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TRAINING ANALYSIS METHODOLOGY: A NEW APPROACH TO DESIGN EH101 AIRCREW TRAINING SYLLABUS

by

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TRAINING ANALYSIS METHODOLOGY:
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Abstract

Agusta's experience in training syllabus design has been primarily focused on an analytical approach for the antitank helicopter A129. The past experience is the basis for the design of EH101 training syllabus that is designed adopting a structured methodology.
The EH101 aircrew training syllabus has been focused on the basic naval version of the helicopter. The aim of the study is to define an integrated training system applicable to the maintenance training syllabus, also to be further used for the other helicopter configurations.
The aircrew operational tasks requiring training, and the most suitable media to provide the training for each task, have been selected using several selection criteria. The main issue addressed, during the media selection process is the cost effectiveness.
The training analysis methodology can be used to evaluate preferred and alternate media related to the same training objective. Training analysis allows the customer to choose between different syllabus approaches with an estimate of the associated efforts and costs.

1. Introduction

The past experience on the anti-tank A129 helicopter focused the importance in designing a training syllabus both for aircrew and maintenance personnel appropriate to the complexity of the machine and the level of avionics sophistication; the traditional approach based mainly on classroom lessons and functional mock-ups was not suitable for the anti-tank helicopter.The A129 training syllabus was the result of the collaboration between the Agusta training specialist and the Italian Army. What arose from this collaboration was the possibility to distribute the training on several systems, each devoted to a specific task, being the Customer requirements to develop an integrated syllabus for aircrew and maintenance personnel.
The syllabus starts from a common point that is Computer Based Training dedicated to get a general knowledge of the helicopter, then training splits in two ways, respectively for maintenance staff and crew. Maintenance students complete their training on the Maintenance Trainer (MT), while aircrew practices the use of the on-board computer and visionic systems on the Part Task Trainer (PTT), to fulfill the final requirements and complete the training with the Combat Mission Simulator (CMS).
The design of this training syllabus, a scheme of which is shown on fig.1, was also performed with the provision of the application of Artificial Intelligence techniques, for a quick and appropriate evaluation of the student performance in order to easy and fast

reconfigure the training path with an adaptation to student capacity.

The past experience on the A129 training syllabus makeS Agusta aware of the importance to design the process by means of a training analysis and this approach has been carried out for the EH101 helicopter. The Agusta approach in designing training syllabus is supported by a general methodology to perform training analysis for both aircrew or maintainers.

The training analysis methodology is a pragmatic approach to make buyer/user of training systems and training specialists able to jointly discuss and examine the choice related to the following aspects :

* what are the training requirements;
* what type of technology would be most effective;
* what type of products would be more appropriate, a ready-made or a bespoke solution;
* what options and trade-off solutions are available;
* what are the allocation of the training requirements in term of training courses and plans.

The EH101 training syllabus design is distinguished to be a complex process being several EH101 Customers requirements and programs involved.
The EH101 training syllabus has been designed to satisfy a general requirements for the Naval version of the aircraft with a common start training for aircrew and maintainers followed by devoted paths.
Relevant customers requirements having an influence to the training system designed to meet common training objectives in a general syllabus, will be addressed into relevant EH101 programs.

The EH101 is a complex helicopter equipped with high-sophisticated on-board computers devoted to aircraft control, Aircraft Management Computer (AMC), and to mission control, Mission Computing System (MCS).
The avionic and mission architecture are high-integrated and the relevant aircraft interface are primary the Electronic Instrument System, six displays dedicated to the flight/navigation and power system monitoring, two mission displays, and the Common Control Unit to manage the AMC and MCS.

Common training needs between MMI and RN configurations have been identified and then converted by Agusta into measurable training objectives and specific training systems for aircrew.

A parallel analysis has been performed by Westland to design a training syllabus for maintenance personnel. The two processes have been compared to select common training objectives between aircrew and maintainers.

The following paragraphs point out the major Agusta results in the analysis jontly performed with Westland.

2. Training Analysis

A working definition of training analysis is any analytic method that allow trainer to define the training need for a task in sufficient detail to meet its need. Agusta was aware of the importance to get a standardization of the owned experience in training approach for the EH101 program.

The adopted approach follows an Instructional System Design (ISD) criteria, that enables corrective actions to be fed into the process of training design and specification, being the whole process interactive.
The flow through the training analysis, a scheme of which is provided on fig. 2, is the following:

Collect Job Data

The aircrew or maintenance actions to be performed for all operational job are collected in an Occupational/Job Analysis. Performance objectives are defined.

Define the Training Needs

The training requirements are identified in terms of training objectives (TO) collected in an Training Task Analysis. The operational tasks requiring training are identified by means of a selection criteria taking into account:

* Task importance;
* Probability of inadequate performance;
* Task learning difficulties;
* Task complexity (including the use of special tools or techniques);
* Tolerance for delay;
* Task frequency.

Each training objective can be specified in terms of knowledge, operation, environment, skill and time requested to allow the analyst to detail:

* what the trainee is expected to know about a TO to use the system and to understand displayed data;
* the actions that a trainee must perform;
* the important conditions under which the trainee must perform;
* the competence required;
* the performance that the trainee must attain.

Training objectives which are applicable to aircrew and maintainers can be identified and commonality stated.

Typically all those information can be better managed using a tool able to support training analysis decision process, being the amount of information and correlations considerable. Appropriate algorithms definition to support training analysis have been examinated and than an evaluation of commercial training analysis tools has been performed to verify the real capability to support the Agusta's approach and the training analysis defined.

Define the Range of Suitable Generic Training Devices:

Candidate training devices are associated with training objectives in an objective and media analysis, in order to select preferred and alternate media. An alghoritm specifies media capability to satisfy training requirements: in this way a media can be rejected or scored and a rational evaluation can be reached.
The investigated training requirements for each TO are the following:

* Training categorization (theory, practical, isolated aircraft system, etc.);
* Training communication (audio, visual, tactile, kinaesthetic, etc.);
* Training instructional (individual, group, self-study, etc.);
* Training environment (cockpit, in-flight, only one aircraft system, first line maintenance, etc.);
* Training safety (safer than operational environment);
* Fault or malfunction replica.

These selection criteria have been implemented in a dedicated program. An example concerning the training media matrix is provided on fig. 3. The media Rank value is a global index defined taking into account economics and logistics parameters applicable to devices characteristics.
The values for each training media in comparison to each defined training requirement, or attribute, are provided into the attribute matrixes. The values reflect the analyst experience to evaluate the media capability to be suitable in satisfying the training attribute. High score means high media performance, a zero score means media rejection. Making a selection of the training requirements appropriateness for each TO, the media can be ranked utilizing the defined attribute matrixes. The selection of the preferred and alternate media is supported by this rational investigation, and the device effectiveness can be audit.

Define the Training Devices Specification:

The training devices selected against the specified set of requirements are defined in terms of functional capability to be satisfied while design the subsequent technical specification and configuration.

Define the Training Syllabus:

The training courses and plans to complete the training syllabus design can be detailed being the training objectives specified and the training devices selected. The syllabus can be detailed taking into account population data, constrains of the user organization, including budget, training location and so on.
Those parts of the training courses which are applicable to aircrew and maintainers are identified as common.

The described approach is completely general and can be performed also to support trade-off analysis to define and explore training options.
The training analysis can be also assisted by a cost-utilization analysis focused at least on the following aspects:

- device operational hours for each training subject;
- total hours required for each device to achieve syllabus each year;
- the utilization for each device;
- the numbers and types of training devices;
- the annual and life-cycle costs for each option.

3. EH101 Aircrew Training Syllabus

The EH101 aircrew training study identifies the importance to optimize the training requirements on the academic and the hands-on aspects of the syllabus.
The training analysis has been performed to define the training objectives for the aircrew and then the following critical training requirements have been identified:

* Aircraft systems familiarization (knowledge skill).
  The students, at the end of the training, are able to understand operation of aircraft systems, and to operate aircraft system throught the correct use of cockpits controls and panels.
* Flight procedures practice (practical skill).
  The students, at the end of the training, are able to execute flight procedures with the correct operational standard.
* Flight and navigation practice (practical skill).
  The students, at the end of the training, are able to flight aircrfat throughout nornal and emergency conditions in a safe environment.

The objective and media analysis has been performed for the training requirements and dedicated training media have been selected for each requirement.

Computer Based Training

The students must reach a correct familiarization with the cockpit environment functionality, in terms of architecture description, functions performed and system operation, to reflect the first training area requirements.
A CBT system is the selected media to provide effective systems familiarization, because of the following important capabilities:

- the learning process can be assisted in term of students performance evaluation;
- the utilization of animated graphics draws the student attention, improving the traditional lesson;
- the self-paced training allows an enhancement of the traditional teacher role, and improves the standardization of the students training.

The courseware topics have been selected utilizing an approach focused to find the common training areas between maintenance and aircrew for the Basic Naval vehicle, on the assumption identified as common training objectives, and in terms of topics priority. The levels of detail identified as common aircrew and maintenance requirements for each topics are the following:

- Introduction;
- System Description and Operation;
- System Management;
- Health and Usage Monitoring.

Further levels of detail

- Component Description and Operation;
- Special Equipment and Techniques;

are considered peculiar for the maintenance personnel training .

Cockpit Procedure Trainer

The students practice with the ground and flight procedures request a training environment able to reproduce the correct cockpit physical layout and operational stimuli. These training stimuli requirements make the CBT a non effective training device. The suitable media could be a PTT or a CPT, but the typical systems correlation and integration of the flight procedures forced the selection of a CPT system as the most effective in comparison with several dedicated PTT. The CPT must be a functional replica of the aircraft cockpit.

The previous pilots familiarization with the aircraft systems on the CBT has not been designed to provide also flight procedures familiarization, because the analysis does not highlight the CBT as the most effective device for this aim.
In order to provide the procedures explanation the CPT must be able to operate as a logical training device to provide a student assistance to procedures familiarization. This means the CPT must be supported by a devoted tutorial environment to provide indications related to procedure steps and give the required interactive feedback for incorrect actions.

The instructor can skip the tutorial assistance for students requiring training on procedure memorization. In this case the training is supported by a free-play simulation in a real-time environment in order to give to students the real systems response to the input performed. The CPT system must be able to record the students actions to provide the instructor with indications concerning the procedure execution time and monitoring the correctness of actions performed.

The training areas covered by the CPT are the following:

- Cockpit familiarization
- Crew coordination

- Pre-flight procedures
- Pre-start and start procedures
- Engine runup
- Take-off
- Instrument and navigation procedures
- Normal and abnormal procedures
- Emergency procedures
- Manoeuvre with the AFCS engaged
- Manoeuvre with the AFCS disengaged
- Hovering
- Engine shutdown
- Blade and pylon fold

Flight Simulator

The flight simulator must provide the necessary training to practice students throughout all flight and ground regimes under normal, abnormal and emergency conditions in order to complete the training requirements. The flight simulator is the effective device to provide training in the development of the pilots skills and techniques required to fly the EH101 efficiently, effectively and safely.

The FS must be a replica of the aircraft cockpit environment, and must include a motion system and a full color visual system simulating day, dusk and night conditions.

The training areas are the following:

- Cockpit familiarization
- Crew coordination
- Pre-flight procedures
- Pre-start and start procedures
- Engine runup, pretaxi and taxi
- Take-off
- Instrument and navigation procedures
- Operation in thunderstorms and turbulence
- Normal and abnormal procedures
- Emergency procedures
- Visual meteorological conditions
- Visual flight rules approach
- Landing and approach procedures
- Manoeuvre with the AFCS engaged
- Manoeuvre with the AFCS disengaged
- Hovering
- Engine shutdown
- Blade and pylon fold
- Recovery from unusual attitudes
- Autorotation

4. Conclusion

The advantages of performing a training analysis is directly correlated to the capability to select training devices which are as effective as possible for the training tasks, satisfying operational as health and safety requirements and the available budget.

A training analysis methodology makes auditable the process of syllabus design, in this way the statements of the functions the instructional equipment must fulfil can be detailed taking into account the real customer requirements.

The consequences of getting a not accurate training analysis might have a strong impact on user's organization. For the customer this might be applied through buying a range of devices that have obvious shortcomings in their performance, or require technical skills for their use incompatible with the organization skill base, or present an inappropriate mix of training devices which may be under utilized for the capital investment.

The training analysis approach adopted by Agusta to design the EH101 Aircrew Training Syllabus can be considered as a first response to the advised to have a structured methodology .
The main aim of adopting such approach is to reach a standard process, supported by means of dedicated tools, to a consolidate capability to convert customer requirements into training syllabus for complex aircraft.
The alghorimts implemented into dedicated programs and the evaluated commercial tools to perform training analysis have improved the Agusta's capability while designing training syllabi, i.e. training devices specifications, courses and plans.

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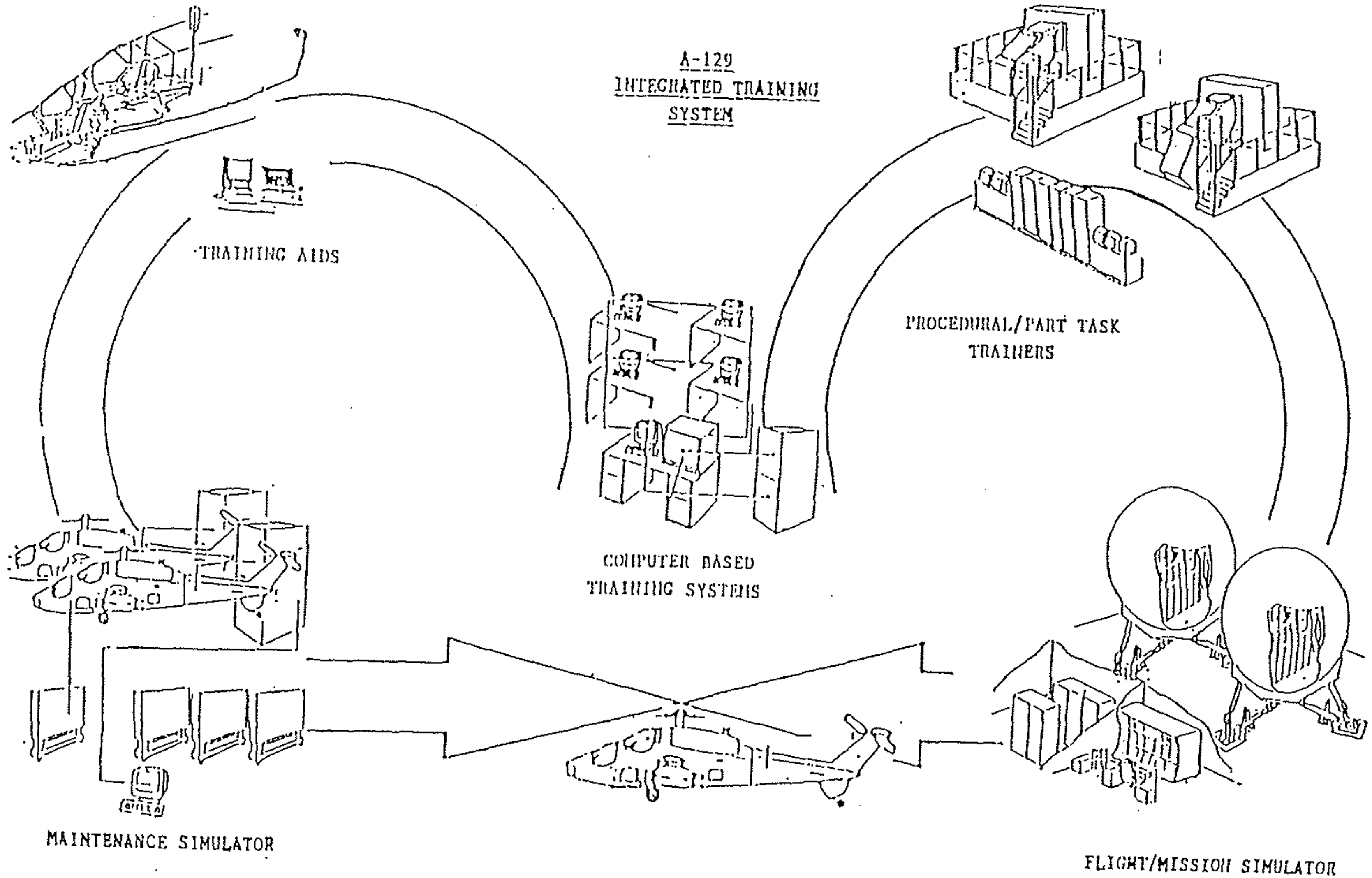
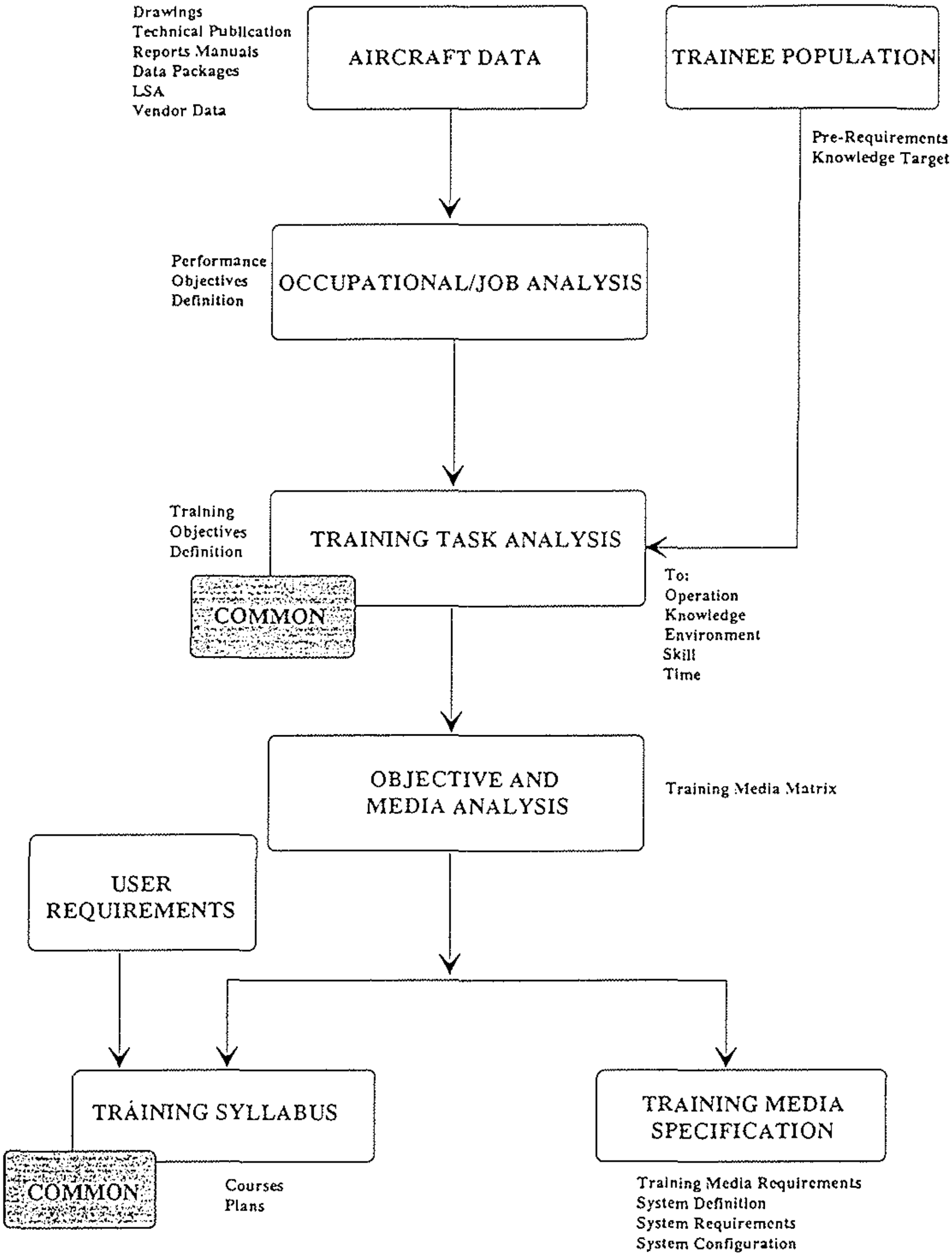


FIG. 1 - THE A-129 INTEGRATED TRAINING SYSTEM



AGUSTA TRAINING ANALYSIS AND DESIGN - FLOW DIAGRAM

FIG. 2

Media	RankVal
Aircraft	0.96
Simulator	1.88
Maintenance Trainer	1.96
Cockpit Procedure Train	1.96
Part Task Trainer	1.98
Computer Based Train	2.00
Computer Aied Instruct	1.96
Linear Video	1.96
Overhead Projector	1.74
Chalk and Talk	1.80
Mock-Up	1.88
Manuals	1.96

Attribute		A/C	SIM	MT	CPT	PTT	CBT	CAI	VID	OHP	C&T	MCK	MAN
CATEGORISATION													
Theory Objectives	YES	0,10	0.10	0.50	0,50	0,50	2.00	1,50	2.00	0.80	0,50	0,50	0.50
	NO	1,00	1,00	1,00	1,00	1,00	1,00	1.00	1,00	1,00	1.00	1,00	1.00
Task Knowledge	YES	2.00	2.00	1,50	1,50	1,50	1,00	0.70	1,00	0,20	0.20	1.80	0,50
	NO	1.00	1,00	1,00	1,00	1,00	1.00	1.00	1,00	1.00	1,00	1,00	1,00
Task sequencing	YES	0.50	0.80	2,00	2,00	2,00	0.50	0.80	0.80	0,10	0,10	1.70	0,50
	NO	1,00	1,00	1,00	1,00	1,00	1,00	1.00	1,00	1,00	1,00	1,00	1,00
Practical Job	YES	2.00	2.00	1,50	1,50	1,50	0,10	0,10	0.00	0.00	0.00	2.00	0.00
	NO	1.00	1.00	1,00	1,00	1,00	1.00	1.00	1.00	1.00	1,00	1.00	1.00
Isolated A/C System	YES	1.00	1.00	1.00	1.00	1,50	1,50	1.50	1,50	0,50	0.20	1,00	0,50
	NO	1,00	1,00	1.00	1,00	1,00	1,00	1.00	1.00	1.00	1.00	1,00	1.00
Multiple A/C System	YES	1,20	1,20	1.80	1.80	0,50	1,20	1,20	0,50	0,50	0,10	1,20	0,50
	NO	1,00	1.00	1.00	1,00	1,00	1,00	1.00	1,00	1,00	1,00	1,00	1,00
Procedure Memoris	YES	2,00	2,00	2,00	2,00	2,00	0,10	0,10	0,10	0,10	0,10	1.80	0,10
	NO	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00

Media Ranking Matrix

Fig. 3