knowledge development within the armed forces and scientific research.

4.2 Funding

As a consequence of the Defence organisation's financial situation, a sense of realism is required when discussing implementation of the SKIA. It is inevitable that both scientific and professional knowledge will be lost as consequence of the cutbacks, even though specific attention will be given to the retention or handover of knowledge during the reorganisation process. In the light of the objectives set out in the Letter to Parliament, the Defence organisation will endeavour, despite the far-reaching cuts, to achieve a sound financial base for the development and sustainment of the defence-specific knowledge base. The Letter to Parliament therefore contains no further cuts to the Defence budgets allocated to knowledge and technology development, which partly meets the Ten Broeke motion (Parliamentary Document 32 500-X, no. 58). Furthermore, a one-off amount of € 6 million has been released for TNO projects on the back of the Ten Broeke amendment. However, the Defence organisation's endeavour does not mean that the cutbacks at Defence and within government organisations in general, mentioned in the Spring 2011 Financial Report, will leave the defence-specific knowledge base of Defence's strategic partners untouched. In order to restrict the consequences for that knowledge base as far as possible, the Defence organisation will, in consultation with its strategic partners and other ministries, monitor and map out any possible effects.