ECONOMICS, ENGINEERING, OR O.R.

(as presented to the O.R. Society on Monday 23 November 1970 by A.H. Milkop)

This talk was provoked by the idea that seems to be prevalent in some quarters, that O.R. and a computer file may be the panacea for all ills. This impression will do O.R. no good for one's opinion of it can only be deflated. It is almost as serious as not recognising the value of O.R. at all.

O.R. techniques really had their big boost during World War II, and were then the province of the mathematician. Its present position does not suggest a defined parentage, and O.R. can be seen rearing its head in university

(a)   Economics Departments

(b)   Engineering faculties

(c)   Information Science or Computer Science Departments.

(d)   Separate Departments, especially in the United Kingdom or United States, but usually with some euphemistic name like "Management Science".

(e)   Mathematics Departments.

I feel, however, that the mathematicians are getting purer and purer and abstracting from reality while they search for infinity and the rigorous solution to the general case. The practitioner meantime is content with a 30 year time horizon, the businessman might use 5, while the politician may find it difficult to see past the next general election always less than 3 years away. The mathematician seems to have dis- owned O.R. in the same way as he disowned practical statistics and left it to economists and psychologists.

Structure of O.R. Problems

(1)   Problems are generally of 2 types:

     (a)   Optimising the operation of present systems

     (b)   Optimising the allocation of development
           expenditure.

(2)   The objective function for private enterprise is
     fairly simple as it can be stated as the maximisation
     of profit or return on shareholder's funds.   Govern-
     ment cannot define its own objectives through the same
     rose-coloured spectacles and qualifies its objectives
     by considering

     (a)   Social problems - the involvement of people and
           their homes;

     (b)   Labour problems - proposals to become more capital
           intensive and displace manpower would not have the
           same desirable effects in Wanganui as in Wellingtor

     (c)   Political pressures.

     The economist is best fitted to define the objective
     function.

(3)   Physical laws such as climate and the potentialities
     of a large number of possible processes with their range
     of input requirements and products can best be assessed
     by the engineer.   The economist should be able to
     evaluate likely product demands, market values, and the
     effect of advertising, as the laws of supply and demand
     are properly the field of the economist.

(4)   There are a number of constraints that need to be taken
     into account in building up the structure of the model,
     namely :

     (a)   infrastructural (i) availability of labour skills
                                   (economist)

                       (ii) cost of labour (economist)

(iii) availability of fuel
                              and power (engineer)

                        (iv) availability of water
                                        (engineer)

(b)   Government statutes (i) hours of work and working
                               conditions (accountant)

                        (ii) taxation, taxation in-
                             centives, subsidies
                                        (accountant)

                        (iii) tariffs (accountant)

                        (iv) royalties, rates;
                                        (accountant)

(c)   Availability of finance & cost and its cost
                                        (accountant)

(d)   Possible sites and costs   (engineer)

(e)   Transportation cost, logistics   (engineer)

(5)   The above set the structure of the problem.   It now
       needs to be verified as a true representation of the
       actual system.   The data also needs to be reliable,
       as a sophisticated analysis of unreliable data can be
       rated dubious to the nth degree.   While the accountants
       argue over LIFO (last in, first out) and FIFO (first
       in, first out), the O.R. man would do well to remember
       GIGO - "Garbage in, garbage out".

(6)   The optimal solution will now be found through trial
       and error of different techniques.   These range from
       extremely sophisticated analyses to straight mundane
       bush arithmetic.   For the latter I make no apology;
       in fact, I feel that the computer print-out may hold
       some magical or mystical aura.   I am convinced that
       the O.R. man needs to be problem oriented;   the

                        - 3 -

knowledge of a marvellous technique with no practical application has the same effect as the knowledge of techniques and an inability to employ them - both will quickly open the door of the tradesmen's entrance, and provide a one way ticket to an unemployment benefit.

(7)   The last stage is a sensitivity analysis.   Point estimates are far too common and imply an unjustified accuracy.   I wonder whether the professors of statistics have let us down, as their explanations on uncertainty, risk, and confidence intervals have not permeated.   The sensitivity of the solution to variations in important parameters must be checked out.

In closing I would submit that projects are not solely the province of the O.R. man who may be trained as a model builder and a number cruncher.   Rather the expertise and skills of the economist (social, economic effects), the engineer (processes and logistics) and the accountant (financial) are needed right from the start in model development to ensure that the various inputs are correct and a higher probability of implementation of the final solution.   This view is the same as that of Ackoff, Arnoff, and Churchman when they represented in their classical text on O.R. now with its faded red cover, the successful O.R. needed a team approach with people like physicists, mathematicians, and psychologists.

I would conclude by suggesting that O.R. has not yet been able to find its spiritual home;   I consider that the Civil War over ownership and shareholding will wage for a time yet.