

**MASTER'S PROGRAMME MILITARY
TECHNOLOGY, PROCESSES AND SYSTEMS**

FACULTY OF MILITARY SCIENCES

NETHERLANDS DEFENCE ACADEMY

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This report was finalised on 23 November 2019.



REPORT ON THE MASTER'S PROGRAMME MILITARY TECHNOLOGY, PROCESSES AND SYSTEMS OF NETHERLANDS DEFENCE ACADEMY

ADMINISTRATIVE DATA REGARDING THE PROGRAMME

Master of Science in Military Technology, Processes and Systems

Name of the programme:	M Military Technology, Processes and Systems (MTPS)
CROHO number:	69323
Level of the programme:	master's
Orientation of the programme:	academic
Specialisations or tracks:	Processes Systems
Number of credits:	60 EC
Location(s):	Den Helder
Mode(s) of study:	part-time
Language of instruction:	English
Expiration of accreditation:	30-05-2023

ADMINISTRATIVE DATA REGARDING THE INSTITUTION

Name of the institution:	Faculty of Military Sciences of the Netherlands Defence Academy
Status of the institution:	private institution providing higher education
Result institutional quality assurance assessment:	not requested

COMPOSITION OF THE ASSESSMENT PANEL

The NVAO approved the composition of the panel on 24 June 2019. The panel that assessed the master's programme Military Technology, Processes and Systems consisted of:

- Prof. L. (Lou) van der Sluis [chair], emeritus professor at the Delft University of Technology in the Power Systems Department;
- Prof. E. (Erik) Barendsen, full professor in Science Education at Radboud University and full professor in Computing Education at Open University of the Netherlands;
- Dr K. (Koen) Eneman, associate professor and chair of Leuven Campus – campus group T, KU Leuven – Group T Leuven Campus (Belgium);
- Col. R. (Rudy) Vlasselaer, director of the academic education of the Royal Military Academy in Brussels (Belgium);
- W.E. (Wietske) Rem, BSc [student member], master's student Mechanical Engineering at University of Twente.

Dr M. (Marijn) Hollestelle, certified NVAO secretary, was project coordinator for QANU and acted as secretary during the site visit.

WORKING METHOD OF THE ASSESSMENT PANEL

On 9 March 2017, a panel visited the master's programme Military Technology Processes and Systems (MTPS) of the Netherlands Defence Academy for an initial accreditation assessment within the NVAO Assessment framework for extensive initial accreditations 2014. The NVAO issued a positive decision on the Netherlands Defence Academy's application for an initial accreditation of the master's programme MTPS (5 April 2017, NVAO/20171283/ND). According to this decision, a supplementary assessment has to take place after three years on the following aspects: *A. The realised level, in perspective with what is internationally desirably and acceptable* (corresponding to Standard 12 of the NVAO Assessment framework for extensive initial accreditations 2014), and *B. Soundness of the assessment, testing and examination of the student work* (corresponding to Standard 10 of the NVAO Assessment framework for extensive initial accreditations 2014).

Therefore, a new assessment panel was created, including most members of the initial assessment panel from 2017. Prof. L. van der Sluis, Prof. E. Barendsen, Dr K. Eneman and Colonel R. Vlasselaer were involved in the initial assessment of the master's programme. The new panel visited the site on 16 September 2019. This report describes its findings and considerations regarding these standards. On behalf of the Netherlands Defence Academy, the quality assurance agency QANU was responsible for logistical support, panel guidance and production of the report.

Preparation

On 4 September 2019, the panel chair was briefed by QANU on his role, the assessment framework, the working method, and the planning of site visits and reports. The other panel members were also briefed in advance. The procedure to assess the particular standards for this supplementary assessment was discussed with the chair and the panel members with assessment expertise.

A preparatory panel meeting was organised on 15 September 2019. During this meeting, the panel members discussed the way in which they would use the standards in the assessment framework. They also discussed their working method and the planning of the site visit and report. The secretary composed a schedule for the site visit in consultation with the programme management. Prior to the site visit, the programme management selected representative partners for the various interviews. See Appendix 3 for the final schedule.

Before the site visit to the Faculty of Military Sciences of the Netherlands Defence Academy in Den Helder, QANU received the self-evaluation report of the programme, a selection of course examinations taken by the students and the respective course outlines, and forwarded them to the panel. After studying the self-evaluation report, examinations, course outlines and assessments, the panel members formulated their preliminary findings. The secretary collected all initial questions and remarks and distributed them among the panel members at the preparatory meeting. Prior to the site visit, the panel discussed its initial findings on the self-evaluation report and the selected examinations, as well as the division of tasks during the site visit.

Site visit

The site visit to the Faculty of Military Sciences of the Netherlands Defence Academy took place on 16 September 2019. Before and during the site visit, the panel studied the additional documents provided by the programme. An overview of this material can be found in Appendix 4. The panel studied course work of the programme during a separate programme slot; two computers linked to the secure intranet were available during the day, and the panel looked at the different course files, course material, and exam questions, results and rubrics. It examined different courses, and its members discussed their findings collectively. It conducted interviews with representatives of the programme: students (including one alumnus of the programme), staff members, the programme management, and representatives of the Board of Examiners. It also offered students and staff members an opportunity for a confidential discussion during a consultation hour. No requests for private consultation were received. The panel used the final part of the site visit to discuss its findings

in an internal meeting. Afterwards, the panel chair publicly presented the preliminary findings and general observations.

Report

After the site visit, the secretary wrote a draft report based on the panel's findings and submitted it to a colleague for peer assessment. Subsequently, he distributed the preliminary report to the panel members. After processing the panel members' feedback, he sent the draft report to the programme management in order to have it checked for factual irregularities. He discussed the ensuing comments with the panel's chair, and changes were implemented accordingly. The report was then finalised and sent to the Faculty of Military Sciences and Board of the Netherlands Defence Academy.

Definition of judgements standards

In accordance with the NVAO's Assessment framework for extensive initial accreditations 2014, and after deliberation with the NVAO bureau, the panel used the following definitions for the assessment of Standards 10 and 12:

Generic quality

The quality that can reasonably be expected in an international perspective from a higher education bachelor's or master's programme.

Meets the standard

The programme meets the generic quality standard.

Partially meets the standard

The programme meets the generic quality standard to a significant extent, but improvements are required in order to fully meet the standard (see Additional assessment rules regarding conditions).

Does not meet the standard

The programme does not meet the generic quality standard.

In accordance with the NVAO's Assessment framework for extensive initial accreditations 2014, and after deliberation with the NVAO bureau, the panel formulated a general conclusion regarding the programme.

The assessment panel answers the question of whether the programme meets the quality that, from an international point of view, can reasonably be expected from a higher education bachelor's or master's programme.

Judgement: Positive, negative or conditionally positive (weighted and substantiated)





SUMMARY JUDGEMENT

The programme monitors the students' development during the courses with formative interim tests and presentations, which the panel applauds as a good way to assess their knowledge development and to ensure that they stay on course to achieve the learning goals of the subjects and the ILOs. The assignments are of an adequate level for the students.

The students get sufficient feedback on assignments and exams, both in a personal setting and by discussion or plenary feedback of results, enabling peer learning. The teachers are open to input and feedback regarding course assessment.

The BoE monitors the quality of the examiners and reflects on the examinations, together with the programme board and the lecturers. The peer-review principle is used for establishing exams and reviewing the theses.

The panel advises the programme to make it transparent which body (the BoE or the programme management) is responsible for resolving issues like the occasional absence of documentation of interim tests, or ensuring an even spread of interim tests and assignments during the study period. The BoE has established an assessment matrix, but the panel advises incorporating preliminary assessments in this matrix, to structurally avoid stacking of assignments. It advises implementing a clear policy for systematically using plagiarism software when checking assignments.

The panel is positive about the diligent way the BoE formally safeguards the fit of the thesis proposal with the MTPS programme. It would like to compliment the programme on a well-constructed thesis rubric, which enables a transparent and reliable way of assessment.

With the above pointers in mind, the panel would like to compliment the BoE on very adequately addressing the points the earlier panel made in the previous initial accreditation of the programme with the implementation of a well-designed thesis rubric and by strengthening its proactive role in safeguarding that the assessment system functions adequately.

The panel obtained a more or less complete and clear picture of the achieved level of education. It assessed that, as a whole, the subjects of the programme tie in with the intended learning outcomes (ILOs). Based on the quality of the thesis, the studied course work and exams, and the interview with the alumnus, the panel concludes that graduates of the master's programme MTPS acquire the ILOs and are sufficiently skilled to work in the field of military technology, processes and systems, in both an academic and professional setting. The studied master's thesis is of a sufficient level.

To further safeguard the scientific level of the theses, the panel would like to suggest that the relatively implicit conditions for the scientific level of the thesis are described more explicitly in the thesis guide and rubrics. It concludes that the subjects and exams studied are on the level of what can be internationally expected for students of a master in Military Technology, Processes and Systems. It assesses that the students have obtained a sufficient level that, taking into account the parts of the programme that still have to be completed, should enable them to reach the required final level and sufficiently achieve the programme's ILOs.



The panel assesses standards 10 and 12 stemming from the NVAO decision (5 April 2017, NVAO/20171283/ND) and in accordance with the *Assessment framework for extensive initial accreditations 2014* in the following way:

Master of Science in Military Technology, Processes and Systems

Standard 10: Assessment	Meets the standard
Standard 12: Achieved learning outcomes	Meets the standard
General conclusion	Positive

The panel's chair, Prof. L. van der Sluis, and secretary, Dr M. Hollestelle, hereby declare that all panel members have studied this report and that they agree with the judgements laid down in it. They confirm that the assessment has been conducted in accordance with the demands relating to independence.

Date: 23 November 2019

DESCRIPTION OF THE STANDARDS FROM THE ASSESSMENT FRAMEWORK FOR EXTENSIVE FRAMEWORK ASSESSMENTS

ABOUT THE PROGRAMME

The Master's programme in Military Technology, Processes & Systems (MTPS)

The academic Master's degree programme MTPS is concerned with understanding, analysing, explaining and improving the military dimension of complex systems and processes. MTPS continues where the Netherlands Defence Academy (NLDA) military academic bachelor's programme MS&T ends but is also open to students from other bachelor's programmes, including those from other institutions. A prerequisite for students is that they have gained sufficient experience during several years of active service in the professional field. To enable active defence professionals to enter the programme, education is provided in a 2-year part-time programme of 60 EC, with a face-to-face:self-study ratio of 1:4. The programme's goal is to equip graduates for positions in the military organisation that require more in-depth knowledge and analysing capabilities at a higher level, for example posts like engineer, project manager and weapons system manager.

MTPS welcomes students with experience and knowledge of the challenges one faces in the real military world and who are able to add this professional experience to their academic bachelor education in their commitment to solving real military problems. It focusses on the military technological perspective on the design, implementation and use of defence systems. These systems have to operate in complex, network-enabled, constantly changing environments. The programme provides the students with quantitative skills, using simulation and modelling for current and near future problems in these missions and the corresponding support. This requires deeper knowledge and investigation into a range of military technological processes and systems. It is precisely this broad military perspective that defines the unique basis of MTPS.

The curriculum of MTPS addresses the following topics:

- Cyber awareness
- Unmanned and autonomous systems
- Systems engineering
- System analysis and modelling
- Structured data analysis
- Optimisation of military operations
- Life Cycle Management, Life Cycle Costs
- Reliability engineering, material behaviour and predictive maintenance
- Spare parts and inventory management
- Simulation of platform, sensor, weapon, C2 and communication systems
- Cyber threat simulation

The Programme Board is responsible for the quality of the programme and manages the programme organisation and the overall programme cohesion. It consists of four members, including a chairman, representative of the Section Education, the programme coordinator and a student member.

All students are provided with a mentor. Mentors are members of the MTPS teaching staff and can be chosen by the students during their enrolment. Mentors offer study guidance, counselling and study advice (work-family-study balance). For additional support, remedial and extracurricular training, the NLDA Section Education offers help and may transfer students to external professionals at the faculty's expense.

The curriculum core

The first part of the programme is shaped by a core of five compulsory courses taken by all students, worth 25 EC. The second part of the programme consists of a track worth 15 EC. The students can choose between two tracks, aligning with the major research themes of the Faculty of Military



Sciences. The programme is completed with a 20 EC thesis. The language of instruction and assessment is English, but regular classes during courses are taught in Dutch when both the students and the teacher are fluent in the Dutch language.

The compulsory first part consists of the courses *Advanced Technologies in Warfare (ATW)*, *Modelling and Simulation part 1 (M&S)*, *Systems Engineering Principles (SEP)*, *Life Cycle Management (LCM)*, *Command & Control (C&C)*, and *Modelling and Simulation part 2 (M&S)*. The increasing importance of unmanned systems and cyber aspects are the main topics in the *Advanced Technologies in Warfare (ATW)* course. This creates an important part of the necessary mind-set of the students. In parallel, they begin to study *Modelling and Simulation (M&S)*, also a subject of increasing importance. Then *Systems Engineering Principles (SEP)* and *Life Cycle Management (LCM)* provide another part of the necessary academic basis for the each of the tracks. Finally, regarding the core, *Command and Control (C&C)* and the 2nd part of *Modelling and Simulation* ensure that the students will be able to apply modelling, simulation and programming skills in an operational setting at an advanced level in both tracks.

The Processes track courses

The focus of this track is operational *effectiveness* and *sustainment* of military force. The *Optimal Deployment (ODT)* course puts effectiveness of military force into practice by making connections to current research and operational problem-solving. The *Sustainment of Military Systems (SMS)* course strongly applies a research approach to operational deployability (maintenance) matters. The final Processes track course, *Topics in Logistics, Maintenance and Operations Research (TLMOR)*, challenges students to reflect on recent themes from both an effectiveness and a sustainment point of view.

The Systems track courses

The Systems track contains three courses elaborating on the SEP course. In the *System Modelling and Integration (SMI)* course, the students familiarise themselves with modelling and simulating the integration of military systems of interest. In the *Military System Specialisation (MSS)* course, they enter more deeply into the architecture and the outcomes of the chosen system. The final Systems track course, *System In Context (SIC)*, considers the system(s) under consideration in the wider context such as enemy systems, cyber threats, weather influences and budgetary considerations.

The thesis

A 20 EC thesis (TSS) including a final presentation integrates all of the acquired knowledge and skills. It is based on the acquired track-linked knowledge. It aims to conduct research for a problem that the student has chosen ('bring your own problem'), related to either his or her own work environment or one of the existing MTS research programmes. It completes the programme. The panel of the initial accreditation found the choice not to include social sciences methodology in the thesis phase a convincing and legitimate one, and encouraged the programme to make this choice more explicit. The current panel observed (in the self-evaluation, but also by speaking with teachers and the programme management) that while the programme at times touches upon subjects that could benefit from a social sciences approach, and thus could make use of social sciences methodology, the focus is clearly on technology, and the programme requires students to bring in technological problems. This is made clear in the study guide and the respective course guides, and is also communicated to the students during the introduction at the start of the programme.

Each Friday, students travel to Den Helder to attend lectures in the morning and work actively on assignments in the afternoon. During these days, topics like the relationship with their supervisor at work, the work-study balance and their private life are addressed during class. Students indicated that attending class every Friday, and having Saturday and Sunday available for self-study, is rather pleasant. They stated that an extra day per week available for self-study could significantly increase the feasibility of the study. If modules of 1-2 weeks of class were to be given, this would be hard to combine with their jobs. The number of contact hours and the hours necessary for self-study are roughly 3:5 for each course.

Because the entire master and each individual course within the master were new, each course was evaluated by the NLDA education section. Each evaluation has been discussed by the programme board and reported to the faculty board. Course evaluations were discussed with the entire team of lecturers in evaluation meetings organised after completing the core courses and at the end of the curriculum. The programme holds a strategic deliberation with the management of the NLDA once every three months in order to define which developments in the field could influence the topics or the design of the programme. The panel is pleased to see a regular evaluation and discussion of the programme with staff, the faculty and the NLDA management, which helps to keep the Intended Learning Outcomes (ILOs) up to date. To take the process of securing the ILOs and the programme in a rapidly evolving international setting to the next level, it suggests investing in international benchmarking with other similar programmes as planned.

As a result of the evaluations and student feedback, the curriculum has been adapted. The programme management explained to the panel that the main adaptation is to discontinue the Data Analysis (DA) part of the core course Modelling, Simulation and Data Analysis (5 EC). The study load required for Data Analysis turned out to be too high, and the connection with other courses was rather limited. It was ascertained that the knowledge of data analysis required in the Life Cycle Modelling course (LCM) can easily be learned within this course. The panel agrees with the programme management that the effort required for the Modelling and Simulation course is now better represented by the number of ECs, with some additional time taken to reflect on the results of the simulation. The Modelling and Simulation course has been positioned partly at the end of the core programme, to provide students with some of the basic skills required for Systems Engineering (SE). The knowledge gained in the core courses can now be used in the Modelling and Simulation course.

Teachers became aware of the rising prominence of ethics within the field of military sciences, and opted to address the ethical aspects of technology more substantially in the Advanced Technologies in Warfare course (ATW), also reflecting more in depth on the research methods and techniques used. The panel agrees with the programme that the ATW course provides the best possibility to include these subjects, which are in need of attention in a master's programme, especially in a programme aiming to further educate students from 'thinking soldier' to 'officer scholar'.

The panel, after speaking with the programme management, teachers and students of the programme, is convinced that the programme has made sound and well-argued choices in fine-tuning the programme in this way, taking into account the advice the previous panel gave at the initial accreditation, especially regarding the ATW course.

Student influx

The programme initially started with ten students. From this group, one student has finished the master's programme on schedule. Two other students were sent abroad on a military mission after completing the track-specific courses but before finishing their thesis, and put their study on hold for the duration of the mission. They are expected to finish within the two years' part-time study duration, taking into account their mission period. Two students experienced a delay in completing their thesis, mainly because direct implementation of their findings in daily practice required more effort than was expected. Five students resigned from the programme. Exit interviews with them indicated that they quit mainly because it proved to be difficult to combine a demanding job with this study. One student's previous education, in combination with a relatively long time period without studying, appeared to be a mismatch.

The programme is implementing action to improve the retention of students. Based on the results of the pilot group of ten students, a pre-master course was created for potential students (online courses combined with regular contact with a teacher). This pre-master is compulsory for bachelor students from universities of applied science, and voluntary for students enrolling the programme with a technical academic bachelor. For each course, prerequisites are given for potential students. Also, prior to enrolling in the programme, students must ensure that the work environment is



committed to their study by means of a form signed by their commanding officer. The panel applauds this but would like to advise seeking a means to raise the awareness of the added value of this study at the line director level to increase the credibility and application of the study in the future. It would also like to suggest that the programme ensures sufficient guidance of the students to enhance the number who complete the programme. It is positive about these actions, because it feels that this will better harmonise the fit between the profile of the potential students, their work environment and the programme itself.

Standard 10: Assessment

The programme has an adequate assessment system in place.

Findings

The panel reviewed the course outlines that are used for each course, which describe the goal and content, the requirements to pass a test, and the types of assessment that will take place. In reviewing them, it clearly perceived a link between the exam contents and the learning outcomes. The programme monitors the students' development during the courses with formative and summative interim tests and presentations, plus less 'classical' written tests at the end of each course. The panel found these assignments to be of a good level for the students. It compliments the programme on this way of assessing the course results because they are in line with the nature of this programme (a two-year, part-time academic master aiming at military professionals in service). Given the limited number of students, it suggests that the programme consider whether oral examinations could form a larger part of the assessment format. This combines in-depth examining with reducing the teaching staff's workload. This is sometimes done when students resit an exam, usually one period later than the course in question.

The students indicated that they sometimes considered the workload (number of assignments) too high. When this became apparent to the teachers and programme management, they took action to spread the assignments out better over time. As a result, in the year-planning, courses are now separated by a gap, enabling the students to finish their assignments before starting a new course. The students confirmed to the panel that they feel the programme management does listen to them, and they appreciate the actions taken to level out the workload. For the ATW course, they indicated that the number of computer programming languages they had to learn in a limited time period was too high. In the next phase, the number of programming languages was reduced.

The students confirmed that they get sufficient feedback on assignments and exams. For instance, during the M&S course, the assignments are discussed with the teachers, who give plenary feedback to enable the students to learn from each other. In a course like TLMOR, the students give presentations, for instance on articles they read, to collectively assess and learn how to read and interpret the scientific literature.

The programme requires its teaching staff to have a University Teaching Qualification (UTQ). Exams are always peer-reviewed by another staff member as part of the design process. Students and teachers alike indicated to the panel that due to the small scale of the programme, the connection between teachers and students is tight. The teachers are open to input and feedback regarding the content or assessment of their courses. The students stated that the staff has good teaching competence. For each course, they fill in an evaluation form. The Education Committee, students and the Board of Examiners (BoE) review these forms. The Board of Education takes appropriate measures, when necessary. The panel was positive about the application of the peer-review ('four-eye') principle in creating exams.

The panel was pleased to ascertain the validity and transparency of assessment, which is on a level that is to be expected of an academic master's programme.

The panel found that the programme monitors the development of the students during the courses with formative and summative interim tests and presentations, plus less 'classical' written tests at the end of each course. It is in favour of this and therefore feels that this enables the programme to monitor the achieved level of the students throughout the programme, instead of testing the achieved level solely at the completion of the curriculum. This is a good way to assess the knowledge development and to ensure that the students stay on schedule to achieve the learning goals of the subjects and the ILOs.

The Board of Examiners (BoE)

The Board of Examiners (BoE) is responsible for the quality of the examinations, for the assessment procedure and for judging the admissibility of applicants. It consists of three members, including an external member with extensive knowledge of the working environment for which the master is intended who is well acquainted with the bachelor's programme and with the quality standards of the institute. The panel is pleased with the contribution of this external member to the BoE, but the programme could explore the possibility of attracting an external member from outside the NLDA. The BoE has established rules and guidelines. They are published in the Teaching and Examination Regulations MTPS 2019-2020. The BoE checks the quality of the examiners and provides a list of qualified examiners. It has the right to remove teaching staff from the list of examiners if it is convinced that the quality of their assessments does not meet the standard. Prior to assessing a course, the teachers hand in an assessment matrix to the BoE, to be verified for alignment with the course goals and the ILOs. The BoE also advises the Board of Education on accepting students. Care is taken to check if students from an older variant of an NLDA bachelor's programme, or from older KIM or KMA programmes, fit the master MTPS. It also checks the thesis proposals.

The BoE regularly reflects on the assessment within the programme, together with the team of lecturers. Every six months, the programme board and the BoE jointly organise a review session with all lecturers of the programme. In this meeting, the course evaluations are discussed, and all exams taken (and their results) are presented by the responsible lecturer. The team of lecturers then reflects on these examinations and discusses possible changes in the examination method. This meeting aims to safeguard a shared vision on the desired level and standards of the courses and the examinations for this new programme.

The joint review sessions of course evaluations and exams by teachers and the BoE is a strong asset of the programme, according to the panel. During these sessions, course files are evaluated. It came to the attention of the BoE that some of these files were incomplete. The BoE addressed this issue, but the panel still observed an occasional absence of documentation of interim tests in the course files. While speaking with the programme management and the BoE, it concluded that it was not completely clear who is ultimately responsible for ensuring that issues resulting from the review sessions will be addressed. Having a completely clear overview of the responsibilities helps to ensure that all interim tests are documented, and it could also help to ensure a structural solution for spreading the interim tests and assignments more equally over the study period. The BoE could take monitoring of tests to the next level by incorporating a regular (e.g. every six months) individual review of courses and examinations.

The BoE has established assessment matrices in which the periods for all assessments for each course are given. The preliminary assessments and assignments could also be incorporated in a general course matrix. The panel considers it preferable to monitor the overall assessment and assignment load, so stacking assignments (as experienced previously) can be structurally avoided. It advises the BoE to implement a clear policy for systematically using plagiarism software when checking assignments. With these pointers in mind, it would like to compliment the BoE for very adequately addressing the remarks the earlier panel made in the previous initial accreditation of the programme with the implementation of a well-designed thesis rubric (see below) and its proactive role in safeguarding the adequate functioning of the assessment system.



Thesis assessment

A 20 EC thesis (TSS) including a final presentation integrates all acquired knowledge and skills. It continues with the acquired track-linked knowledge. It is aimed at researching a problem that the student has chosen, coming either from his own job or from one of the existing MTS research programmes. The students are required to give an oral defence of their thesis. The thesis concludes the programme.

The students are able to choose their own thesis coordinator, to align with the domain of the thesis. The thesis proposal is prepared by the student. He or she discusses the topic with his or her preferred supervisor, who is a lecturer of the programme. The supervisor checks whether the proposal concerns a technical question (assesses how the topic is related to the state-of-the-art of the technological environment) and if the topic is feasible and realistic. If the lecturer and the student agree, the BoE checks in a more generic way whether the thesis proposal fits the goals of the programme as described in the ILOs. The panel is positive about this diligent way to safeguard the fit of the thesis proposal with the MTPS programme.

The programme has developed rubrics to guide the thesis examiners in their grading and to give students insight into how their work will be assessed. The rubrics are included in the thesis guide provided to students at the start of their thesis. The NLDA Section Education currently develops the examination design and evaluation in more depth, including examination using rubrics. All results are discussed with the programme board. When the five remaining students from the pilot group have finalised their theses and obtained their grade, the programme will evaluate how members of the teaching staff and external members of the individual thesis committees used the rubrics to determine the final grade. The panel studied the thesis rubric and its use in assessing the first available thesis, and would like to compliment the programme on a well-constructed thesis rubric, which enables a transparent and reliable way of assessment. It was positive about the application of the peer-review ('four-eye') principle in reviewing the theses.

Considerations

The programme monitors the students' development during the courses with formative interim tests and presentations, which the panel applauds as a good way to assess their knowledge development and to ensure that they stay on course to achieve the learning goals of the subjects and the ILOs. The assignments are of an adequate level for the students.

The students get sufficient feedback on assignments and exams, both in a personal setting and by discussion or plenary feedback of results, enabling peer learning. The teachers are open to input and feedback regarding course assessment.

The BoE monitors the quality of the examiners and reflects on the examinations, together with the programme board and the lecturers. The peer-review principle is used for establishing exams and reviewing the theses.

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With the above pointers in mind, the panel would like to compliment the BoE on very adequately addressing the points the earlier panel made in the previous initial accreditation of the programme



with the implementation of a well-designed thesis rubric and by strengthening its proactive role in safeguarding that the assessment system functions adequately.

Conclusion

Master's programme Military Technology, Processes and Systems: the panel assesses Standard 10 as 'meets the standard.'

Standard 12: Achieved learning outcomes

The programme demonstrates that the intended learning outcomes are achieved.

Findings

In August 2017 the master Military Technology, Processes & Systems started with a pilot group of ten students. At the time of the site visit, one student had completed the master on schedule, so one thesis was available to assess the final attainment levels. Therefore, in order to assess the level achieved by the master students, the panel examined the course work of the ten students who had started the programme. It studied completed exams that covered all courses from the programme. Because all of the courses were new, the programme evaluated at the end of each course how far they indeed related to the different ILOs. The panel assessed that, as a whole, the subjects of the programme tie in with the ILOs of the programme, as shown in Appendix 1.

Monitoring achieved learning outcomes

The programme uses different ways to monitor that students achieved the ILOs. The panel was especially interested in how teachers guide their students through the study material, which it thinks is an important topic for a part-time programme with only limited contact hours, and the way testing contributes to assessing that the ILOs are achieved. At its request, the panel was shown some of the introductory slides to the subjects Cyberthreats, Advanced Technologies in Warfare, Sustainment of Military Systems, and Life Cycle Management. Because of the rapidly evolving field of knowledge, and the vast amount of literature to be studied during the programme, the panel was curious about how the teachers select and introduce certain topics to the students. By studying the slides, reading the available course material, and talking with teachers and students, it came to the conclusion that the teachers have a firm grasp on the content material and how to introduce it. They are able to guide the students through the study material.

The panel studied the first finalised thesis of the programme, which it found to be of good quality, scientifically sound, and clearly on the level that can be expected from an academic master's programme. It clearly showed that the student had achieved the ILOs. The programme upholds a 'Bring Your Own Problem' philosophy, in which students are required to select a topic for their thesis from their own work experience. This clearly links the programme to the actual military field, which the panel thinks is a strong asset of the programme. The programme management ensures that the topics presented are not too practical. The theses should focus on a technical problem, taking into account the state of the art in, for instance, Artificial Intelligence, connecting and focussing on an academic question in this way. In speaking to the teaching staff, the BoE, programme management and students, the panel acknowledged the relatively implicit conditions for the scientific level of the thesis.

The scientific level is assessed by the teachers and the BoE, but to further safeguard it structurally and more transparently, the panel recommends documenting these conditions explicitly in the thesis guide and rubrics. The students and the alumnus indicated that the programme adds a much sought reflection on the daily practice. They feel that the programme truly equips students for working with the latest operational-technical concepts and challenges within a knowledge-intensive, technology-driven defence environment. They feel they are equipped to critically address issues from a research-based perspective, and collaborate with military and civilian professionals in an interdisciplinary (international) context. Studying the course work and the assessments of the courses further strengthened the panel in its conviction that the programme enables students to achieve the ILOs.



Considerations

The panel obtained a more or less complete and clear picture of the achieved level of education. It assessed that, as a whole, the subjects of the programme tie in with the intended learning outcomes (ILOs). Based on the quality of the thesis, the studied course work and exams, and the interview with the alumnus, the panel concludes that graduates of the master's programme MTPS acquire the ILOs and are sufficiently skilled to work in the field of military technology, processes and systems, in both an academic and professional setting. The studied master's thesis is of a sufficient level. To further safeguard the scientific level of the theses, the panel would like to suggest that the relatively implicit conditions for the scientific level of the thesis are described more explicitly in the thesis guide and rubrics. It concludes that the subjects and exams studied are on the level of what can be internationally expected for students of a master in Military Technology, Processes and Systems. It assesses that the students have obtained a sufficient level that, taking into account the parts of the programme that still have to be completed, should enable them to reach the required final level and sufficiently achieve the programme's ILOs.

Conclusion

Master's programme Military Technology, Processes and Systems: the panel assesses Standard 12 as 'meets the standard'.

GENERAL CONCLUSION

The panel assesses Standard 10 as 'meets the standard' and Standard 12 as 'meets the standard'.

According to the decision rules of NVAO's Assessment framework for extensive initial accreditations, the panel assesses the *Master's programme Military Technology, Processes and Systems (MTPS)* as 'positive'.

APPENDICES



APPENDIX 1: INTENDED LEARNING OUTCOMES

Each MTPS graduate:

1. has insight into the most important military operational-technical developments and scientific results including its relationship with other areas;
2. has the ability to apply this insight in the military operational-technical field;
3. is able to describe and explain the complexities and possibilities of operational-technical processes and systems in a military environment;
4. is able to apply modelling, simulation and decision support techniques that are used for understanding and problem solving in the field of study;
5. is able to describe and explain the complexities and possibilities of techniques for system engineering in the field of study;
6. is able to describe and explain the complexities and possibilities of techniques for optimising maintenance and logistics of military systems;
7. is able to systematically analyse and critically assess data;
8. communicates effectively about his own academic work in the English language, to both professionals and non-specialists, including presentations and reports;
9. is able to work both independently and in multidisciplinary teams, interacting effectively with specialists and taking initiatives where necessary;
10. demonstrates a professional attitude towards evaluating existing knowledge, acquiring and integrating new expertise, research and towards changing circumstances with an understanding of its incompleteness, ambiguities, limitations and ethical implications;
11. is aware of the importance of life-long learning in order to maintain his recently gained professional qualifications.

In addition to qualifications 1-11 and having followed the Processes track, the MTPS graduate:

- 12a. has technical knowledge and capabilities that enable the graduate to build new models and to expand existing models for problem solving in operations research, logistics and maintenance;
- 13a. is able to conduct research related to military operational-technical processes;
- 14a. is able to explain the influences of changing parameters on the model outcomes in the field of study;
- 15a. is able to assume management positions related to the materiel-logistic support of military systems.

In addition to qualifications 1-11 and having followed the Systems track, the MTPS graduate:

- 12b. has technical knowledge and capabilities to conduct integrated simulations of platform, sensor, weapon, C2 and communication systems;
- 13b. is able to conduct research related to the integration of military systems;
- 14b. is able to explain the influences of changing circumstances and cyber threats on the system's performance and effectiveness;
- 15b. is able to assume management positions related to technical integration for new and existing military equipment.



APPENDIX 2: OVERVIEW OF THE CURRICULUM

EC	Processes track	Systems track
5	Advanced Technologies in Warfare (ATW)	
1	Modelling and Simulation (M&S)	
5	Systems Engineering Principles (SEP)	
5	Life Cycle Management (LCM)	
5	Command & Control (C&C)	
4	Modelling and Simulation (M&S)	
5	Optimal Deployment (ODT)	System Modelling and Integration (SMI)
5	Sustainment of Military Systems (SMS)	Military System Specialisation (MSS)
5	Topics in Logistics, Maintenance and Operations Research (TLMOR)	System In Context (SIC)
20	Thesis (TSS)	
60		

APPENDIX 3: PROGRAMME OF THE SITE VISIT

16 september 2019, Complex Koninklijk Instituut voor de Marine (KIM) in Den Helder

08.30 – 09.00	Aankomst en welkom
09.00 – 10.00	Intern overleg
10.00 – 10.45	Interview inhoudelijk verantwoordelijken
10.45 – 11.30	Interview studenten, alumni
11.30 – 11.45	Uitloop/intern overleg
11.45 – 12.30	Interview docenten
12.30 – 14.00	Lunch / inloopspreekuur + leestijd toetsmateriaal
14.00 – 14.45	Interview examencommissie
14.45 – 15.00	Uitloop/intern overleg
15.00 – 15.30	Interview formeel verantwoordelijken
15.30 – 16.30	Opstellen oordelen
16.30 – 16.45	Mondelinge terugkoppeling
16.45 – 17.30	Ontwikkelgesprek



APPENDIX 4: DOCUMENTS STUDIED BY THE PANEL

During the site visit, the panel studied, among other things, the following documents (partly as hard copies, partly electronically):

Course outline and course material for:

- Advanced Technologies in Warfare
- Life Cycle Management
- Systems Engineering Principles
- Sustainment of military Systems
- Optimal Deployment
- System in Context
- Topics in Logistics, Maintenance, & Operations Research
- Military System Specialisation
- Modelling and Simulation
- Command & Control
- Systems Modelling & Integration

Slides for courses:

- Cyberthreats
- Advanced Technologies in Warfare
- Sustainment of Military Systems
- Life Cycle Management

Furthermore, the panel accessed the course material and completed assessments and assessment forms for all MTPS courses and the finalised thesis in a secure NLDA environment on site.

-Self Evaluation MTPS

-Information File MTPS November 2016

-Panel report wo-master Military Technology, Processes and Systems (MTPS), Faculty of Military Science, Netherlands Defence Academy, 5 april 2017

-NVAO accreditatiebesluit 31 mei 2017

-Study Guide MTPS 2019-2020

-Education Quality Manual, Faculty Military Sciences, NLDA, May 2016

-Teaching and Examination Regulations MTPS 2019-2020

-Jaarverslag 2017-2018 Examencommissie MTPS

-MTPS Evaluation Policy, 10 July 2019, NLDA Section Education

-MTPS Guide for Master's Thesis, 2019-2020

-Studenttevredenheidsonderzoek MTPS 14 augustus 2019

-2017-2019 student evaluation MTPS

-Loket studentbegeleiding Sectie Onderwijs Den Helder

-Personnel involved in MTPS

-Pre-master exit qualifications

-Questions and answers pre-master subjects on: Linear Algebra, Calculus, Electricity and Magnetism, Probability and Statistics, Signals and Systems