

Competency-Based Training and Grading for the RNLAf Fighter Controllers

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ABSTRACT

The Fighter Controller training staff of the Royal Netherlands Air Force (RNLAf) regularly seeks to improve training to enhance the transfer of training to the operational environment and to reduce attrition of students. Recently the Fighter Controller training has been redefined using a competency perspective. The competency-based approach, as tailored for the RNLAf, ensures that the competencies identified are consistent to the Four Component Instructional Design (4C/ID) model. This approach provides a hierarchic model of competencies and skills, enabling a close relation to training design decisions, including performance assessment and grading. The paper will describe and discuss the competency analysis, the method, the results and its practical applicability.

ABOUT THE AUTHORS

Jelke van der Pal (1963) has earned a Ph.D. in 1995 (Educational Science and Technology, University of Twente, NL) and is Senior Scientist at the National Aerospace Laboratory NLR of the Netherlands. Since 1996 he is active in the aviation training R&D, which includes training analysis for the NH90, for the proposed pan-European military pilot school (Eurotraining), and for NATO-level networked simulator mission training. He has also performed simulator motion effectiveness studies for airlines and military applications. Finally, Van der Pal has coordinated the European ADAPT-IT project, producing training design tool that provides competency-based support for several phases of the ISD cycle.

Berber Nicolai (1978) received her Masters degree in Social Psychology in 2004 (Free University, Amsterdam, NL) and has been active as a trainer/coach for airline personnel. Her current position is R&D Engineer at the National Aerospace Laboratory NLR, Netherlands, working on military training projects including task-and competency analysis and development and checking of (training) operation manuals.

Roman van Rooijen has been serving the Royal Netherlands Air Force since 1997. He became a Fully Combat Ready Fighter Controller in 1998 and was assigned to the Training School shortly after. He gained international experience at the NATO E3A AWACS at Geilenkirchen, Germany, where he worked as a Fighter Controller and Fighter Allocator. At the moment Roman van Rooijen is the Head of the Training School for Fighter Control. Van Rooijen is working towards a Bachelor of Education degree on the Training and Human Development subject.

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INTRODUCTION

Training institutes nowadays recognize the relevance of competency-based training and develop competency profiles to ensure their training is focused to the needs of the actual job. Since 2006, middle and higher level vocational schools in The Netherlands by law educate students in line with competency profiles. More than 7000 profiles have been developed and are now used in an experimental phase until 2008. For military education in The Netherlands, there is a tendency to adapt to civil regulations and accreditation.

The Fighter Controller education of the Royal Netherlands Air Force (RNLAF) has a long record of absorbing new instructional principles. With few candidates available and a limited number of student positions per year, the Fighter Controller (FC) training department can neither allow high student attrition nor lower the standards. While the FC training program, by nature, always had an implicit competency-oriented approach, no formal profile was defined. A first competency profile was developed in 2005. While not necessarily incorrect, the FC instructors were not able to use the rather abstract competencies for improvements to the syllabi or to grading.

The problem these instructors are facing is not unique. Many teachers and instructors, even those embracing a competency-based training approach and accepting the developed competency profile, have no means or guidance to link the profile to a concrete syllabus or lesson plan.

The challenges of competency-based training are 1) to define profiles that are fully accepted and understood by both operators and instructors, and 2) to ensure that elements of the profile can be used easily for training design improvements, in particular for dealing with current training issues.

This paper describes the NLR¹ approach to competency-based training as tailored for the fighter

controllers of the RNLAF and its application to the FC training.

NLR COMPETENCY-BASED TRAINING APPROACH

The competency-based training approach as worked out by NLR is based upon a designer oriented version of the four component instructional design (4C/ID) model of Van Merriënboer (1997) named ADAPT^{IT} (Van der Pal, 2003). The 4C/ID model delivers a hierarchic set of skills, where the higher levels represent integrated skills sets of the lower level, more elementary skills. In ADAPT^{IT}, the analysis of the integration of skills into operationally relevant skills is complemented by analyzing job conditions of varying complexity while the operational performance standards are met.

Ideally, the hierarchy represents the integration of skills in psychologically valid constructs and such that the learning process behind the integration is visualized. This ideal cannot yet be reached using scientific data only. Knowledge about competencies and integration aspects has to be gathered from the operational work force, preferably by means of consulting the more experienced and reflective representatives.

The NLR competency model (Abma & Van Bavelgem, 2004) includes knowledge, skills, attitudes and the ability to integrate them while performing under operational conditions and standards (see Figure 1). The skill or complex of skills is the core of the competency. In this model an attitude or knowledge does not constitute a competency on its own.

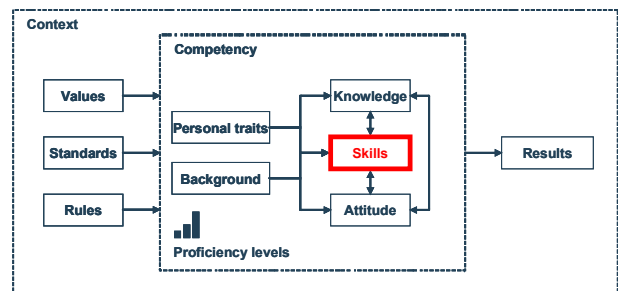


Figure 1. NLR competency model

¹ NLR = Nationaal Lucht- en Ruimtevaartlaboratorium (Dutch National Aerospace Laboratory).

The combination of analyzing the integration of skills and identifying the operational conditions, in which the skills are used, enables a structured approach to identify and define competencies. (See Figure 2).

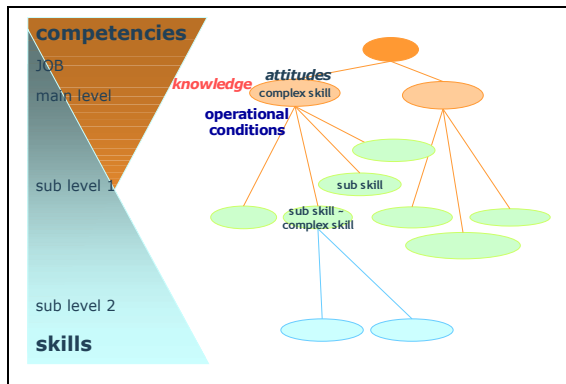


Figure 2. ADAPT™ competency profile

The ADAPT™ method was lacking guidance to acquire the necessary operational knowledge with regards to the required skills, know-how, attitudes, competencies, and operational conditions of the job to be trained for. The ADAPT™ method has been enhanced by a tailored knowledge elicitation approach that is inspired by scenario based design approaches (Carroll, 1995) and the MEC approach (Colegrove & Alliger, 2002). The combination of ADAPT™ and the elicitation of operational knowledge forms the NLR competency-based training approach. The enhanced approach has been applied earlier for the proposed pan-European pilot school Eurotraining (Van der Pal & Ligthart, 2003).

Where useful, the NLR competency-based approach is complemented by well-known techniques like a DIF (Difficulty, Importance, Frequency) analysis or a proficiency analysis. Taken all techniques together, the NLR competency approach describes KSAs and competencies specifically, tangibly and as far as possible in terms of concrete behavior.

The resulting competency profile provides information that matches input requirements for the ADAPT™ training design activities (De Croock, Van Merriënboer, Van der Pal, Abma, Paas & Eseryel, 2002).

Differences of the NLR Competency-based approach and the MEC approach

A primary goal of the Mission Essential Competency (MEC) approach is to enable the trainees to acquire and

maintain essential competencies by providing the required experiences via a sufficient number of training events. The MEC approach is unique as it seeks to maintain the operational perspective, terminology and focus throughout the knowledge elicitation process and further analysis. Furthermore, the results are validated using an extensive questionnaire filled in by a large representation of operational subject matter experts.

The NLR competency-based approach similarly aims to identify competencies that are well recognized by operational subject matter experts. The NLR approach differs from the MEC approach as the first primarily :

- aims to improve existing training given known training gaps (instead of aiming to identify training gaps);
- provides a hierarchic structure to the skills and competencies identified (instead of lists of competencies, skills and knowledge);
- Uses small scale review session to validate the results (instead of questionnaires).

IDENTIFYING FIGHTER CONTROLLER COMPETENCIES

In order to establish a competency profile of the Fighter Controller the NLR competency-based training approach was tailored to the possibilities and needs of the Air Operations and Control Station (AOCS) in Nieuw Milligen, where the Dutch Fighter Controllers are based. As a result, the following three workshop sessions were arranged with six operational SME's/instructors:

1. Identify the FC tasks
2. Identify the knowledge, skills and attitudes (KSAs) necessary to perform FC tasks.
3. Structure KSAs and identify essential competencies.

Two training experts without specific FC background facilitated the workshops. Prior to the workshops, the facilitators observed an on-the-job training exercise. The approaches of three workshops are presented in some detail below.

Analyzing Tasks

Following Carroll's scenario-based design approach (1995), the facilitators asked the workshop participants to describe a typical day on the job as a Fighter

Controller from the first scheduled activities up to the final task in the shift. Next to the task content the level and type of proficiency needed for successfully executing every task was identified. Proficiency could be defined in terms of speed, accuracy, compliance with procedures, attitude and (tolerance for) thinking errors.

In addition, operational conditions including team characteristics that could complicate task execution or hamper task completion were identified. Examples of these complexity factors are pressure from team members/management or system failure. The workshop was concluded with a DIF-analysis, identifying the Difficulty, Importance, and Frequency of individual tasks.

Identifying Knowledge, Skills, and Attitudes

During the second workshop, the task list and operational conditions from the first workshop were used to elicit the related knowledge, skills and attitudes from the workshop participants. The approach taken was highly interactive and thoughts and ideas were exchanged between workshop participants and facilitators.

Structuring Knowledge, Skills, Attitudes and Identifying Essential Competencies

In the final workshop the KSAs were defined and examples of both best practice as well as undesirable and unwanted displays of the KSAs were identified. Outside the workshop, the facilitators structured the KSAs in a hierarchic manner. The hierarchy was reviewed by the workshop participants who discussed and fine-tuned the competency profile. Another aim of the review session was to identify the competencies that are of critical importance to the success of the mission.

RESULTS

Fighter Controller competency profile

The structured and agreed set of competencies and KSA's of the final review session with the SMEs forms the validated competency profile (see Figure 3). The terminologies used in the profile are operational denotations as used in the Fighter Controller context. The Dutch Fighter Controller community uses a hybrid of Dutch and English terminology. The Dutch terms have been translated for this paper.

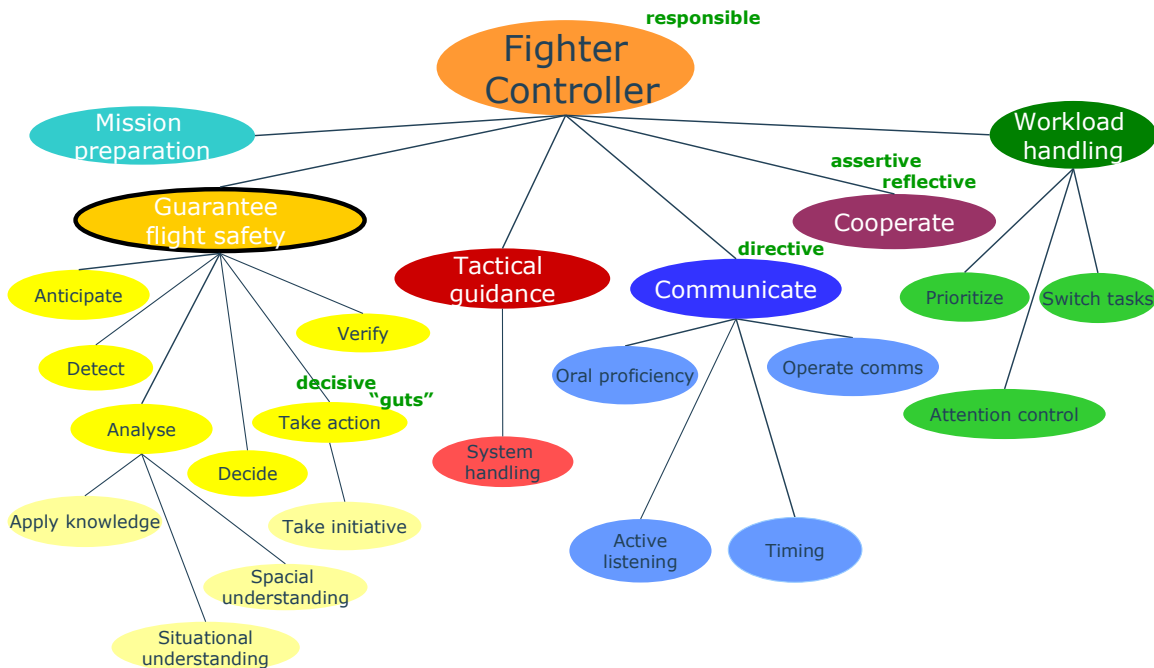


Figure 3. Fighter Controller competency profile

The top of the hierarchy represents the full job of the Fighter Controller, integrating all competencies. One level lower, the competencies or integrated skills that constitute the Fighter Controller function are presented. These are *Mission preparation, Guarantee flight safety, Tactical guidance, Cooperation and Workload handling*. The hierarchy level does not imply equal importance. It simply enlists the groups of high-order competencies that are distinguished. More elementary skills constitute the composite competencies and enable the behavior related on the higher level. The skill of prioritizing, for example, is one of the ways to enable the handling of workload.

Attitudes are added to the competency profile and are one of the three trainable parts of the NLR's competency model. Fighter Controller attitudes are presented in the profile at different levels as they influence specific skills and competencies. High-level attitudes as "taking responsibility" are inherited by lower level competencies and skills. Lower level presented attitudes are particularly relevant for the skill-set (including lower levels) to which the attitude is attached, but this does not imply that the attitude has no relevance for other competencies. For example, assertiveness is an essential attitude for co-operation, but will be relevant too for communication in general.

For the Fighter Controller the behavior-leading function of attitudes is vital. Not taking responsibility, for example, can lead to reduced attention control and reduced co-operation. This will influence behavior and ultimately may result in low flight safety.

Guarantee flight safety was identified as an essential competency. This is a particularly difficult competency to acquire and to train because of its strong cognitive character with primarily indirect behavioral indicators for results. The description of the *Guarantee flight safety* competency is provided in Table 1.

Suggestions for FC Training Design

Training design recommendations were provided on three levels.

Firstly, general ADAPT^{IT} suggestions are provided to improve the full curriculum. For example: Insert Part-Task Training in a just-in-time manner into a whole task training syllabus (in contrast to provide part-task training prior to full mission training).

Table 1. Example competency description and recommendation

Guarantee flight safety
<p>Type Essential competency; complex skill</p>
<p>Definition Look after a safe operation of fighters in the controlled airspace using an action loop of anticipation, detection, analyzing, decision and verification. At all times, a constantly updated understanding and mental model of the current events in the controlled air space is available including a prediction of possible future events. By using the loop "what-if" scenarios are developed by the Fighter Controller. This is used for the prediction and detection of different future situations, avoiding conflicts, collisions, accidents, and refrain from flying out of the controlled airspace. Finally, after taking action the execution of the action is checked to ensure the flight safety once again.</p>
<p>Concrete behavior</p> <ul style="list-style-type: none"> - Directions to the fighters are checked on whether aircrew execute them; follow-up checks may be performed; - There is no delay in communication with fighters and with others in the FC section when referring to controlled aircrafts positions and future positions in the controlled area. - Maintaining minimal separation between aircraft <p>Examples of erroneous or insufficient behavior are:</p> <ul style="list-style-type: none"> - Being surprised by an aircraft in the controlled airspace; - Providing erroneous information to pilots - Task is taken over by a colleague because flight safety is not guaranteed anymore - Freeze as a result of stress and cognitive overload
<p>Quick wins Syllabus & Grading Add action-loop indicators to the grade sheet. Stimulate instructors to note attitude aspects and the direct behavior on which they base their interpretation of underlying cognitive processes.</p> <p>Introduce the idea of responsibility already at the early stage of (basic) training. Understanding of the concept of responsibility can be created and extended by showing films about the role of fighter controller's responsibility in flight safety, by listening to tape recordings or live conversations between fighter pilots and fighter controllers and by organizing group talks about the subject matter.</p>
<p>Recommendations Syllabus improvement Provide more examples of situations (best cases, worst cases) in which flight safety is critical.</p> <p>Because of the highly cognitive character and complex nature of the competency introduce exercises focusing on this competency and its skill components from the beginning of the training. Construct easy scenarios that require various types of competencies (e.g. communicate & anticipate) already in simulator sessions.</p>

Secondly, competency specific recommendations are provided in two forms: 1) quick win recommendations,

which require relatively little effort to implement, and 2) recommendations requiring considerable syllabus revision or investment, e.g., a full redesign of modules or introduction of new training devices. See Table 1 for an example related to the *Guarantee flight safety* competency. This competency is particularly difficult to train as it involves mainly mental processes which manifest themselves through communication, speed and smoothness of actions, or when less successful, through incidents and accidents. Following the 4C/ID model an important instrument in acquiring understanding of the complex domain of a competency and to create a cognitive schema is to present a variety of examples of the behavior associated with the competency prior to and in combination with on-the-job training. This can be done by presenting videos of expert behavior or by having talk-through sessions. Cognitive schemata are shaped during practice, for example on a simulator, while understanding may increase through group discussions about the subject and presentations focusing on the sub skills associated with the *Guarantee flight safety* competency. The more examples provided and practice offered, the greater the understanding will be of the scope and variation of dangerous flight safety situations. Enhanced understanding and practice will also decrease the detection time of a potentially hazardous situation.

Thirdly, a complete new grading sheet was recommended (see Figure 4). This grading sheet lists the competency items and, where possible, concrete behavioral markers. The sheet also includes an option to identify attitude issues for the competency items. Behavior examples per competency or performance measure are provided to guide or remind the instructor.

	Rating	Attitudes	Comments
Guarantee flight safety			
anticipate			
detect			
analyse			
take action			
verify			
apply knowledge			
work pace			
flexibility			
Communicate			
accuracy			
listening			
timing			
clear communication / voice control			
format			
flow/ frequency			

Figure 4. Extract from the recommended FC Grade sheet

DISCUSSION & CONCLUSION

The NLR approach to competency-based training has produced a new competency profile that is accepted by a representative Fighter Controller community of the RNLAf. Further validation amongst all Fighter Controllers is recommended. In addition to the concrete products, the FC instructor section expressed that the method has produced an improved shared view on FC competencies and training.

Currently, most of the training revision recommendations remain generic and slightly academic. Stronger application of the competency profile in the syllabi as well as application of the ADAPT^{IT} method requires a more in-depth application of the method to training design in addition to the current study's focus on training analysis. The FC training school has installed a design team to work out a number of suggested training revisions. It is foreseen that considerable changes in the earlier phases of training will be required.

The grading sheet has reduced the number of rating items and is more in line with the view of the instructors on critical aspects of the Fighter Controller job. The new grading sheet is now in use along with the current grading sheet for further testing.

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