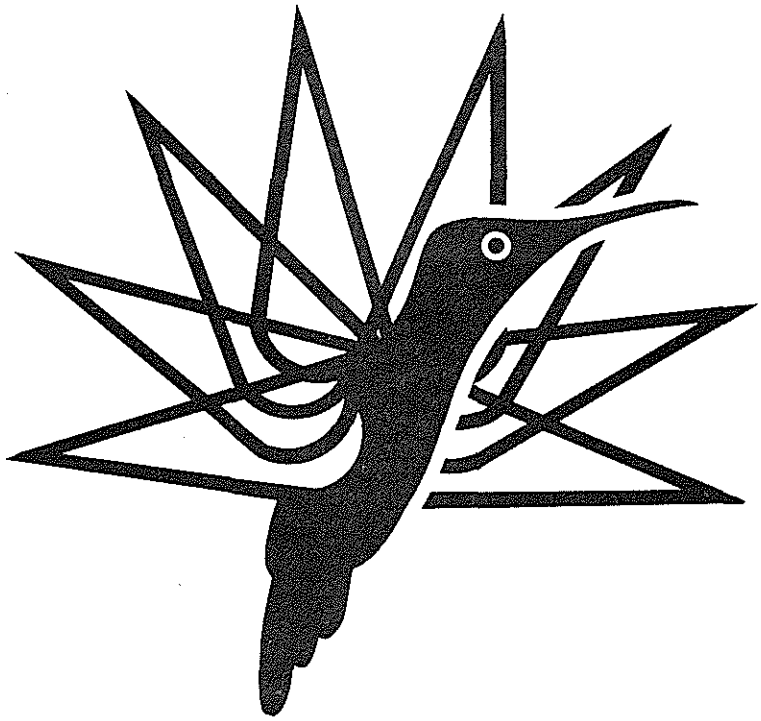
PAPER Nr. : 22



MILITARY OPERATIONS RESEARCH IN THE NETHERLANDS RELATED TO HELICOPTERS

BY

IR. R.J.W. MERISON
MAJOR ROYAL NETHERLANDS AIR FORCE

FIFTH EUROPEAN ROTORCRAFT AND POWERED LIFT AIRCRAFT FORUM
SEPTEMBER 4 – 7TH 1979 - AMSTERDAM, THE NETHERLANDS

MILITARY OPERATIONS RESEARCH IN THE NETHERLANDS RELATED TO HELICOPTERS

by

Ir. R.J.W. Merison
Major Royal Netherlands Air Force

1 ABSTRACT

This paper describes the helicopter types within the Royal Netherlands Army and Air Force, the roles for which they are used, the organisational structure which employs them and the structured decision three necessary for supporting operational use of the available helicopters.
It illustrates the role Operations Research (OR) plays on the different decision levels as well as the way in which OR is applied in varying detail and complexity during the process of finding answers to specific operations.
The illustrations given are mostly practical examples from the following subjects:

a. evaluation of new roles for helicopters;
b. evaluation of existing helicopters or helicopters under development for a specific role;
c. evaluation of new equipment for helicopters in use and the impact of that equipment on the suitability of the helicopter for its role;
d. evaluation of tactics for a given role in a given scenario, a terrain for field trials as well as for computer studies;
e. integration of the foregoing points into an overall operational philosophy, in which all elements have to be brought into proper perspective.

In the examples given references are made to Netherlands establishments and laboratories involved in helicopter studies. The examples and references do not give a complete picture, they highlight the helicopter from the Army/Air Force users side seen through OR eyes.

The paper gives a problem flow chart (Fig.2) which can be applied to a great many problems and questions. It helps to structure problem areas so that it becomes possible to have at least an indication where to look for solutions.

CONTENTS

2 INTRODUCTION

It seems a bit out of place to present a paper on Operations Research at a Rotorcraft and Powered Lift Aircraft Forum, where the normal menu consists of a mixture of appetizing factory chopper talks and scientific formulae in heavy syrup.

It is often difficult for those who are not completely scientifically inaugurated to find their way in an environment where they do not exactly know what they are looking for and how to interpret the things they see. That is where Operational Research (OR) -, or Operations Research as those from across the Atlantic prefer to call it - comes into the picture and offers help.

Many people will be amazed as they have never had anything to do with OR and nevertheless are living along happily without the feeling of missing anything. This paper will try to tell how OR can help people in making decisions, in this case in particular decisions concerning helicopters. Therefore the paper has the following set-up; it explains the meaning of Operations Research, especially as used in the Royal Netherlands Air Force in connection with Army/Air Force helicopters. Finally some examples of the application of OR to specific problems are given.

However, the purpose of the paper is not merely to give some RNLAF examples, but to show how OR methods can be used to solve problems, to make people aware of their needs concerning helicopters and to show how they can evaluate alternatives and find solutions satisfying their needs. This paper is a further excursion along the lines given in reference 1 (Dutch) and reference 2.

3 OPERATIONS RESEARCH

Too many definitions of Operations Research exist. Many encyclopaedia and dictionaries describe OR as follows:

> "OR is the application of scientific (esp. statistical) methods to the study of complex industrial, governmental or military problems" (Longmans).

or:

"Operational Research i.e. research into the best ways of using, improving etc. (new) weapons, machinery etc." (Oxford dictionary).

Both definitions are too specific, they give OR a too narrow meaning. The second equals OR to research and the first suggests that research is in most cases carried out with the aid of statistics.

For the purpose of this paper Wagner (Ref.3) gives a better description:

"For convenience and with reasonable accuracy, one can simply define OR as a scientific approach to problem solving for executive management".

This definition tells us, that OR is an approach to problem solving. It does not confine executive management to the use of statistics or computers. Of course those tools will be used if necessary but only if the executive management is convinced their use is indispensable in a certain decision making process. This will be the case if the problem area is too vast or too complicated to comprehend "manually". But let this be a warning: never resort to computers if you do not understand a problem and therefore do not know why such tools, which cannot even think, are necessary.

Many people, including some executive managers, consider new technological inventions as all solving miracles: one does not have to understand them (is often supposed not to understand them). These inventions are designed to work for you and do the work faster, more accurate, in a more consistent way and cheaper than man can ever do. Indeed, technology is an enormous aid and without it man would still be nowhere, but it has many limitations and constraints. One should be more than aware of those limitations otherwise one is likely to fool oneself without even realizing it. Operations Research can help in bringing those limitations into broad daylight when defining a problem area.

Nowadays people are running to computers to find solutions to their problems. But computers cannot think. Often one does not ask oneself if the use of a computer is really necessary for the solution of a certain problem. If the decision to use a computer is well-founded then one may detect that the available programs for a specific problem are written in a cumbersome old fashioned computer language or are not well suited to the problem. And even if computer and program are wonderfully well adapted it remains true that if the input is nonsense the output will be nothing better. Also it may happen that the input is the most beautiful proven set of consistent data in the world whereas the computer output still is nonsense. However, the computer presents this nonsense in a neat row of confidence inspiring facts and figures. Operations Research can help in analysing the usefulness of computers and computer programs for a certain problem.

OR is considered an art more than a science, though it is an art using scientific methods. It helps the executive management to find ways to solve problems by making the management understand how the problems can be structured and by making them aware of weaknesses and strengths in their thought processes. In the end managers themselves clearly can see the possible solutions to their problems and therefore can take well founded solutions without having to fall back to magic values or black boxes spitting out answers applicable to all kinds of often unasked questions.

4 MILITARY OPERATIONS RESEARCH

It is quite logical to assume that Military Operations Research (MOR) will probably mean OR applied to military - or even better defence - problems. In itself the term MOR is a strange development as OR originally started during the Second World War as an aid to military operations - especially strategic bombing - to find the targets likely to cause the enemy most harm

in the long run. After the war OR was discovered by and further developed for civil management, mainly to optimize production processes in factories or to improve product effectiveness. Although in the Vietnam war the USA seems to have used OR for military purposes again to find ways of permanently disrupting the Ho Tsji Minh Trail, people mainly tend to have forgotten that the origins of OR are military. Therefore the addition of "Military" to OR, to clearly distinguish it from its civil counterpart.

In a defence organisation there are many levels on which MOR can be used (Fig.1). On each level there are many problem types to which MOR can

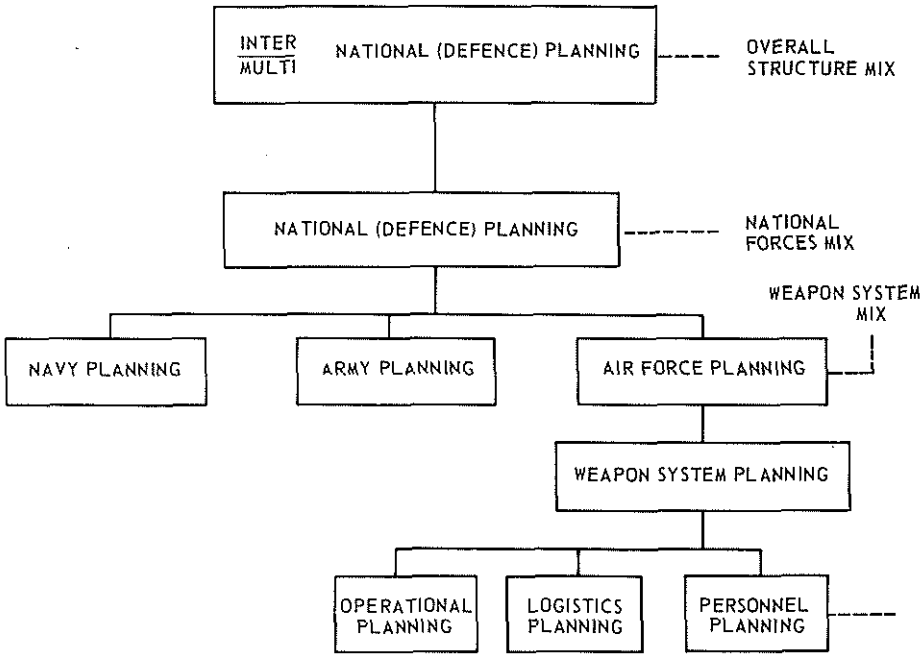


Figure 1 Defence Planning Scheme

be applied. This application can be either for long, medium or short term planning as well as for ad-hoc purposes. MOR has to be applied in a consistent way otherwise its result maybe not more than an unneccessary sub-optimization, which is the opposite from what one is striving to attain. Also in many cases there are conflicting requirements: the equipment the military want may be different from that needed and affordable. To stay with the last: money also has to be used for other needs with maybe higher priorities. The right priorities have to be given to the different problems and to the different variables in a certain problem, otherwise money will either be an all governing variable or just a constraint.

The consistent application of MOR can be like the following example. One can start as a group of nations looking at common interests and common threats. The highest threats have to be sorted out and it has to be decided how best to counter these threats: as a group of nations or as individual nations, as threats may differ from country to country. After priorities of threats have been assigned counters have to be found. These have to be evaluated and equipment in use with or ordered by any of the armed forces has to be examined to see if it can fulfil the role of a specific counter. Only after that evaluation has been completed a task (based on a counter) should be given to a specific armed force (Army, Navy or Air Force) which then can start to modify or evaluate specific hardware.

The above is logical and should be standard procedure, but there are still many decisions in which no well-defined thought process is detectable

and which therefore may have gone like this: An Air Force using a number of helicopters detects these need replacement because spare parts are difficult to obtain, fuel consumption is high and maintenance man-hours per flying hour are on the increase. So a new type is chosen, modern, smart looking and business like: the dream of any technician, and the pride of the financial people. But after it has been put into operational use it is discovered that much role dedicated mission essential equipment is either lacking or has to be modified. In that stage it is usually very costly to modify an aircraft, if at all possible. And even when modification is possible it may have a detrimental effect on aircraft performance. The timely application of MOR could help preventing such late discoveries of deficiences.

5 MOR REGARDING HELICOPTERS IN USE WITH THE ROYAL NETHERLANDS AIR FORCE

The Royal Netherlands Air Force operates quite a number of Alouette III and Bolkow BO105C helicopters but strange as it may seem, owns only a small number of them. The majority of those helicopters is owned by and operated for the Army, who has acquired them for liaison and reconnaissance duties. The Air Force only operates and maintains them. Just a handful of helicopters are owned by the Air Force for Search and Rescue duties, a task shared with the Royal Netherlands Navy.

In the Netherlands, the Army writes the operational concepts for helicopters, stating which roles they will have to fulfil. The Air Force translates those concepts into operation an technical requirements. Those requirements are used and measured during evaluation of helicopters. Sometimes as new roles are planned for helicopters, roles hitherto untried in the Netherlands, computer simulations are used during the writing of the requirements. The simulations serve to give an indication which parameters are most relevant when carrying out that new role. The parameters are either belonging to the group "mission accomplishment" or to the group "attrition". Suppose attrition is of overriding importance one then has to decide which parameters influence survivability most. These most likely will be speed, altitude, manoeuvrability, agility, conspicuousness (for all types of sensors) or combinations of any (or all) of those. That may seem simple, until one begins to realize that survivability depends on threats, which consist of airborne and ground based systems. The ground based systems consist of small arms, triple A and Surface to Air Missiles.
Each group consists of many systems with different characteristics. Likely one needs not always go into that detail while doing simulations to assist in writing requirements, but it can be necessary.

When performing such scenario simulations one is often tempted to compare armed helicopters with armed fixed wing aircraft. In many of the scenarios armed helicopters are more effective. Does this mean that helicopters are better weapon system than fixed wing aircraft? For the investigated scenarios: Yes. In general: No. It all depends on the scenario (i.e. threat, terrain, own task etc). Fixed wing aircraft usually have a higher speed and a greater range than helicopters, therefore they can be put into action in places where helicopters cannot come. Helicopters can stay in a certain area, often without being seen, they have time to spot approaching vehicles and they can appear/disappear quickly and unseen, exploiting terrain features to the fullest extent without having to worry about ditches and bomb cratered roads. Both types of aircraft have their specific advantages, which should be used as much as possible by the operational commander. MOR can make him aware of these possibilities and how to employ them under a great variety of circumstances. MOR survivability studies on the one hand are a help in defining requirements for new helicopters, on the other hand they can give a field commander tactical guidelines for the use of his new helicopters.

In defining questions and/or problems to determine ways to solve them Problem Flow Charts like the one depicted in figure 2 have proven very

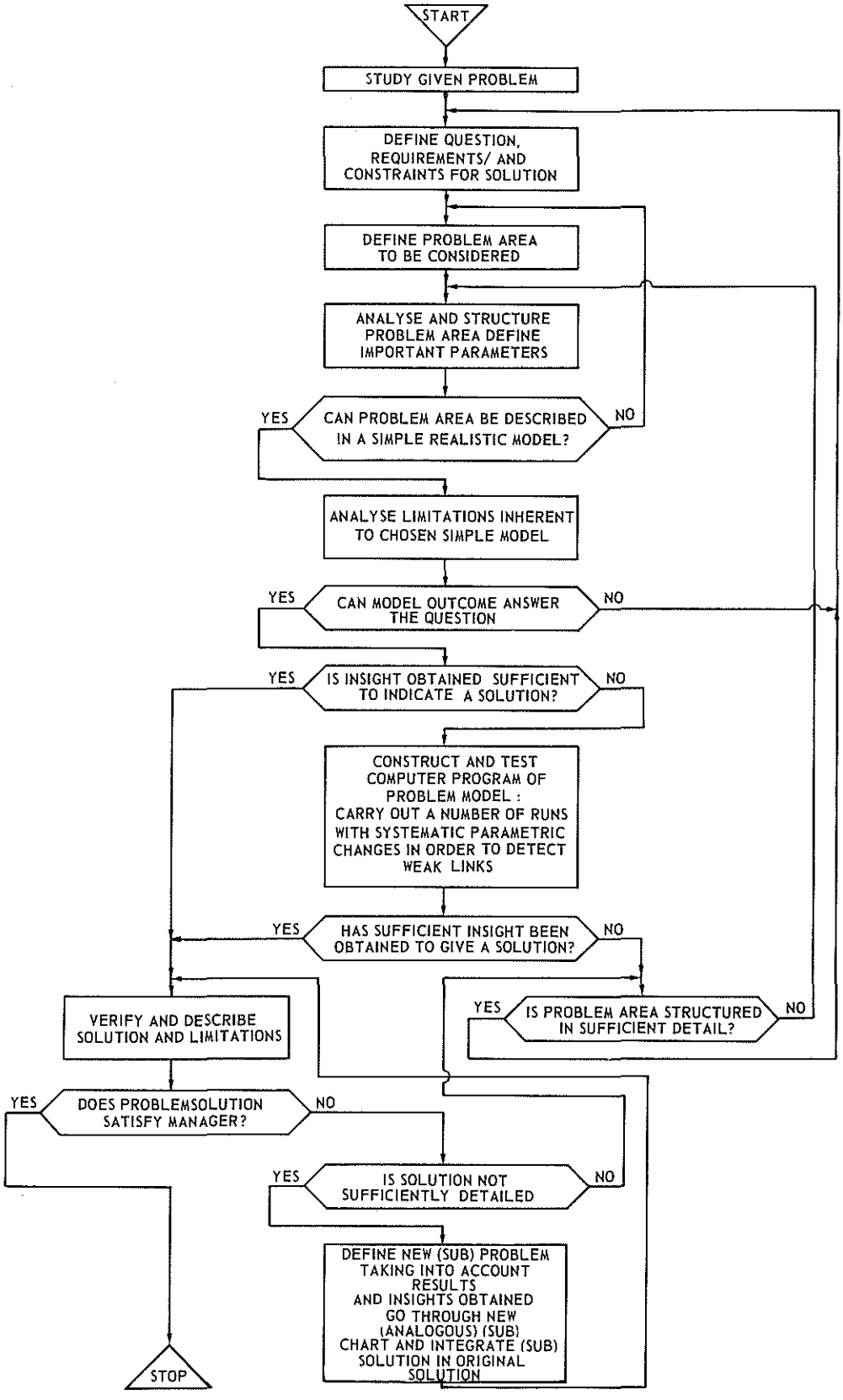


Figure 2 Problem flow chart

useful. Not that they solve everything or can be universally applied without further thinking; no, they only help in directing ones mind to a specific problem. And when one tries to structure that problem it is often found that the one simple question of the manager evokes a large number of questions to him in order to define more precisely what his problem is, what he is looking for and why. During this process the manager will in many cases become aware of solutions to his problem and he will be able to define (sub)questions in order to investigate some of the possible solutions. For these (sub)questions he may need specialistic help and even (sub)studies if parameters or aspects are not clear on first view.

As an example to problem approach "Anti Tank Helicopters" (ATHs) are taken. The military management has stated the need for ATHs.
One of the first questions to the management is whether they really do need ATH's, or are they just following the overall trend shown by other countries in using armed helicopters against tanks? Often study of treat, terrain, timeframe, weather, time to withstand an attacker has to be made to get an answer to the above question. That study may indicate that the military need more artillery, more anti-tank teams, more close air support aircraft, attack helicopters, anti-tank helicopters or air droppable anti-tank mines. If the outcome is: anti-tank helicopters the military management have to answer the next series of questions: when are those ATH's needed, do they have to operate at night and in bad weather, do they need fire and forget weapons, is defensive armament necessary? If ATH's fulfilling those requirements are not yet available can the military wait for them or do they need an immediate (interim) solution?

Questions like those above seem a tedious time consuming process, but they are an enormous help. They narrow down the group of ATH's eligible for the first evaluation. The questions also help to get an indication about how the helicopters are going to be used in the field. This will pose limits on weight; size and performance of the types to be considered. One can, following these considerations, also hold preliminary field trials to investigate some users aspects of the new type. In these field trials of course helicopters presently in use are employed; if necessary fitted with special equipment. When all factors have been considered in questions, scenario studies and field trials, MOR can help integrating the results into an overall picture and into overall requirements with generally agreed standards thresholds and goals. Only then time has come to go to helicopter manufacturers and see what ATHs they have on offer.

From the examples given it can be seen that problem/question definition is an iterative process, going from a first (high level) general approach into as much detail as the manager wishes - no decides - for the remains in control. MOR specialists are assisting him in constructing the problem flow charts and by being mediators between him and the specialists working out sub problems, who he does not need to understand. Understanding and steering specialists is the job of the MOR "analyst", who also has to understand the manager. And sometimes that proves to be the more difficult part of the problem.

6 MOR HELICOPTER STUDIES DONE IN THE NETHERLANDS

During the past few years studies have been carried out for the RNLA/RNLAF by the National Aerospace Laboratory (NRL) Physics Laboratory (Ph.L.) and Royal Military Academy (KMA) on quite a number of operational helicopter subjects. To name only a few: pilot workload, visual (night) approach aids, anti-tank guided missiles, anti-tank helicopter operations, helicopter survivability and ways to improve it by developing tactics (for the user) and

guidelines for mission essential equipment. Much attention is being given to the translation of study results into easy-to-use guidelines.

In many cases the Air Force does not ask for a complete study but only for a prefeasibility study, in which a laboratory explains the way it plans to tackle a problem. This can be compared with a first iteration of figure 2. The prefeasibility study gives a good indication what result in what timeframe can be expected from the complete study.

As the Air Force generally is result oriented, only promising studies which seem to investigate part of the way to the answer of a problem are endorsed, and even then only on a step by step basis. In a number of cases prefeasibility studies have indicated that the wrong questions have been asked or that other studies have to be carried out before it will be possible to define the original question to such an extent that answering it becomes possible.

In all those cases the MOR "analyst" is the mediator between executive management and specialized superspecialists. He has to understand both categories to such an extent that he can make them talk to one another in a common language as well as trust one another. He has to show all parties concerned their relative importance in the decision making process. Often it is easty to use schemes like figure 2 for that purpose. Schemes, however, must not become an institution, they are just another aid to problem definition and solving, just another "model", a simplification of reality, to which they have to be adapted every time.

7 RESUME

It is hoped that this paper has brought some understanding to the structure of problem solving, especially connected with helicopters. Military Operations Research, as used within the RNLAF is a tool, a mediator between executive management and specialists, helping the manager to understand the problem and the most influential parameters affecting solution, so he can make his decisions in a well-founded manner taking into account and in proper perspective all constraints he has posed or has to live with.

8 REFERENCES

1) R.J.W. Merison, Krijgsmacht en Operations Research, article in De Militaire Spectator, jaargang 147 nr. 7 juli 1978.

2) T.J. Stahlie and R.J.W. Merison, Military Operations Research for the RNLAF, in Systemanalysen für die Luftrüstung by R.K. Huber and J.M. Dathe, Oldenbourg Verlag, München 1978.

3) H.M. Wagner, Principles of Operations Research Prentice/Hall International, Inc. London.