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A STUDY ON TRAINING NEEDS ANALYSIS (TNA) METHOD FOR MILITARY AIRCRAFT

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Abstract

Training needs analysis (TNA) is not only the starting point, but also the key point of training work. Only correct and accurate TNA can effectively guide subsequent trainings and enable the army to gain better battle effectiveness. On the basis of advance training mode of civil aviation, a creative TNA method fitting for military aircraft which is different from civil aviation that highlights the training efficiency and combat performance has been put forward, and solidified analysis flow have been established, TNA quality is ensured.

The TNA analysis method has been verified in the training work, and this paper takes the subject of cockpit cover system for the military aircraft maintenance crew as an example to illustrate how to apply this method.

Keywords: Training Needs Analysis (TNA), RDIF analysis, trainee KSAS analysis, task KSAS analysis, KSAS discrepancy analysis.

1. General Introduction

Training which is to provide the necessary teachers, procedures, methods, technology, teaching materials, equipment and facilities for equipment training, use and maintenance, is a decisive measure to transform the design results of aviation weapons and equipment into actual combat capabilities, and determines whether the equipment can be quickly and effectively formed combat effectiveness. With the development of aviation weaponry and equipment technology, higher requirements for equipment combat capabilities have been put forward. Only correct and accurate training needs analysis (TNA) can effectively guide subsequent trainings and enable the army to gain better battle effectiveness [1].

At present, the analysis of domestic military aircraft training needs is mainly depend on designers of the equipment system who based on the gap between the equipment performance requirements and draw up the training content. The method of speculating training needs based on each system designer reveals weaknesses of fragmented training knowledge points, inability to achieve graded training for trainees, and training content not applicable to trainees' task needs in training practice.

Therefore, it is urgent to establish a scientific method of training needs analysis method, which combine the knowledge of aircraft function, performance, use and maintenance with the actual situation of the troops. So as to set up theoretical teaching and practical courses reasonably, and applicable to the characteristics of user tasks, improve the training effect quickly.

TNA is a method or technique to set up the training content and training objectives. This method mainly combines the task with trainee analysis, modularizes the knowledge points, and arranges the training time reasonably in order to accurately complete the training task [2].

Currently, TNA is mainly used by civil aviation in pilot training, which collecting the regular tasks or emergency tasks that pilots need to complete during each phase of a mission, analyzing their characteristics and inherent requirements, screening out the content that needs to be trained and forming a draft, and finally by the expert committee to determine the training needs. International mainstream manufacturers such as Boeing, Airbus and Bombardier have adopted the TNA method to set up the training content of flight crews, which has greatly improved the quality and efficiency of training.

The purpose of this paper is to use the TNA, which according to the experience of civil aviation TNA and depend on the characteristics of military aircraft, to integration of military aircraft task analysis and trainee analysis and accurate analysis of military aircraft training needs. The TNA method provides important guidance for domestic military aircraft to improve the quality and efficiency of training.

2. TNA method

2.1 The main content of TNA method

The classical model of Training Needs Analysis (TNA) proposed by McGhee and Thayer is generally adopted, and this method includes organizational analysis, task analysis and trainee analysis.

According to the actual situation of military aircraft, military aircraft training generally does not require organizational analysis, that training tasks are from the military authorities and higher-level organizations. Task analysis refers to the analysis of the difficulty, importance, frequency and readiness of each subtask under a specific training task, which is RDIF analysis (here the readiness that is newly added, based on the characteristics of the military aircraft which concerns about the rate of readiness), to determine training the subtask or not. Then analyze the training requirements of knowledge, skills, attitude and specialty for each sub-task, which is KSAS analysis, to set up the specific content of training for each specialty. The trainee analysis determines who needs to be trained and what training is required by analyzing the gap between the current KSAS of the trainees and the KSAS required by the mission objectives [3].

2.2 The advantage of TNA method

The TNA method which is basing on task, take into account the trainees profile in the task analysis and think about the actual task requirements in the trainee analysis, as well as make certain admission standards for the trainees.

This is a reasonable integration of the actual task needs and the characteristics of the current situation of the trainees, which not only avoids the fragmented knowledge points and poor targeting by the designers' speculative training needs, but also avoids the focus on task analysis and generalized training for the trainees, which lacks effective assessment of the trainees' actual ability to enter the training and leads to poor targeting of the training, wasting resources and not effectively fitting the actual needs of the trainees.

3. Study on TNA method for military aircraft

Based on the characteristics of military aircraft operations and maintenance tasks, military aircraft training makes reasonable use of the TNA method to combine the task division of trainees' positions and ranks, refine the training content and set up the corresponding training objectives to achieve the expected training effect.

According to technical features of the aircraft to be trained and actual needs of trainee, the TNA method determines training tasks and admission standards of trainees (if they do not meet the access conditions and must be trained, additional pre-training supplemental training is required), and analyzes the KSAS status quo (trainee KSAS analysis) of trainees. In light of the knowledge and experience of trainees, the readiness, difficulty, importance and frequency (RDIF) of subtasks are analyzed in sequence to determine whether it is necessary to carry out training for this subtask. If necessary, the knowledge, skill, attitude and specialty (task KSAS analysis) required by each task are further analyzed. In accordance with task KSAS analysis and trainee KSAS analysis results, discrepancies between the status quo of trainees and factors of task KSA analysis are determined as a way to finalize training contents and provide the requirement for training tasks/proficiency levels. All training factors can be modularly combined and output when it comes to different trainees, thus analysis results for training needs of military aircraft are gained. Finally, the TNA method has already been verified in training practice.

This is the method of TNA for military aircraft (as shown in Figure 1).

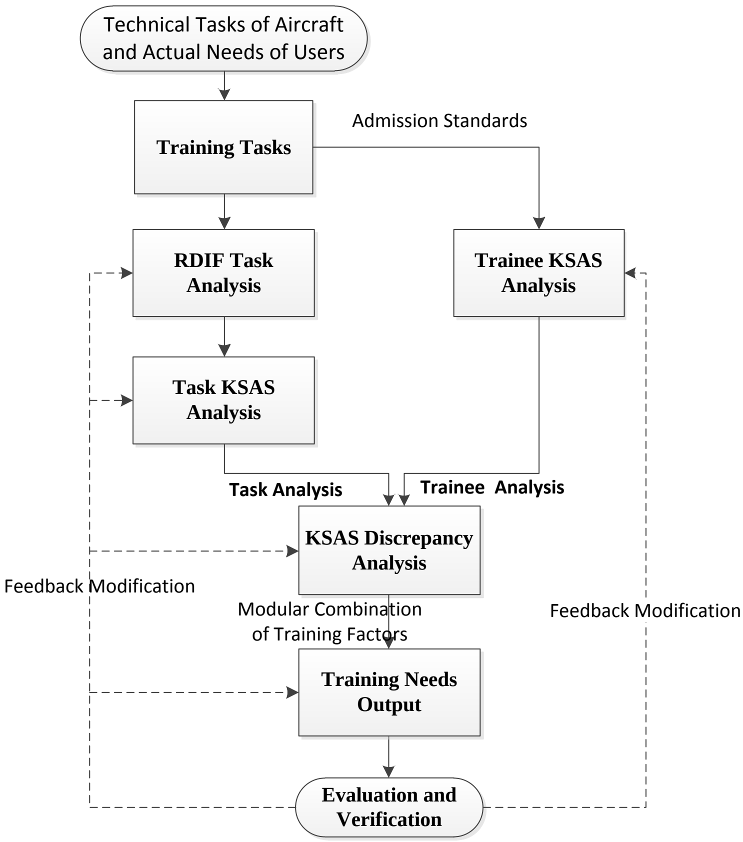

Figure 1 –Method of military aircraft TNA.

3.1 Determine the training task of the aircraft

According to the requirements of the trainee and the organization, the training plan of a certain aircraft is determined. The specific training tasks of the aircraft are determined according to the general technical documents, aircraft manuals, flight manuals, operation manuals, comprehensive security work plans, aircraft maintenance procedures and maintenance work cards, etc. With the research of the trainees' actual task needs, the training tasks can be adjusted.

For example: according to the trainees' actual task demand, the military aircraft ground crew training is mainly for the military aircraft maintenance and guarantee tasks, taking the fighter plane as an example, that is, mainly for the ground crew in the Mechanics, Electrics, Avionics, Armament four types of specialty for training, mainly undertake the aircraft daily maintenance, fault location and troubleshooting, weekly/regular inspection, special inspection, hanging ammunition, Non-destructive testing, etc., involved in the maintenance and security work content should be reflected in the training tasks. This is to determine the training tasks based on the usage and maintenance tasks of the aircraft type.

3.2 Set up the admission standards and do trainee KSAS analysis

This step is to analyze the trainees and determine their admission standards based on the aircraft tasks. The analysis is generally done in terms of knowledge, experience, and qualifications, including personal education and specialty, flight/maintenance experience, relevant training and certificates, etc.

The admission standards are set to ensure that the trainees have a certain professional foundation and learning ability, to ensure that they can better master the training content, to reduce repetitive training, and to improve the efficiency and quality of training. If the trainees do not meet the admission standards, they must supplement the corresponding training.

To analyze of the knowledge (K), skills (S), attitude (A), and specialty (S) of the trainees, that includes three main areas of the information.

- The basic level of the trainees, including the level of education and vocational training of the institution;
- Trainees' career experience, years and qualifications of flying/maintaining similar aircraft;
- Previous training status of the trainees, etc.

Basing on the above information, we divide the trainees into four levels: primary, intermediate, advanced and special. The assessment method is as follows.

Table 1 –KSAS analysis table for trainees

Trainee KSAS Analysis	Knowledge (K_1)	Basic knowledge (education, major, graduation institution) (K_1)
		Professional knowledge (time of enlistment and profession) (K_{12})
		Troop education and training experience (K_{13})
	Skills (S_1)	Flight/maintenance experience (S_1)
		Special situation handling/fault analysis and troubleshooting experience (S_{12})
	Attitude (A_1)	Ability to learn (A_1)
		Collaboration ability (A_{12})
		Language ability (A_{13})
	Specialty (S)	Manned aircraft: aircrew (pilot), ground crew (Mechanics, Electrics, Avionics, Armament) Unmanned aircraft: aircrew (pilot, task controller, link monitor, etc.), ground crew (Mechanics, Electrics, Avionics, mission payload, ground station)

The full score of trainee KSAS analysis is set to 100. It is recommended to use the expert scoring method and hierarchical analysis to determine the weight of each element of knowledge, skills, attitude, specialty for α_i (i = 1, 2, 3), each element corresponds to a sub-weight of α_j (j = 1, 2, 3), each element corresponds to a score of X_{ij}, the nth participant quality score of X_n.

$$X_n = \sum_{i=1}^{3}\sum_{j=1}^{3} \alpha_i \alpha_{ij} * X_{ij} \quad (n=1,2,3\cdots\cdots) \quad (i=1, 2, 3; j=1, 2, 3); \qquad (1)$$

The training was divided into four levels according to the KSAS analysis scores of trainees, as shown in Table 2.

Table 2 –The level of trainee KSAS analysis

Class level	Score X
Primary(Ⅰ)	X < 60
Intermediate(Ⅱ)	60≤X<75
Advanced(Ⅲ)	75≤X<90
Special(Ⅳ)	X≥90

3.3 RDIF analysis

For the training tasks identified in step 3.1, each task is analyzed for readiness, difficulty, importance and frequency (RDIF) according to different specialties.

- Readiness refers to the impact of the parts performing the task on the aircraft integrity rate (refer to the domestic classification standards for important life parts);
- Difficulty refers to the difficulty of completing the task, generally considered whether special skills, special tools and equipment, proximity, etc., as long as any of the conditions are met, can be judged as difficult;
- Importance refers to the assessment of the impact of the completion of the task on flight safety and mission accomplishment;
- Frequency refers to the frequency of performing the task, which needs to be considered in terms of task interval and component reliability.

After RDIF task analysis (analysis criteria [4] shown in Figure 2), a list of tasks that need further analysis can be obtained.

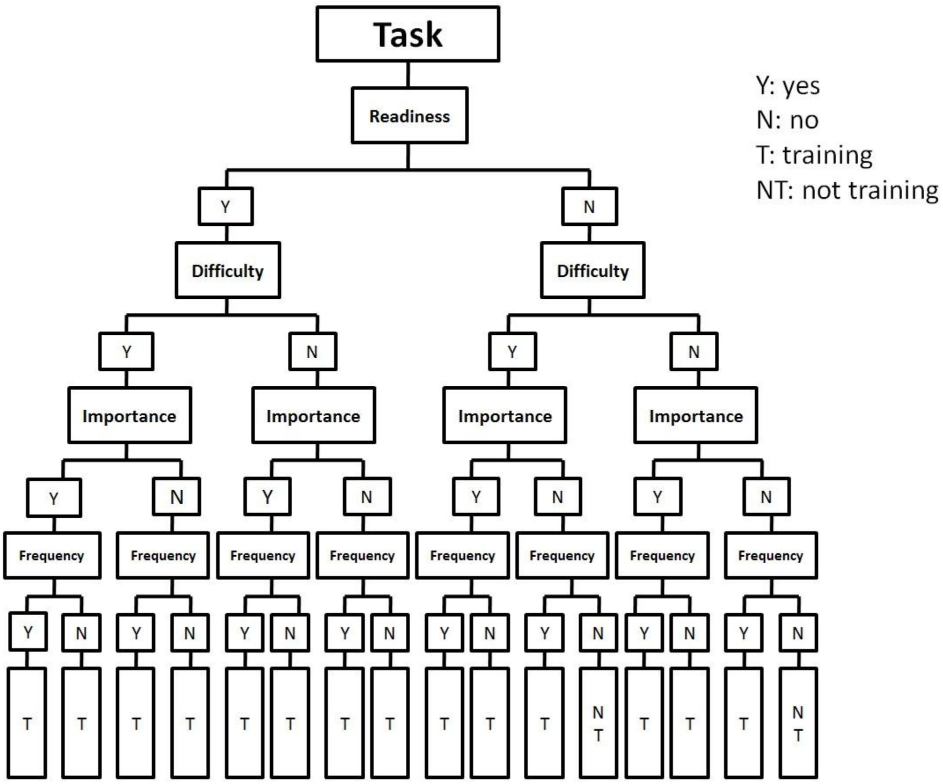

Figure 2 –Criteria of RDIF analysis

3.4 Task KSAS analysis

For the tasks RDIF analysis, the knowledge, skill, attitude and specialty required to complete the task are further analyzed, i.e. task KSAS analysis.

Table 3 –Task KSAS Analysis Table (Manned)

Type	Elements of Analysis	Analysis Elements
Aircrew	Knowledge (K_2)	Functional overview, composition and location (K_{21})
		Basic operations, instructions and controls, working principle description (K_{22})

Type	Elements of Analysis	Analysis Elements
		Working principle analysis, out-of-field flight failure analysis, troubleshooting strategy analysis (K_{23})
	Skill (S_2)	Display identification, basic operations (S_{21})
		Basic piloting techniques, air warfare skills and emergency response (S_{22})
		Joint warfare, system operations (S_{23})
	Attitude (A_2)	Flight precautions, safety warnings (A_{21})
		Site management, teamwork (A_{22})
Ground crew	Knowledge (K_2)	Functional overview, composition and location (K_{21})
		Identification of special tooling, instructions and controls, working principle description (K_{22})
		Working principle analysis, typical field failure analysis, troubleshooting strategy analysis (K_{23})
	Skill (S_2)	Component identification (S_{21})
		Basic operation and diligence, component disassembly and testing, general troubleshooting (S_{22})
		Typical troubleshooting, functional inspection, typical parts replacement (S_{23})
	Attitude (A_2)	Maintenance precautions, safety warnings (A_{21})
		Site management, teamwork (A_{22})

3.5 KSAS Discrepancy Analysis

According to the results of trainee KSAS and task KSAS analysis, the discrepancies between the current KSAS status of trainees and the KSAS of task can be obtained. Therefore, the training contents for trainees and the target level requirements can be achieved. Moreover, typical fault analysis, product optimization and upgrading according to the actual usage of the aircraft can be added.

All training contents can be divided into two categories: knowledge and skills. The classification of tasks and proficiency requirements are indicated by a combination of numbers and letters, respectively. The requirements of knowledge-based tasks are represented by capital letters, and the requirements of skill-based tasks are represented by lowercase letters, which are combined with numbers representing different proficiency levels to indicate the mastery requirements of the profession for a particular task (see Table 4), e.g., 1a and 1A represent the minimum proficiency requirements for skill-based and knowledge-based tasks, respectively.

Table 4 –The requirements for training task of different levels

	Level Value	Requirements
Task Performance Levels	1	(Extremely limited) Can do simple parts of the task. Needs to be told or shown how to do most of the task.
	2	(Partially proficient) Can do most parts of the task. Needs help only on hardest parts. May not meet local demands for speed or accuracy.
	3	(Complete all) Can do all parts of the task. Needs only a spot check of completed work. Meets minimum local demands for speed and accuracy.
	4	(Highly Proficient) Can do the complete task quickly and accurately.
Task Knowledge Levels	a	(Nomenclature) Can name parts, tools, and simple facts about the task.
	b	(Procedures) Can determine step-by-step procedures for doing the cask.

	Level Value	Requirements
	c	(Operating Principles) Can explain why and when the task must be done and why each step is needed.
	d	(Complete Theory) Can predict, identify, and solve problems about the task.
Subject Knowledge Levels	A	(Facts) Can identify basic facts and terms about the subject.
	B	(Principles) Can explain the relationship of basic facts and state general principles about the subject.
	C	(Analysis) Can analyze facts and principles and draw conclusions about the subject.
	D	(Evaluation) Can evaluate conditions and make proper decisions about the subject.

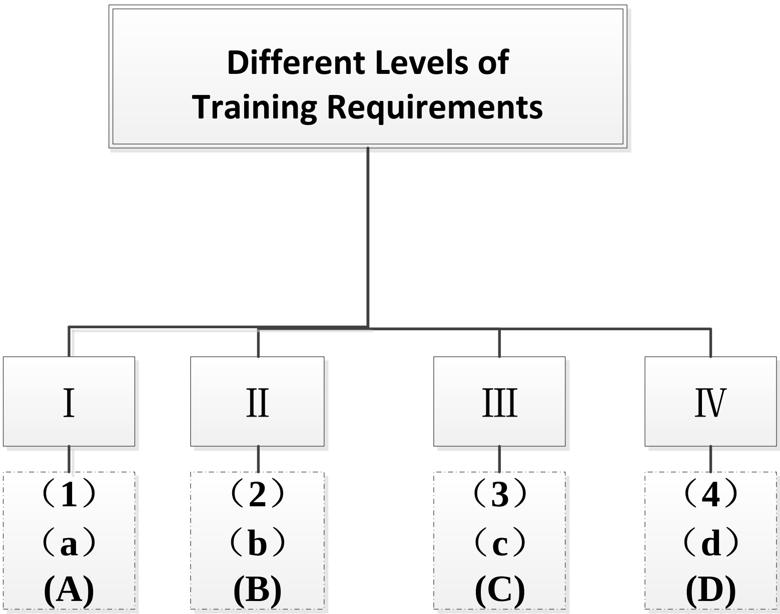

Figure 3 –Different levels of Training requirements (recommended)

3.6 Training Needs Output

Based on the above analysis, the training tasks are further refined according to the specialty classification of the trainees.

For example, the specialty classification of manned ground crew are divided into four categories, Mechanics, Armament, Electrics and Avionics, i.e. Class Ⅰ, Class Ⅱ, Class Ⅲ and Class Ⅳ for Mechanics, Class Ⅰ, Class Ⅱ, Class Ⅲ and Class Ⅳ for Armament, Class Ⅰ, Class Ⅱ, Class Ⅲ and Class Ⅳ for Electrics, and Class Ⅰ, Class Ⅱ, Class Ⅲ and Class Ⅳ for Avionics.

According to the classification, the training elements of KSAS points are modularly combined, and the task and proficiency level requirements are given to meet the training targets. On the basis of the above combination, when developing training programs, the correlation and logic of military aircraft systems should be fully considered, and the order of training courses should be reasonably arranged, such as the overall of aircraft course should be placed before the sub-system courses.

3.7 Evaluation and Verification

In order to ensure the quality of TNA for military aircraft, a quality control process of expert committee and expert evaluation is introduced. The expert committee is generally composed of air/ground crew, training instructors, system designers and technical workers who have flight/maintenance experience with the corresponding aircraft or similar aircraft.

Expert evaluation is the final step of the TNA method which determines the final content of each training (training contents, training level, etc.). Any points that need to be discussed or disputed during the process of TNA are referred to the expert committee for decision.

The training needs determined by the expert committee deliberations need to be fully tried and verified in the military aircraft manufacturer's internal maintenance training, which can feedback on the training effects. The training needs should be optimized and updated continuously, and the process should be under quality control.

This is the entire process of the TNA for military aircraft.

4. Quality Control Process

Each step of the above TNA should be clearly recorded in a standardized manner in order to achieve quality control of the process and as a basis for continuous improvement depend on usage feedback.

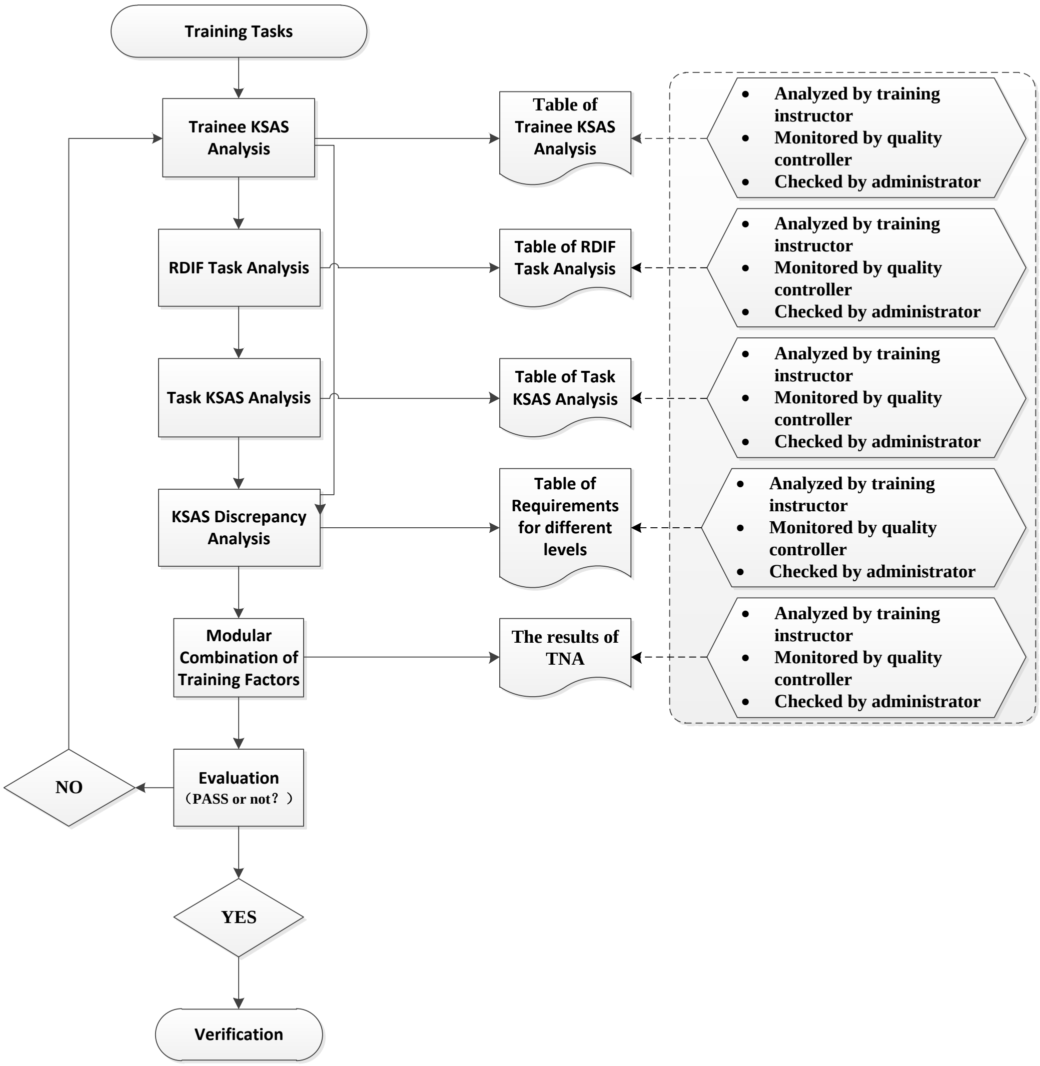

Figure 4 –Quality control process

5. Example Analysis

According to the study of TNA for military aircraft, the cockpit cover system of a certain aircraft (system code 56) was selected as the example. And a trainee of ground crew who graduated from an aviation academy with a bachelor's degree, engaged in the work of a maintenance Armament personnel for two years, and received theoretical training of Armament specialty of other aircraft, was taken as an example for analysis.

First, the basic maintenance tasks are determined according to the maintenance regulations of this aircraft, and adjusted and optimized according to the actual needs of the trainee. Thus, the specific tasks are confirmed and shown in Figure 5.

Maintenance timing		Task Number	Task / Subtask
1 Aircraft preparation	1.1 Pre-flight inspection	56-40-00-00A-310A-D	Cockpit cover drop system-visual inspection
		56-50-00-00A-310A-D	Cockpit cover rupture system-appearance check
	1.2 Pre-flight inspection again	56-40-00-00A-310A-D	Cockpit cover drop system-visual inspection
		56-50-00-00A-310A-D	Cockpit cover rupture system-appearance check
	1.3 Post-flight inspection	56-40-00-00A-310A-D	Cockpit cover drop system-visual inspection
		56-50-00-00A-310A-D	Cockpit cover rupture system-appearance check
2 Periodic work	2.1 Work every 25±5 hours	56-10-00-00A-340A-D	Windshield subsystem-appearance check
		56-20-00-00A-310A-D	Cockpit cover subsystem-appearance inspection
		56-30-00-00A-340A-D	Cockpit cover normal system-functional check
	2.2 Work every 50±5 flight hours	56-40-00-00A-310A-D	Cockpit cover drop system-visual inspection
		56-50-00-00A-310A-D	Cockpit cover rupture system-appearance check
3 Periodic operation	3.1 Every 300±25 flight hours	56-40-00-00A-340A-D	Cockpit Canopy Drop System-Functional Check
		56-50-00-00A-340A-D	Cockpit cover rupture system - functional check
4 Specialized calibration and other work	4.1 Non-scheduled inspection - special inspection	56-40-01-00A-920A-D	Mechanical Detonator I - Disassembly and Installation
		56-40-02-00A-920A-D	Mechanical detonator II - disassembly
		56-40-03-00A-920A-D	Explosion transmission system - disassembly
		56-40-04-00A-920A-D	Shut-off valve - disassembly
		56-40-07-00A-920A-D	Flying target detonation device - disassembly
		56-40-08-00A-920A-D	Gas throwing actuator-disassembly
		56-50-02-00A-920A-D	Mechanical detonator III - disassembly
		56-50-03-00A-920A-D	Flying target detonation device - disassembly
		56-50-04-00A-920A-D	Micro-exploding cable - glue patch
		56-50-04-00A-920A-D	Micro-exploding cable - replacement

Figure 5 –Maintenance tasks

Second, set the admission standards for the trainees (with college degree or above in aviation, with more than one year of basic maintenance experience in related professions, and need to have basic maintenance knowledge and theoretical foundation of maintenance Armament specialty). For example, the trainee meets the admission standards. Furthermore, trainee KSAS analysis of the trainee shows that the scores of analysis results are 89 and the information is shown in Figure 6.

	Elements	Key Points	Trainee's information	Score
Trainee KSAS Analysis	Knowledge (K1)	Basic knowledge (education, major, graduation institution) (K_1)	graduated from an aviation academy with a bachelor's degree	100
		Professional knowledge (time of enlistment and profession) (K_{12})	engaged in the work of a maintenance Armament personnel for two years	90
		Troop education and training experience (K_{13})	received theoretical training of Armament specialty of other aircraft	90
	Skills (S1)	Flight/maintenance experience (S_1)	had maintenance experience of 1.5 years	85
		Special situation handling/fault analysis and troubleshooting experience (S_{12})	had troubleshooting experience about 1year	85
	Attitude (A1)	Ability to learn (A_1)	Good	90
		Collaboration ability (A_{12})	Good	90
		Language ability (A_{13})	Good	90
	Specialty (S)	Manned aircraft: aircrew (pilot), ground crew (Mechanics, Electrics, Avionics, Armament)	Armament	Armament
			The scores of trainee's KSAS analysis	89

Figure 6 –The results of trainee KSAS analysis

Third, do the RDIF analysis of tasks, so as to get the sub-tasks that should be trained and required further analysis. The analysis results are shown in Figure 7.

SN	Task / Subtask	Readiness (R)		Difficulty (D)		Importance (I)		Frequency (F)		Whether to choose
		Judgment basis	Intact	Judgment basis	Difficulty	Judgment basis	Importance	Judgment basis	Frequent	
1	Cockpit cover drop system-visual inspection	No impact	No	None	No	No impact	No	Less than or equal to 50 flight hours	Yes	Yes
2	Cockpit cover rupture system-appearance check	Affects readiness	Yes	None	No	Impact on safety	Yes	Less than or equal to 50 flight hours	Yes	Yes
3	Windshield subsystem-appearance check	Affects readiness	Yes	None	No	Impact on safety	Yes	Less than or equal to 50 flight hours	Yes	Yes
4	Cockpit cover subsystem-appearance inspection	Affects readiness	Yes	None	No	Impact on safety	Yes	Less than or equal to 50 flight hours	Yes	Yes
5	Cockpit cover normal system-functional check	Affects readiness	Yes	None	No	Impact on safety	Yes	Less than or equal to 50 flight hours	Yes	Yes
6	Cockpit Canopy Drop System-Functional Check	Affects readiness	Yes	Special equipment	Yes	Impact on safety	Yes	Greater than 50 flight hours	No	Yes
7	Cockpit cover rupture system - functional check	Affects readiness	Yes	Special equipment	Yes	Impact on safety	Yes	Greater than 50 flight hours	No	Yes
8	Mechanical Detonator I - Disassembly and Installation	Affects readiness	Yes	None	No	Impact on safety	Yes	Greater than 50 flight hours	No	Yes
9	Mechanical detonator II - disassembly	Affects readiness	Yes	None	No	Impact on safety	Yes	Greater than 50 flight hours	No	Yes
10	Explosion transmission system - disassembly	Affects readiness	Yes	Difficult to access	Yes	Impact on safety	Yes	Greater than 50 flight hours	No	Yes
11	Shut-off valve - disassembly	Affects readiness	Yes	None	No	Impact on safety	Yes	Greater than 50 flight hours	No	Yes
12	Flying target detonation device - disassembly	Affects readiness	Yes	None	No	Impact on safety	Yes	Greater than 50 flight hours	No	Yes
13	Gas throwing actuator-disassembly	Affects readiness	Yes	None	No	Impact on safety	Yes	Greater than 50 flight hours	No	Yes
14	Mechanical detonator III - disassembly	Affects readiness	Yes	None	No	Impact on safety	Yes	Greater than 50 flight hours	No	Yes
15	Flying target detonation device - disassembly	Affects readiness	Yes	None	No	Impact on safety	Yes	Greater than 50 flight hours	No	Yes
16	Micro-exploding cable - glue patch	Affects readiness	Yes	Special equipment	Yes	Impact on safety	Yes	Greater than 50 flight hours	No	Yes
17	Micro-exploding cable - replacement	Affects readiness	Yes	Special equipment	Yes	Impact on safety	Yes	Greater than 50 flight hours	No	Yes

Figure 7 –The results of RDIF analysis

Fourth, for the sub-tasks gained by RDIF, task KSAS analysis is conducted, and the knowledge points of training content are obtained. The analysis results are shown in Figure 8.

SN	Task / Subtask	Knowledge (K)			Skills (S)			Attitude (A)		Specialty(S)
		K1	K2	K3	S1	S2	S3	A1	A2	S
		Functional overview, composition and location	Identification of special tooling, instructions and controls, description of working principles	Analysis of operating principles, emission strategy analysis	Component identification	Basic operation and diligence, component disassembly and testing, general troubleshooting	Typical troubleshooting, functional inspection, typical parts replacement	Maintenance precautions, safety warnings	Site management teamwork	Specialties
1	Cockpit cover drop system-visual inspection	Composed			Component location identification	Basic operations				Mechanics, Armament
		Position								Mechanics, Armament
2	Cockpit cover rupture system-appearance check	Composed			Component location identification	Basic operations				Mechanics, Armament
		Position								Mechanics, Armament
3	Windshield subsystem-appearance check	Composed			Component location identification	Basic operations				Mechanics, Armament
		Position								Mechanics, Armament
4	Cockpit cover subsystem-appearance inspection	Composed			Component location identification	Basic operations				Mechanics, Armament
		Position								Mechanics, Armament
5	Cockpit cover normal system - functional check	Function		Working principle analysis	Component location identification	Basic operations		Safety warnings	Site Management	Mechanics, Armament
		Composed								Mechanics, Armament
		Position								Mechanics, Armament
6	Cockpit Canopy Drop System-Functional Check	Function		Working principle analysis	Component location identification	Basic operations		Safety warnings	Site Management	Mechanics, Armament
		Composed								Mechanics, Armament
		Position								Mechanics, Armament
7	Cockpit cover rupture system - functional check	Function		Working principle analysis	Component location identification	Basic operations		Safety warnings	Site Management	Mechanics, Armament
		Composed								Mechanics, Armament
		Position								Mechanics, Armament
8	Mechanical Detonator I - Disassembly and Installation	Function			Component location identification	Basic operations	Component replacement	Safety warnings		Armament
		Position								Armament
9	Mechanical detonator II - disassembly	Function			Component location identification	Basic operations	Component replacement	Safety warnings		Armament
		Position								Armament
10	Explosion transmission system - disassembly	Function			Component location identification	Basic operations	Component replacement	Safety warnings		Armament
		Position								Armament
11	Shut-off valve - disassembly	Function			Component location identification	Basic operations	Component replacement	Safety warnings		Armament
		Position								Armament
12	Flying target detonation device - disassembly	Function			Component location identification	Basic operations	Component replacement	Safety warnings		Armament
		Position								Armament
13	Gas throwing actuator-disassembly	Function			Component location identification	Basic operations	Component replacement	Safety warnings		Armament
		Position								Armament
14	Mechanical detonator III - disassembly	Function			Component location identification	Basic operations	Component replacement	Safety warnings		Armament
		Position								Armament
15	Flying target detonation device - disassembly	Function			Component location identification	Basic operations	Component replacement	Safety warnings		Armament
		Position								Armament
16	Micro-exploding cable - glue patch	Function	Identification		Component location identification	Basic operations	Troubleshooting skills	Safety warnings		Armament
		Position	Control							Armament
17	Micro-exploding cable - replacement	Function	Identification		Component location identification	Basic operations	Component replacement	Safety warnings		Armament
		Position	Control							Armament

Figure 8 –The results of task KSAS analysis

Fifth, according to the results of task KSAS and trainee KSAS analysis, it is determined the discrepancies between the current KSAS status of trainees and the KSAS of task can be obtained, so as to determine the training contents of the training and give the training task level requirements. The analysis results are shown in Figure 9.

Work card chapter	Theoretical content	Training Elements	Task/proficiency level
56-10	Windscreen subsystem	Composed	3C
		Position	3C
		Component identification	3c
56-20	Cockpit cover subsystem	Composed	3C
		Position	3C
		Component identification	3c
56-30	Hatch normal system	Function	3C
		Composed	3C
		Position	3C
		Principle of operation	3C
		Component identification	3c
56-40	Cockpit cover throwing system	Function	3C
		Composed	3C
		Position	3C
		Principle of operation	3C
		Component identification	3c
		Component replacement	3c
	Mechanical detonator I	Disassembly operation	3c
	Mechanical detonator II	Disassembly operation	3c
	Explosion transmission system	Disassembly operation	3c
	Shut-off valve	Disassembly operation	3c
	Flying target detonator	Disassembly operation	3c
	Gas throwing actuator cylinder	Disassembly operation	3c
56-50	Cockpit cover rupture system	Function	3C
		Composed	3C
		Position	3C
		Principle of operation	3C
		Outfield failure principle analysis	3C
		Component identification	3c
		Component replacement	3c
		Troubleshooting strategy	3C
	Mechanical Exploder III	Disassembly operation	3c
	Flying target detonator	Disassembly operation	3c
None	Typical Failure Analysis	Outfield failure principle analysis	3C
		Troubleshooting steps	3C
		Field disposal situation	3C
		Notification of major failures	3C
		Product optimization and upgrade	3C

Figure 9 –The results of KSAS discrepancies analysis

Sixth, there are many training points obtained from KSAS analysis, and it is necessary to carry out modular combination of training points to facilitate knowledge systematization, so as to get the initial training content of the cockpit cover system. The analysis results are shown in Figure 10.

Work card chapter	Theoretical content	Training Elements	Task/proficiency level	Theoretical hours
56-10	Windscreen subsystem	Composed	3C	0.5
		Position	3C	
56-20	Cockpit cover subsystem	Composed	3C	0.5
		Position	3C	
56-30	Hatch normal system	Function	3C	1
		Composed	3C	
		Position	3C	
		Principle of operation	3C	
		Outfield failure principle analysis	3C	
56-40	Cockpit cover throwing system	Function	3C	1
		Composed	3C	
		Position	3C	
		Principle of operation	3C	
		Outfield failure principle analysis	3C	
56-50	Cockpit cover rupture system	Function	3C	1.5
		Composed	3C	
		Position	3C	
		Principle of operation	3C	
		Outfield failure principle analysis	3C	
		Troubleshooting strategy	3C	
None	Typical Failure Analysis	Outfield failure principle analysis	3C	0.5
		Troubleshooting steps	3C	
		Field disposal situation	3C	
		Notification of major failures	3C	
		Product optimization and upgrade	3C	

Work card chapter	Practical content	Practice method	Task/proficiency level	Practice hours
56-10	Identification of windshield subsystem components	Real machines	3c	0.5
56-20	Identification of hatch subsystem components	Real machines	3c	0.5
56-30	Identification of hatch normal system components	Real machines	3c	0.5
	Operation of the normal system of the cockpit hatch	Test bench	3c	0.5
56-40	Identification of components of the hatch cover drop system	Simulation parts	3c	0.5
56-50	Hatch cover rupture system component identification	Simulation parts	3c	0.5
56-40	Mechanical initiator I - disassembly and assembly operation	Test bench	3c	2
	Mechanical initiator II - disassembly and assembly operations	Test bench	3c	
	Explosion transfer system - disassembly and assembly operation	Test bench	3c	
	Shut-off valve - disassembly and assembly operations	Test bench	3c	
	Flying target detonator - disassembly and assembly operations	Test bench	3c	
	Gas throwing cylinder - disassembly and assembly operations	Test bench	3c	
56-50	Mechanical detonator III - disassembly and assembly operations	Test bench	3c	1
	Flying target detonator - disassembly and assembly operations	Test bench	3c	

Figure 10 –The results of TNA

Seventh, the whole analysis process was discussed and evaluated by the expert committee, and the results of TNA were tried and verified internally.

6. Conclusion

This paper researches the method of military aircraft TNA, establishes the analysis process. In accordance with the process of TNA, considering the characteristics of the task requirements and the current level of trainees, the required training tasks are gradually confirmed through RDIF analysis, and each training task KSAS analysis is analyzed, and then the KSAS gap is analyzed, so that the training contents and task requirements for different levels are determined. The results of TNA is reinforced by internal trial validation link for quality control.

The establishment of this military aircraft TNA method breaks the traditional mode of presuming trainees' training requirements based on the assumptions of system designers, avoids the defects of focusing on task analysis and neglecting trainee analysis, solves the practical problems of inability to realize different levels of training for trainees and training contents not applicable to trainees' task requirements. It can provide reference for the development of military aircraft training programs and training syllabus.

7. Copyright Statement

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