<table>
<thead>
<tr>
<th>In this issue</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Setting up a Value Programme</td>
<td>5</td>
</tr>
<tr>
<td>by R. Dick-Larkam</td>
<td></td>
</tr>
<tr>
<td>The Challenge of V.E. – Value Training</td>
<td>9</td>
</tr>
<tr>
<td>by Frank Bowyer</td>
<td></td>
</tr>
<tr>
<td>Developing and Organising an Effective Value Engineering Programme –</td>
<td>15</td>
</tr>
<tr>
<td>Part 3: A Case History on the Largest Scale</td>
<td></td>
</tr>
<tr>
<td>by B. G. Matossian</td>
<td></td>
</tr>
<tr>
<td>Theoretical Evaluation of Function</td>
<td>21</td>
</tr>
<tr>
<td>by Arthur Garratt</td>
<td></td>
</tr>
<tr>
<td>Purchase Cost Estimating and Analysis</td>
<td>25</td>
</tr>
<tr>
<td>by K. F. Boddy</td>
<td></td>
</tr>
<tr>
<td>Negotiation and Specification Checklists</td>
<td>31</td>
</tr>
<tr>
<td>An Introduction to Value Management</td>
<td>41</td>
</tr>
<tr>
<td>by D. I. Speirs</td>
<td></td>
</tr>
<tr>
<td>An Analysis of the Method of Value Analysis</td>
<td>45</td>
</tr>
<tr>
<td>by C. F. Graham</td>
<td></td>
</tr>
<tr>
<td>Change is a Challenge</td>
<td>53</td>
</tr>
<tr>
<td>by K. R. Whyles</td>
<td></td>
</tr>
<tr>
<td>The Value Engineer’s Bookshelf</td>
<td>57</td>
</tr>
<tr>
<td>Selected Abstracts of Recent Literature on Value Analysis/Engineering</td>
<td>63</td>
</tr>
</tbody>
</table>

Pergamon Press
The Operational Research Quarterly is an international journal which examines the broad scope of operational research as the application of scientific analysis to management problems. This important publication covers all aspects of management including administration, organisation, economics, work flow, measurement, and productivity, which are directly related to man's technological environment.

Operations research has an established position in industrial fields, such as building, health, engineering, construction, fuel, power, management information and local government problems policy. It is also being developed in other areas, including banking, commerce, manpower and implementation.

Papers deal with forward planning, the development of management control systems and the way in which management organises itself to achieve its objectives. Emphasis is placed on a practical approach, oriented to the solution of the real life problem.

Please write for an Index and information leaflet giving full details and subscription rates.

Published for the Operational Research Society by

Pergamon Press
Headington Hill Hall Oxford OX3 0BW England
Maxwell House Fairview Park Elmsford New York 10523 USA
In this issue

Editorial: Value Visibility

Setting up a Value Programme
R. Dick-Larkham
Manager of Value Engineering,
The British Oxygen Company Ltd.

The Challenge of V.E. – Value Training
Frank R. Bowyer
Consultant,
Value Engineering Ltd.

Developing and Organising an Effective Value Engineering Programme – Part 3: A Case History on the Largest Scale
B. G. Matossian
B. G. Matossian and Associates

Theoretical Evaluation of Function
Arthur Garratt
Technical Director,
Value Engineering Ltd.

Purchase Cost Estimating and Analysis
K. F. Boddy
Senior Buyer,
J.C.B. Chasside Ltd.

An Introduction to Value Management
D. I. Speirs
Harold Whitehead & Partners Ltd.

An Analysis of the Method of Value Analysis
C. F. Graham

Change is a Challenge
K. R. Whyles
Group Methods Engineer,
Automotive Products Company Ltd.

Checklists

The Value Engineer’s Bookshelf

Abstracts [98] to [103]
Aims and Scope
The aim of Value Engineering is to encourage the wider use of Value Analysis/Engineering techniques throughout industry.

Value Engineering provides a link between those who are practising and studying the subject all over the world.

It is the policy of the journal to contain information which promotes the wider and more efficient application of Value Analysis/Engineering methods. Its abstracting service will draw attention in a conveniently summarised form to the main publications on the subject throughout the world.

Key-word Index
Titles sometimes do not cover all the aspects of the subject referred to in an article, book review or abstract, and in order to assist readers with their information retrieval problem key-words have been placed at the top of each item in the journal.

To illustrate - the article 'Setting up a Basic Concepts' in the journal.

To illustrate - the article 'Setting up a Basic Concepts' in the journal.

The list of key-words will be built up issue by issue until a useful list of key-words covering Value Engineering subjects can be published in a future issue of the journal.

Reprint Service
Reprints of the articles and checklists appearing in Value Engineering may be ordered in multiples of fifty copies by writing to the Manager, Training & Technical Publications Division, Pergamon Press, Headington Hill Hall, Oxford.

The Regional Editor for North Eastern United States

 Lt.-Col. Bert D. Decker, USAFR (Ret.), Director, Project 3000, Milliard Fillmore College, State University of New York at Buffalo, Hayes A, Buffalo, N.Y. 14214

Southern United States
Mr F. Delvis, Lockheed-Georgia Company, Marietta, Georgia.

Western United States
Mrs Patricia B. Livingston, Management Systems Analyst, North American Rockwell Inc., Space Division, Downey, California.

United Kingdom
Mr R. Perkins, Technical and Works Director, Barfords of Belton Ltd., Belton, Grantham, Lincs.

Europe
Mr P. F. Thew, Manager - Industrial Engineering, I.T.T. Europe Inc., 11 Boulevard de l’Empereur, Brussels 1, Belgium.

Regional Editors

Canada
Mr C. Bebbington, Value Program Coordinator, United Aircraft of Canada Ltd., P.O. Box 10, Longueuil, Quebec.

North Eastern United States
Lt.-Col. Bert J. Decker, USAFR (Ret.), Director, Project 3000, Milliard Fillmore College, State University of New York at Buffalo, Hayes A, Buffalo, N.Y. 14214

Southern United States
Mr F. Delvis, Lockheed-Georgia Company, Marietta, Georgia.

The The publisher reserves the right to dispose of advertisement colour blocks after twelve months, monochrome blocks after six months with or without prior notification.

Value Engineering, June 1969
Value Visibility

Conversations concerning what Value Engineering is or isn't have always impressed me as useless debates. For creative reasons, I deem it advantageous to discuss what Value Engineering might be. Further, because of its many unique aspects, I claim it has much more potential than many realise. However, if one were to insist that I place the important essence - the real guts - of Value Engineering on one Editorial page - in 900 words at most - I would recklessly cover the beautiful white space with the topic of Value Visibility.

Value Visibility can be defined as both a result of effective Value Engineering and a basis for profitable decisions. No matter what Value Engineering Job Plan or creative techniques one uses, all is wasted if Value Visibility is not produced. Further, Value Visibility can not be produced by Traditional Cost Analysis alone. One must go beyond Traditional Cost Analysis which is total product and organisational oriented rather than verifiable function oriented.

Value Visibility is not produced - repeat not - when one places a cost on the functions in a product. To achieve Value Visibility, one must place a cost on every verifiable function in the product. There is a vast difference between a function and a verifiable function. And in that vast difference hide bundles of wasted bucks!

A function has been defined as a verb and a noun. It tells what something does. For instance, we can say that a radar 'detects/objects'. That, in essence, is what a radar does. But placing a cost on the function 'detects/objects' is the same as placing a total cost on the product radar. Traditional Cost Analysis does that. So doing is inadequate. It does not provide Value Visibility.

A verifiable function is a demonstrable verb and a measurable or countable noun. Because a word by itself has no meaning, there is no such thing as a demonstrable verb by itself. There is only a demonstrable verb and a measurable or countable noun. One can not, for instance, point at the many meanings of the verb 'support/weight'. This means that it is the meaning of the verb-noun combination which is visible. Only that combined meaning can be demonstrated and agreed to on the non-verbal level without using other words.

This, then, is the scientific, semantic trick. We place a cost on a function whose meaning is visible, demonstrable, and therefore, verifiable. This and this only, provides the required, precise Value Visibility. Both the cost and the meaning of the function are visible. Otherwise, we are placing a cost on vagueness. Further, it is a sad vagueness whose meaning upon which we can never agree. Take the function, 'detect/objects'. Can you demonstrate its meaning on the non-verbal level without using other words? No one has ever done it yet for me in a satisfactory manner. This is because many different sets of verifiable functions can detect objects. Objects can be detected with pulse radar, frequency modulation radar or optically. Such a function can be defined as a gestalt (function of a whole) or composite function.

Value Visibility is more than merely placing a cost on every verifiable function in a product. Verbs and nouns have verifiable modifiers. The verifiable modifiers of the verbs usually concern performance of the function. How far away must the object be detected? The verifiable modifiers of the noun might include aspects such as the size of the object or in some cases its necessary degree of polish. Costs of these verifiable functions must be in relation to those verifiable modifiers or value is not visible.

In addition to the above, Basic Function Value Standards must be developed either by formula or comparison and Cost-to-Standard Ratios computed if precise value is to be made visible. Value Visibility is also improved when those verifiable functions which contribute to or enhance required product characteristics such as reliability are annotated. In other words, the essentiality of every verifiable function must be clearly displayed.

The above are the bare essentials of providing Value Visibility. When realistic costs have been placed upon such meaningful symbols, even a manager can tell how the product should be redesigned. Design simplification can only be achieved when such Value Visibility has been achieved. Every other important aspect of Value Engineering - and there are other important aspects - aims at that purpose, that 'raison d'etre', that function of Value Engineering which is 'provide/value visibility'. It allows managers to make decisions which 'create/value'.

To me, this verifiable Value Visibility promises much more than merely a profitable war on waste. Its real promise stems from the fact that it allows us to much more realistically estimate what a product should cost before its design is finalised. This gives us a predetermined objective for innovative processes!

No process can be optimised unless it has verifiable functions which, if varied, vary a verifiable result. Because of this, Value Visibility is the key to laboriously optimising creative, scientific processes. This is our creative challenge and awesome opportunity.

If we use Value Visibility to optimise creative, cooperative, scientific behavior, we might learn to apply science where science is urgently needed in social and political areas. Our present frustrations, our stupid and wasteful wars, our paralysing fear of atomic annihilation, our profitless poverty in the midst of plenty, all indicate that any improvement of creative cooperation would be welcome.

Value Engineering, June 1969
Selective Dissemination of Information (S.D.I.)

An increasingly vital requirement is a service by which selected items of information are shot at selected individuals or groups. This service, known as Selective Dissemination of Information (S.D.I.), may be external; or it may be run internally as a service of, for instance, a research and development department.

It starts with a statement by 'consumers' – in the laboratory, office, or plant – of their interest profiles. Thus a blast furnace operator may wish to be kept informed of developments in iron ore resources, coke production, sintering, pelletising, and blast furnace operation, but is unlikely to request information on steel-making or the properties of steel.

He may as a result receive 20 sheets a week each being an abstract of an article appearing in a journal, or book, or of a translation or patent – together of course with a reference to permit retrieval. Single sheets are preferred, since the reading of more than half-a-dozen abstracts one after the other has a strong soporific effect. It is comparatively easy to deal with a pile of individual information sheets, scrapping those that seem useless, filing those that may ultimately be useful, and asking for additional information on items of immediate interest and potential value.

Many technical bodies provide their members with abstracts, but S.D.I. is still relatively rare.

* * * *

The Best Source of Information is Still the Man who Knows

The best source of information is still 'the man who knows'. Endless examples could be given of how a telephone call, or a letter, to a personal contact saved weeks of work. Such contacts arise in the main from meeting people of similar interests at learned societies, technical and business committees, and in purposeful travel.

To remain useful they must be balanced by giving as well as getting.

Ability to cope assumes that professional men of all types maintain their own basic store of information, including standard texts, reference books, and the journals of the societies of which they are members. Further, that they file incoming information according to a system that they understand and which desirably permits of personal retrieval.

* * * *

Colour Dynamics

In Using Colour to Sell* Eric P. Danger's analysis is perfectly balanced between the emotive and practical aspects of colour. Colour is such a universal, such an obvious matter that definitions become difficult. Few people dare to write about it. Colour is a vital element in any part of selling but just how concerned are the manufacturers with the uses and abuses of colour?

His study covers colour and its applications in every area of selling: in consumer goods, in packaging, in industrial goods, in building materials, in display. He also analyses the use of colour in the home, selling, and industrial environment. He traces the reasons why certain fundamental colours (like red, red-orange, yellow) are the most desirable for food packaging because they are eye catching and because they suggest freshness.

* Gower Press, 60s.
Applications – Basic Concepts

Setting up a Value Programme


Describing the initiation of Value Analysis in the Equipment Division of The British Oxygen Company Limited, the author highlights the reasons why – for the first two years of its operation – the technique was not very successful. Then a fresh approach was tried which embodied training, public relations, and a programme which was designed to produce results. Value Analysis has now been operating for two years on these revised lines of approach. Seventy pieces of equipment have been examined with an overall savings on direct costs averaging 35 per cent.

When the Managing Director of a small company is convinced that Value Engineering can do something for his company there is usually little difficulty in starting a programme. He often starts it himself and consults with the few people involved gives quick answers. The Value Engineering team in such an organisation is usually composed of top decision-makers so that implementation of results presents no great difficulty.

As the company size increases so does the difficulty of implementing an effective programme. Convincing the Managing Director or Chief Executive may be no more difficult, but in turn he has then to appoint someone to set-up the programme and also convince his managers working in different spheres of activity that the technique is a good one. Managers may not be convinced of the potentialities of the technique and thus give it a low priority. The person appointed to set-up the programme may not have quite the personality required, or he too may not be wholly convinced of the techniques potentialities. Lower management may look upon it as a waste of time, or even a ‘witch-hunt’ and what may be worse, become fearful that it is an encroachment on their job. Thus there are many ways in which it can be doomed before it even starts.

In 1964 Value Analysis was introduced in the then Equipment Division of The British Oxygen Co. Ltd. The Chief Executive was convinced of its potentialities, but for the first two years of operation it was not very successful and produced few results. There were a number of reasons for this, the principal ones being:

1. Ignoring the Team Principle
The work was carried out by a number of value engineers at the centre and the results ‘imposed’ on those who had to implement them. If a value exercise is to be successful it must be carried out by a team of people, comprising development, design, purchasing, production and marketing functions of the particular product under consideration. It is usually valueless for the work to be done by someone else, as extreme difficulty will be encountered in getting the resulting design accepted, whereas if the new design is conceived by the team who will have to put its detailed design and manufacture into effect this resistance vanishes.

2. Resistance to New Ideas
It is human nature to resist change. When new ideas are imposed on people they immediately become defensive and obstructive. Draughtsmen invalidate cost savings, in many cases unwittingly, by retaining or introducing chamfers, radii, high quality finishes, tight limits, etc., where these have been specifically removed in order to reduce cost. Production engineers can seriously delay the implementation of a new idea by raising difficulties in production.

This resistance to change must be overcome by a process of education and dissemination of information. The whole principle of Value Analysis is co-operation and involvement and it is essential that everyone knows what it is all about.

3. Wrong Use of Value Engineer
The role of the value engineer should be to coordinate, collect information, and as an outsider who is not in daily contact with the product, he may be able to throw in new ideas. He should not have to do design or development work as this is only extending the facilities of these departments. Working in isolation, however, he was forced to do these things in BOC with the consequent slowing down of the analysis, and the final non-acceptance of his ideas by Design and Development.

4. Lack of Information
One of the great difficulties in carrying out a V.A. exercise is obtaining full and correct information on the present product. This was greatly aggravated by the isolationist attitude of the V.A. team as no-one else had a clear idea of what the information was wanted for and were, therefore, reluctant to give it.

5. Lack of Effort
Value Analysis was not given any priority by management and thus it always went to the end of the queue when any design, development, or production engineering effort was required. This meant that most of the work fell on the value engineer with the consequent slowing down of the V.A. effort.

6. Small Batch Production
Majority of the Division’s products fall into the category of small batch production which have frequent changes in design over the years. When an opportunity presents itself for saving money by carrying out Value Analysis it can so easily happen that although the unit savings are large, the cost of implementation spread over the short period that remains of the equipment’s life completely nullifies these savings. Under these circumstances it is essential that the exercise be carried out quickly and some judgement be used to optimise the benefit by restricting the exercise instead of carrying it out fully.

7. General Lack of Appreciation
There was a general lack of knowledge of the technique. Few were really willing to spend time on committee work and even less to do the work entailed between meetings. It was treated as a time wasting occupation when there were so many other pressing jobs. At the factories value exercises were sometimes thought to be 'witch-hunts' to find out where production engineers were inefficient.

In order to overcome these difficulties in 1966 a fresh approach was taken, and it was decided that three major items were necessary to make it really work.
(a) Training
(b) Public Relations
(c) A Programme which would produce results.

TRAINING
A training programme was set up to run three-day seminars for about twenty people once a month. During these seminars the participants were divided into syndicates of four or five and each one tackled a project. In all cases this demonstrated most forcibly that savings could be made and that these were in some cases quite large. These projects were not, of course, tackled in great depth nor was there time to make outside enquiries or factual estimates. There was, however, an estimator and a buyer available to give the syndicate advice on these subjects.

These projects were regarded as exercises, and although they were carried out on current equipment there was no deliberate intention of implementing the results. Even so a number of suggestions made at these seminars were subsequently incorporated in the equipment and two patents were taken out on ideas which originated from this work.

These seminars were attended by staff of all skills and were open to nominations from any of the cost-producing sectors and at any level. The syndicates were arranged to have a cross-section of skills.

In all, seven seminars were held at which about 150 people were trained in the technique. The response was excellent and it is estimated that more than 90 per cent were convinced of its usefulness and enthusiastic to start working on the equipment for which they were responsible. By the end of 1967 nearly all the design office personnel had been trained and the different attitude to cost in this department was very noticeable.

At the end of 1967 it was felt that the value programme was not proceeding quite as it should, due to the lack of participation by the managers. None of these had been on the courses and many paid 'lip-service' to the technique without wholeheartedly supporting it. In order to rectify this a two-day conference was held which was attended by the Factory, Development and Marketing Managers, where the principles of the technique were explained. An exercise was set which produced numerous ideas supporting it. In order to rectify this a two-day conference was held which was attended by the Factory, Development and Marketing Managers, where the principles of the technique were explained. An exercise was set which produced numerous ideas supporting it. In order to rectify this a two-day conference was held which was attended by the Factory, Development and Marketing Managers, where the principles of the technique were explained. An exercise was set which produced numerous ideas supporting it.

V.A. Section became a source of information on new materials and processes together with their cost and suitability. A comparative cost manual was issued which set out the comparative cost of using different materials for any job and it is the intention to add many more sheets to this manual covering tolerances, finishes, processes, etc.

A distinctive pattern of report cover was used so that reports on V.A. work could be picked out easily.

All these efforts tended to help the relations between the section and other members of the staff. There is nothing more frightening than not knowing what is going on and it was felt that telling everyone who was likely to be involved about all that was happening would be the quickest way to acceptance.

THE VALUE PROGRAMME
Obviously all the training and public relations would have meant nothing if results were not actually achieved to prove that the technique could save the Division money. It was felt, however, that in order to achieve the results the right atmosphere had to be created first particularly in view of past history. Thus there was an interdependence which necessitated work on all of them at the same time.

At the end of 1966 a Value Analysis programme was set up which necessitated weekly meetings of four working parties covering four products groups. Value Analysis - cost reduction - was worked on first as with this you can positively show the results in terms of money saved per annum whereas with Value Engineering - cost avoidance - this is not possible. The latter will, of course, give a greater return and should be the eventual aim of all programmes. We have found that with this total programme that Value Engineering is eventually practised without any deliberate action; it is the natural follow on when it is seen that the technique works.

Each working party consisted of a design, development and production engineer normally working in that field of activity, a buyer, who was a member of the V.A. Section staff and serviced all working parties and a value engineer who acted as secretary. All working party meetings were chaired by the Chief Value Engineer.

None of the teams had a marketing officer as a permanent member; this was partly due to an acute shortage of staff at the time and also as his principal contribution would be at the beginning and end of a project. They were often co-opted for special advice, and worked closely with the value engineer when their advice and help was needed.

Each part-time member of the team had the attendance at the meetings as his number one priority, and he was given an average of one day per week to work on tasks set him by the meetings. Thus 1/2 days per week were, on average, taken up doing Value Analysis. Attending four meetings, doing tasks set him by the meetings and other tasks from design and development mentioned above occupied the buyer on a full time basis. It was found that each value engineer could service two working parties acting as secretary, collecting information, etc., and in addition as one was skilled in estimating he could act in this capacity for all teams and the designers when necessary. The second value engineer also acted as secretary to two teams and, in addition, acted as information officer, indexing all information and disseminating it to the right quarters.

Projects for the working parties were chosen by looking at the total sales value of the products. In each product group the products were arranged in order of their sales value (selling price x quantity) in descending order. These lists were then vetted by the General Managers concerned who knew which products might not have a very long life in front of them, or had only very estimates of cost on ideas, and this service became more generally used as time went on. A buying service to explore the market for any bought-out items needed by design or development was also offered and used.

PUBLIC RELATIONS
Steps had to be taken to publicise the technique within the Division and dispel fears that it would take responsibility, prestige or status from the various members of the staff. To achieve this, a booklet was written and circulated to all members of the staff, and although a proportion did not read it, it helped to get the message over to those that did.

Bulletins were issued which were compiled from items of news on new materials, components and other things which might be adopted to save money. It was published in the design office that the V.A. Section had an estimator who was willing to do rough
recently been marketed, etc. The resultant list gave the priority for the work in an order which was likely to bring the greatest return most quickly.

The working parties did not, of course, finish one project before they started the next, as in the middle of a project there are often considerable delays while development work is being done, quotations are being obtained, while the market is being surveyed to find suitable standard products to incorporate or many other time consuming operations. At this time another project would be started and on occasion as many as five or six might be worked on concurrently.

RESULTS
The teams have now been working for two years and the value of the net savings are substantial. In all, seventy pieces of equipment have been examined, the production quantities varying from 25 - 100,000 per annum. Overall the savings on direct or prime cost of these items averages at 35 per cent.

The ratio of the proposed savings per annum to cost of the exercise worked out about 8.5:1 but unfortunately as is inevitable, implementation lagged behind. During the first year the exercise cost about eight times the actual savings made, but during the second the position was retrieved and the actual savings were about three and a half times the cost. It is certain that during the third year the actual savings will approach closely to those proposed and be in the order of eight to one. Even so, the actual implemented savings amount to about 4 per cent of the total direct costs of the Division and this figure will increase considerably as those accepted proposals now in the 'pipe-line' of implementation come into effect.

There is a great problem of getting proposals implemented speedily. It has been generally found by industry that on average this takes between one and two years and the results that have been obtained in BOC confirm this. Plotting the curves of proposed savings and implemented savings on a time base shows that they are moderately parallel but are about eighteen months apart. The ratio of implemented savings to cost will thus approach the ratio of potential savings to cost as time goes on. It must, of course, be realised that in all these figures only the first year’s savings are taken into account, whereas in fact the savings are continuing to be made for as long as the product is manufactured, and in general only those products which have about a five-year life in front of them are value analysed. It could thus be argued that the ratio of real potential savings to cost of effort are over 40 to 1.

The Seminar Approach to Value Analysis
Shown below is the Job Plan Schedule in the form used by the Eclipse-Pioneer Division of the Bendix Corporation and fully described in the I.R.E. Transactions PEP-5, December 1961 by Mr A. Wojtowicz.

The seminar agenda is designed to conform to the six steps of the V.A. Job Plan. The job plan schedule is given to each member. Successive days are given over to detailed analysis by the training staff and guest speakers of the six steps of the job plan and also relevant subjects such as habits and attitudes, human relations, creative behaviour and so on.

Following these instructional talks at the beginning of each day approximately an hour and a half is allotted to the teams for the workshop portion in which they work on their assigned product.

The coordinator’s staff, who serve as team advisers, constrain the teams to devote their efforts solely to the particular phase of the job plan which has been designated for that day.

VALUE ANALYSIS
JOB PLAN SCHEDULE

<table>
<thead>
<tr>
<th>SESSION NO.</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>HOURS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>INITIAL</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>INFORMATION</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PHASE</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. WHAT IS IT?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. WHAT DOES IT DO?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. WHAT DOES IT COST?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. WHAT IS IT WORTH?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SPECULATIVE</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>INFORMATION</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PHASE</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. WHAT ELSE WILL DO THE JOB?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ANALYTICAL</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PHASE</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. WHAT DOES THAT COST?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PLANNING</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PHASE</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OVER SIMPLIFY</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TRY EVERYTHING</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PUT $ SIGN ON EVERY DECISION</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>USE YOUR OWN JUDGEMENT</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EXECUTION</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PHASE</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SUMMARY &amp; CONCLUSION</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PHASE</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TRANSLATE BARE FACTS INTO MEANINGFUL ACTION TERMS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FINAL JUDGEMENT</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PRESENTATION</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SELLING</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Value Engineering, June 1969
Roman Bath Owner Hit Bad Times

Roman Villa at Hemel Hempstead
The complete excavation of a Roman villa at Gadebridge Park, Hemel Hempstead, Hertfordshire, has yielded a 300-year panorama of life in Roman times.

The site was continuously occupied from the end of the first century A.D. until the onset of the Dark Ages in the fifth century. Mr David Neal, of the Ministry of Public Building and Works has spent six years seasons excavating the entire site. He finds that the earliest building on the site, put up towards the end of the first century, was a wooden villa with a detached stone-built bath-house.

Little remains of the wood, but as times grew more prosperous the bath-house was extended, and by the middle of the second century A.D. the wooden villa had been rebuilt in stone. The bath-house, but not the villa, was equipped with central heating.

The 'Stop-Go' of 3rd and 4th centuries
As the boom conditions continued, the baths were again extended and two farm buildings about 100 ft long were built near the villa. The agricultural economy of the villa, which must have been flourishing if such large buildings were required, was probably based on mixed farming. Verulamium (St. Albans) which was only a few miles away was probably the chief market.

But by the second half of the third century the villa seems to have been sharing in the general economic depression that hit the whole of Britain, and the two large farm buildings had fallen into disuse.

At the start of the fourth century, however, prosperity had returned. Twin towers, apparently two-storied and warmed by hot air heaters under the floor, were built at each end of the central section of the villa. A gatehouse was added to the courtyard and servants' quarters were built near the villa.

A British Fountain or Trevi
Mr Neal believes he has identified the site of a spring which probably fed the pool. Just north of the pool, lying in a depression filled with gravel and sand, he found about 150 coins, all minted in the mid-fourth century and before 353, with some brooches and small jewelry.

These finds may have been votive offerings thrown into the spring, while the bath was perhaps an attempt to exploit the spring water. If so, it is tempting to suppose that the bath owner may have claimed medicinal properties for his spring water. Only a quarter of a mile from the site, at a place called Pickett's End, medicinal springs were exploited in the 1850s when spas were again in vogue.

Intelligent Standardisation
1. The question often asked about standards - do they stifle initiative? The answer is - no, providing they are developed and used intelligently. The challenge of any limiting factor induced by standards should be accepted; after all, no composer has ever been limited by the 12 intervals of sound accepted as a musical standard.

2. Once a decision has been made to standardise it requires a conscious effort to achieve and then to maintain it. Time creates disorder, so that if surveillance is removed the benefits can rapidly diminish.

3. Standards must be dynamic, not static, and therefore alterations to them must be accepted and introduced as soon as is practical. Apart from keeping standards up-to-date with use and experience they must keep pace with technical development. Wherever a new process or technique arises and its advantages can be utilised, there must be no hesitation in amending the standard.

Systems Design Principles
1. A Systems Design must be Both Passive and Active. In operation, the system should be passive so long as expectations are being realised. On the other hand, the moment that expectations are either not met, or are exceeded, the system design must be active and reflect the changed situation.

2. A Systems Design is Almost Always in a State of Dynamic Imbalance. This principle stems from the dynamic nature of the entity - the enterprise - for which the system is designed. The human, physical, and economic variables - both internal and external to the system - are in a constant state of flux. Further, management decision based on the findings of a given system is likely to have consequential effects upon both subordinated and superior systems.

3. The Directional Design of the System is toward Achievement of the Enterprise Objectives. The design of the root, subminor, minor, component, and subsystems should make a progressive contribution toward the goal of the whole enterprise system. The combined results of all systems must achieve the objectives of the enterprise.

4. A Systems Design is Objective. To be objective the information used as input for the systems design must be quantitative. Much qualitative information is translatable to quantitative information through the use of mathematical and statistical techniques. Objectively also introduces the possibility of measuring the effectiveness of the management decision based upon the operating results of the several systems.

5. Simplicity in Systems Design is Essential. Simplicity is of course a relative term. However, sufficient simplicity is necessary to enable uniform interpretation of the results of the controls, resulting from the systems, prior to the management decision.

6. The Operation of the Systems Design Should be Economical. Where a choice between manual and computer operation of the system exists, the most economical method, overall, should be selected. If the relative economy of the two methods is known or can be approximated beforehand, the systems design may be so oriented for most economical operation.

'An Odd Ode to all Physicists'
If what Albert Einstein said was right, it was true, that he knew, the Universe, although unbounded, was Finitie. Mass and Energy, equivalents are which give us light from every star. Surely it is wrong of us to say in our most dogmatic way, the reason why no body can be forced to, exceed the speed of light, is because, its mass, if this were so, must have reached the INFINITE.
Continuing his series of five articles on 'The Challenge of V.E.', Mr Bowyer states 'by no stretch of the imagination can the story of V.A./V.E. training be counted a success... (and) viewed by the potential purchaser it must present a bewildering picture of chaotic contradiction and irresponsibility.' He contrasts the training given in the United States with that given in England and considers that greater emphasis should be placed on implementation in the latter country.

Guidelines in the selection of a training programme are given and the need for the right "climate" emphasised. Mr Bowyer asks: Can agreement be reached as to the most effective method of training in V.A./V.E.? Can industry be persuaded to give value engineers a fair chance to acquire skill in V.A./V.E.? These and other matters are the challenge ahead.

A very large proportion of training expenditure is wasted because it is planned and carried out without proper analysis of the needs and problems of the organisation. Concentration on getting maximum grant back from the training board is a good way to lose money in the training function; instead, line management should concentrate on getting the most out of their human resources.

Christopher Gane,
Management Today (November 1968)

The Present Situation
The regular reader of articles on V.A./V.E. is presented with a series of success stories, each attempting to outvie the other in its claims for bigger and better savings or more efficient methods of programme promotion. In all probability the regular reader has already joined the ranks of the converted anyway and therefore, either obtains smug satisfaction that all is so well with his world; or reflects sadly that it is just as well that the failures are not so widely publicised or his world might come crashing about his ears. By no stretch of the imagination can the story of V.A./V.E. training be counted a success. It might well be so construed by any one expert peddling his own personal panacea, but viewed by the potential purchaser it must present a bewildering picture of chaotic contradiction and irresponsibility. For the author to add yet another interpretation would be to fall into the same trap; yet there is undoubtedly a need for a realistic appraisal of the present situation in order that remedial action can follow. That the writer for the past three years has been privileged to be working on an assignment to specifically investigate the efficacy of V.A./V.E. training and this permits him access to much material felt to be significant to the solution of the training problem. That he works for a particular training organisation obviously exposes him to the danger of bias, both as regards method and of industrial sampling. The purpose of this article therefore is not to come up with a ready-made solution to the V.A./V.E. training muddle, but to try and highlight some of the survey findings in order that those having a vested interest in V.A./V.E. training can collaborate in the task of promoting its efficiency. This responsibility must obviously not be shouldered by the training organisations alone and it is suggested that the following could form the nucleus of opinion and responsibility that could ultimately shape the new material.

The Value Engineering Association
The Value Engineering Magazine
Industrial Management
The Training Consultants
The Professional Institutions
The Colleges and Universities
The Value Engineers
The Government

It's been this way for 21 years. Why change?
Value Engineering has changed. Many would have us believe that this change is negligible, that exactly the same methods as were propounded 21 years ago are as valid today, but the careful appraisal of companies having high returns on their investment shows a significant pre-occupation with training coverage and content. Strangely enough this high investment/return ratio has itself contributed to the lack of sound training programmes. In the early days Value Analysis could be compared to a very rich but unexplored goldfield. A few simple techniques permitted the pioneer to fill his pockets almost overnight. Money was there just for the taking. A new way of thinking came up with results far greater than the original. It was so powerful and had such wide application that any deviation from the original concept was still capable of cost reductions that made traditional methods appear futile.

There were also deviations that seemed likely to promise even greater rewards than the original. All of this was, of course, typical of the development of any management discipline, except for the unprecedented profit ratio and the fantastic growth rate that ensued. It never had the opportunity for feed-back more commonly experienced in the maturing of allied disciplines such as Work Study, Production Engineering, etc. Everyone was so eager for success that if a particular recipe failed another was quickly concocted with little regard of what could have been learned from the failure.

Sheer enthusiasm could, and did, carry many early programmes through the critical two year period that now is recognised as separating initiation and establishment. The first in the field could

* Mr Frank Bowyer is a Consultant with Value Engineering Ltd., of 60 Westbourne Grove, London, W.2.C.2, England. This is the fourth of a series of five articles. The three previous articles were: The Challenge of V.E.—First Appraisal (Vol. 1, No. 2, page 107); The Challenge of V.E.—The Theory Behind the Savings (Vol. 1, No. 3, page 165); and The Challenge of V.E.—Making the Theory Work (Vol. 1, No. 4, page 233).
get the gold by just picking it up, then having made their particular fortune sit back and belittle those that followed for wanting mining engineering! Because V.A./V.E. is so young many of those early pickings are still with us, but the first easy pickings have gone. At that time a company had a competitive lead if it used V.A./V.E., now that it is widely available the lead is in using it better than others.

This has resulted in many bringing to the disciplines all the sophistication and power of the latest developments in modern management. Not, many think, to give V.A./V.E. a more distinctive and acceptable image; but because it has rapidly become apparent that the field of application is far far wider than product cost reduction. The potential as yet untapped is enormous, but it requires much more than the simple tools that launched the disciplines, albeit that these too have as yet far from exhausted their capability. The demand for training spans the spectrum from the introduction of simple techniques of Value Analysis for Product Cost Reduction, right up to Planned Profit Programmes extending over several years and utilising every available resource within the company. This brings so any assessment of V.A./V.E. training needs must be interpretative of company needs, available resources and the development of methods suitable to the achievement of planned objectives.

U.S. and U.K. contrasted

If one attends what is considered a typical Basic Training Workshop in the U.S. and carefully analyses all that is presented and then compares it with a typical U.K. workshop, one is immediately struck by the lack of training content aimed specifically at lowering resistance to change during the implementation period. Likewise a glance through representative literature on V.A./V.E. originating in the States fails to find the heavy emphasis placed on the implementation problem as evidenced in Britain. U.S. seminars are far more PRODUCT oriented than ours are. Technology generally replaces the PEOPLE part of the U.K. programmes. In making this comparison care must be taken to segregate programmes in the U.K. that are slavish copies of what exist, but emphasis for implementation still favours authority or consultants or from academic institutions that have worked in such companies (practitioners (industrial executive staff regularly participating in project work but not fully employed as value engineers) in value project work but not fully employed as value engineers) in the States fails to find the heavy emphasis placed on the implementation problem as evidenced in Britain. U.S. seminars are far more PRODUCT oriented than ours are. Technology generally replaces the PEOPLE part of the U.K. programmes. In making this comparison care must be taken to segregate programmes in the U.K. that are slavish copies of what has been successful in the States since there are many training organisations that are doing just this, regardless of whether it is right for the U.K. environment. A survey of the impact of V.A./V.E. in the U.S. coupled with analysis of the S.A.V.E. proceedings gives clear indication of why the above difference exists. In many of the most successful U.S. programmes V.A./V.E. is a mandatory requirement to the procurement of contract. This makes V.A./V.E. part of corporate strategy, and although V.E. is not confined to companies competing for DoD contracts, value engineers that have worked in such companies are very much in demand and have spread their influence by writing, lecturing and job progression. People problems still exist, but emphasis for implementation still favours authority or a system when viewed through British eyes. Management in the U.S. is decidedly more conformist than in this country and therefore much more likely to accept a system once it has been proven. British management is notorious for its entrenched belief of individualism and whilst there are powerful arguments for and against both of these schools it is no good attempting to deal with management as one thinks it should be, when the reality is quite different.

If this is a fair and objective appraisal of the present situation several factors emerge that vitally influence the effectiveness of V.A./V.E. training in the U.K.

1. However successful the U.S. training methods are, their programmes will only succeed in the U.K. where the existing management structure and philosophy are similar, or one is prepared to base the whole programme on achieving that similarity.
2. If the American method is not applicable, company need alone is not going to govern training content, but company need plus motivation to accept V.A./V.E.
3. Since individualism projects its image onto and into the immediate environment the motivation to accept must be based on the hierarchy of needs as seen through the eyes of an individual, i.e. What is in it for ME as a person? What is it in it for MY profession? What will it do for MY group or department? How will it fit into MY company? What can it do for OUR country?

Each need will be seen as distinctly different from that of the other individuals, groups, companies, etc. and motivational emphasis should accent the above order of priorities or establish alternatives. Note how diametrically opposed this is to the state involvement and promotion in the U.S. Also to be considered is the fact that very few Americans are devoid of the profit motivation, even as individuals; whereas in this country it may be well down the list as a motivating force, which means that this in itself is rarely capable of arousing enthusiasm and its own, despite the fact that most U.K. managers if asked would consider that they were profit minded.

Training patterns in the U.K.

Over 70 per cent of the value engineers or Value Engineering practitioners (industrial executive staff regularly participating in value project work but not fully employed as value engineers) in this country have received their training either directly from consultants or from academic institutions that have worked in collaboration with consultants. The remaining 30 per cent comprise those who have never had any formal training whatsoever or have taken V.A./V.E. as part of work study or general management training. These figures are an estimate based on too narrow a band of sampling and may therefore be regarded as approximately; it will be interesting to compare them with the survey undertaken by this magazine in their recent questionnaire to value engineers.

Training consultants of necessity are achievement motivated. Their methods of training will be constantly under review in order to optimise their results and promote their image. This has a very serious disadvantage. Only the leaders in the field can afford to be open regarding their training methods and objectives. The remainder must either admit to a secondary status, which of course would be commercially unthinkable, or accent some difference in their approach that permits them to promote a deviation. With so many training organisations offering V.A./V.E., the difference of method and content have now become so pronounced as to cause grave concern. Many of these deviations are discernable for what they are, others are not quite so obvious. Most are to the detriment of the disciplines if measured against the yardstick of company success. Obviously it is extremely desirable that there should be some standard by which we can measure V.A./V.E. training.

Eventually there will have to be an independent survey to appraise training requirements so that there can be agreement on what constitutes an effective syllabus. Although only recently constituted the Value Engineering Association in collaboration with the Value Engineering Magazine could do much to promote such a survey and ultimately recommend approved courses. This, however, is very much in the future and many companies wishing to train personnel require an appraisal of the present practice and guidance for their immediate needs. Since the success of the programme depends so much on adequate training and staffing, the selection of the trainer is of prime importance and companies that are prepared to spend a little time to do this properly are more than compensated in the long term.

Selecting a Training Programme

Since the company can not possibly appraise the value of something it has never had the following guidelines will substantially increase the chances of picking wisely.

1. Do some window shopping. The reputable training organisations will always be prepared to come into the company and
If possible know in advance what the company are prepared to discuss training needs at some length free of charge and without obligation. They will not resent that other have had the same opportunity nor will they attempt to denigrate their competition.

2. High pressure salesmanship is always suspect. If the training organisation has a good product it has no need of such methods. If possible know in advance what the company are prepared to spend on training and then mentally match the training offered with the budget available. The client may have to come up in some instances, but programme initiation can start quite modestly and evolution be protracted. The returns will be proportionally modest but this should not stampede the purchaser into buying more than he had originally intended. The hallmark of reputable training is flexibility.

3. Beware of package deals. Good training should be tailored to the resources of the company and will require as much information about the environment as the purchaser wishes to know about the trainer. The reputable training organisations will provide training that spans the full function of management and will therefore know Management thoroughly; this allows the client to rate the training organisation on grounds more familiar to him. Any training for V.A./V.E. that does not have a deep understanding of modern management theory and practice is not worth considering.

4. The leaders in the field will make no bones about the need for depth training for the value engineer. It is to the credit of many value engineers in this country that they have pioneered successful programmes with nothing more than Basic Training Workshops as a background. The fact that many have won through after two or three years of hard struggle is the measure of their tenacity and entrepreneural opportunism. Often when they have proved their capability by sheer guts and thousands of pounds worth of savings, management grudgingly concedes that they might benefit from some advanced training. So often one then hears the remark 'If only I had known all this two years ago, how much easier it would have been'. The training needs of the value engineer are quite different from that of the co-opted team members and the good trainer will not only be able to demonstrate these differences but also validate the soundness of this training investment in terms of time and increased programme effectiveness. This training need is most commonly met by extended courses to follow basic training and is not required by more than one or two people per company. It is very specialised training and should when completed make the company independent of the consultant for basic workshop training internally. It is 'trainers training' in V.A./V.E.

5. Lastly the reputable trainer will not attempt to establish a V.A./V.E. programme if the timing or the present environment is wrong.

V.A./V.E. need enthusiastic support and participation, should the initial appraisal find these lacking the training organisation should ethically do one of two things. (a) suggest waiting awhile until the present situation has been sorted out. (b) advise the company to submit its management to an organisational analysis – variously called, Value Audits, Value Appraisals, etc. – in order that the training organisation can get to know the top management and their problems more thoroughly. This will vary in time according to the number of people interviewed; the norm being about 3 days. This is three days of consultancy fees, but it is often well worth it, for at the end of that time the whole of the top management staff will have had an opportunity to discuss company problems and the proposed programme. This is in fact a very popular way of establishing programmes that have Value Assurance/Control/Administration/Management, etc. as their declared objective.

Ethically a Value Audit is an Independent Survey and it should end with the report to the Managing Director; it is not a commitment to further training by the auditor despite the fact that he will have analysed the training needs and staffing requirements.

Value Engineering, June 1969

Available training
Before attempting to derive 'norms' for the bewildering array of the eyes of the training officer or would be participant, it is necessary to clearly differentiate two schools of thinking in V.A./V.E. and point up some of the misconceptions that their differences have given rise to.

So far these two schools have not be formally categorised by name and probably the simplest labelling would be to call them the Technique School, and the Management School. It is also interesting to conjecture whether the former is not an archaic form of the latter since this would represent a natural evolution. Nevertheless there is a strong representation of the technique school still around and likely to be for sometime.

The technique school point out that the basic techniques of Value Analysis and Value Engineering are extremely simple and can be learned in a few hours. They maintain that once these have been mastered the would be user has all the training he needs and any further training is a deliberate exploitation by the training organisation. Usually the areas of application are conveniently restricted and any probing of the need for this restriction quickly uncovers the inhibitions occasioned by the lack of knowledge that would allow greater freedom and flexibility. This school favours the formula, the checklist and the specialist approach. Since specialisation is the bulwark of individualism it can readily find acceptance in the short term. Teams are perceived as a collection of individual contributors, rather than as developing groups, and tend to be smaller in number (3 or 4) than in the management school, where 5 or 6 would be commonplace. There
is usually continual pressure on management to set up a Value Engineering Department where the selected specialists control the destiny of V.A./V.E. in the company.

This school was at one time very popular in the U.S. but recent researches would indicate that it is on the decline despite the fact that it could have received its impetus from the DoD contracts. Emphasis during training is on technology, processes, materials and methodology. Training commitment is much shorter than for the management school and therefore less costly.

The management school of V.A./V.E. hold that the disciplines should be available to all in management that can profit from their utilisation. The simplicity of the techniques is seen as essential for tools that can be used with equal facility in any field of application. The mastery of the techniques, however, is seen only as the preliminary to the planning and development that must subsequently ensue within the environment. This approach has undoubtedly led to the many sophisticated titles that are commonly met as the logical follow-on for Value Engineering such as Value Assurance/Control/Administration/Management, etc. Strangely enough there are one or two instances where the technique school have tried to follow an early success in the technique field by attempting to move into the higher management application, rarely with any lasting success. These failures in no way reflect on the use of the technique school for hardware cost reduction for which it is perfectly adequate, but it does highlight the main difference of approach.

This is in the belief that since this must ultimately evolutionise into cost effectiveness in Top Management it is as well that training throughout be biased to the development of people as well as the product. In managerial grid terms it is the 9-9 approach, equal consideration for people and product. Although this approach is both recognised and promoted in the U.S. it has not so far found the acceptance there that it has in the U.K. but there is every likelihood that it will do as the implications are realised.

---

**TABLE 1**

Typical V.A./V.E. Training Programmes in Sequence of Presentation

<table>
<thead>
<tr>
<th>Duration</th>
<th>Training Objective</th>
<th>Course Content</th>
<th>Application</th>
<th>Participation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Management</td>
<td>Anything from 2 hr to 2 days.</td>
<td>To tell top Management about V.A./V.E., their</td>
<td>One Day</td>
<td>A MUST for all companies embracing V.A./V.E.</td>
</tr>
<tr>
<td>Appreciation</td>
<td></td>
<td>responsibility involvement and expected profit.</td>
<td>Levels of application. From Value</td>
<td>The higher the better. In small to medium size</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Where it fits in.</td>
<td>Analysis to Value Management. Profit</td>
<td>companies the M.D. should be included. There should be</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Planning.</td>
<td>Director participation.</td>
</tr>
<tr>
<td>2. Basic Workshop</td>
<td>Four to 5 days.</td>
<td>Practitioner training Basic Techniques. Skills to</td>
<td>Two days lectures on Basic Techniques.</td>
<td>Essential for building the Practitioner Pool or</td>
</tr>
<tr>
<td>Training</td>
<td></td>
<td>get a programme started. Introduction to Project</td>
<td>Two days Practical Project Work on</td>
<td>Company resource in V.A./V.E.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>the Companies own product. Half or 1</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>day on Implementation and Programme</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Problems.</td>
<td></td>
</tr>
<tr>
<td>3. 'Implementation</td>
<td>Half day or 1 day every 2 or 3 weeks. (In Plant)</td>
<td>To provide guidance through the Implementation</td>
<td>Half Day</td>
<td>Desirable in the large Company or where the Value</td>
</tr>
<tr>
<td>Guidance'.</td>
<td></td>
<td>Doldrums, to apply corrective feed-back in the</td>
<td>Sit in with project teams to appraise</td>
<td>Audit exposes a likelihood of resistance.</td>
</tr>
<tr>
<td>'In Plant V.A./V.E.</td>
<td></td>
<td>environment.</td>
<td>effectiveness and results. Apply</td>
<td></td>
</tr>
<tr>
<td>Monitoring,'</td>
<td></td>
<td></td>
<td>feedback.</td>
<td></td>
</tr>
<tr>
<td>'Programme</td>
<td></td>
<td></td>
<td>Whole Day</td>
<td></td>
</tr>
<tr>
<td>Promotion', etc.</td>
<td></td>
<td></td>
<td>Half day on project work, half day on</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>lectures or discussions. Apply</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>feedback.</td>
<td></td>
</tr>
<tr>
<td>4. Advanced</td>
<td>One day a month for 15 months.</td>
<td>To make the value Engineer independent of the</td>
<td>Anything and everything pertinent</td>
<td>Where the value engineer wants to become the group</td>
</tr>
<tr>
<td>Training</td>
<td></td>
<td>consultant. Trainers training. To give depth</td>
<td>to Cost Effectiveness across the</td>
<td>consultant in V.A./V.E. Where it is felt essential</td>
</tr>
<tr>
<td></td>
<td></td>
<td>knowledge.</td>
<td>complete managerial function.</td>
<td>that there should be depth knowledge.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Personal and career</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>development and counselling. V.A./V.E.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>and general management.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Leadership training.</td>
<td></td>
</tr>
</tbody>
</table>

Note that so few training organisations are offering advanced training that the example shown below cannot claim to be typical. The writer would welcome comparisons.

---

Value Engineering, June 1969
Emphasis during training is on career development, what V.A./V.E. can do for the individual as well as for the product. Basic training is seen as merely setting the stage for a total programme or alternatively as starting people thinking in a way that has previously never been made available to them.

In either instance it presupposes a start rather than the finish of training. This will be so whether the training organisation itself undertakes the follow on or leaves it to the company or individual.

Available training then will either fall readily into one of these two categories or be a mixture of both. The latter can be extremely confusing to the newcomer since there comes a times in the development of the V.A./V.E. programme when the emphasis shift becomes so marked as to raise questions as to the validity of basic training.

Far too little information is available on the training content but with the exception of Advanced Training most organisations have now settled down to an acceptable Basic and Intermediate training. An interpretation of this norm is shown in Table 1. It is known that training content variation will in the main be governed by the People – Product bias or mix, and also whether the Basic Training is seen as an end in itself or the preliminary to depth training.

The challenge ahead
Can some sort of agreement be reached as to the most effective training in V.A./V.E.? Can it be agreed that the Technique of hardware cost reduction is a vital training ground for the development of the more sophisticated tools and analysis needed for Value Assurance/Administration, etc.

Can industry be persuaded to give the value engineers a fair chance to acquire these skills?
Can all interested parties start the movement for Variety Reduction or Rationalisation in Training?

These and many many questions need to be answered before the training muddle is finally sorted out. The tragedy is that meanwhile the bulk industry employing V.A./V.E. is working at approximately one third of the potential available (product people and organisation). Putting this situation right is the challenge that lies ahead.

Miscellany

Self-motivation
Paul J. Meyer was a millionaire insurance salesman at the age of 27. Then, five years ago, he established Success Motivation Institute, which has its headquarters in Waco, Texas. Meyer has made a success out of making other people successful, and he claims: ‘With a self-motivating attitude, any individual can reach any goal he sets his mind on.’

The Seven Motivators
Here are seven motivators you and your departmental managers can apply to help you tap the latent productive power of employees:

1. Uncover tools of self-motivation that work best for each employee.
2. Get your key people personally involved in the goal-setting act.
3. Kindle employee fires with enthusiastic leadership.
4. Flatter employees by consulting them on important matters.
5. Shoot for total understanding of policies and objectives.
6. Combat job tedium by challenging the employee to surpass himself.
7. Set performance standards high but within grasp. Then give your people free rein to make the grade on their own momentum.

Get to Know Your People
The effectiveness of each motivational tool varies from person to person. The trick is to really get to know your people – to see them as they see themselves. It’s not hard to do. All it takes is a little time; and no investment is more worthwhile.

Talk to your key people. Ask questions. Study their reactions. Identify their frustrations, whether they are groundless or not. Differentiate between those factors that fuel enthusiasm and those that sap interest and initiative.

Only then will you be able to discover and apply the particular self-motivational tools that work best for each employee.

Bacon’s Present
Mr Francis Bacon, a Cambridge scientist of mild and charming manner, has, since 1932, worked single-mindedly towards the development and application of one idea – the hydrogen-oxygen fuel cell. Today Bacon celebrates his sixty-fourth birthday, and three of his fuel cells lift-off from Cape Kennedy providing all the auxiliary power, and incidentally, the fresh water, for Apollo 8’s marathon flight.

‘It never occurred to me...’
‘It never occurred to me that the cells would be used in space’, he says. ‘When I started I was thinking simply in terms of road and rail transport, though I did think the fuel-cells would have special advantages for submarine propulsion.’

His research project, financed first by the Electrical Research Association, then by the National Research Development Corporation, was twice halted because no commercial exploitation could be foreseen for the cells, which generate energy from an electro-chemical reaction between hydrogen and oxygen.

Though by 1959 Bacon was able to demonstrate that his cells could power a fork-lift truck, their only application is still in space, where the cells’ weight advantage justifies all the expense and difficulty of handling liquid gases to provide fuel. But work continues on both sides of the Atlantic.

* * *

Wanted: more standardised parts
Have you ever stopped to think how many parts go into your finished product? As they multiply with the complexity of that product, so do your storage, selection and assembly problems. Ford Motor Company is living with this problem now, but expects a newly launched suggestion programme to come up with a few answers.

Its Product Simplification and Improvement Programme appeals to all employees to submit ideas on ‘standardising’ parts. Areas to investigate:

Value Engineering, June 1969
Employees submitting the best suggestions receive a cheque and a choice of one of the latest models.

Here's how parts have multiplied over the years at Ford. In 1930, a popular model had 5,580 individual parts. By 1939, it had 17,645 and today, a staggering 22,253. Obviously problems of assembly are mounting.

The True Role of Management Services

What Are Management Services?

Before considering what may, or may not, be regarded as coming within Management Services let us look at some definitions and what some authorities see as the role of Management Services.

- all providing a service to management to enable many managerial decisions to be made more accurately and quickly.
- it should be an 'insubordinate minority' working on the assumption that 'if it works it is obsolescent'.
- should take in all the innovators.
- grouping of departments concerned with innovation.
- line managers offered a problem solving force.
- all techniques which help managers to manage.
- techniques which have as their ultimate objective the reducing input of resources necessary for a prescribed output.
- cover those services and techniques which aid economic decision making by management.
- essentially concerned with change.
- which provides information to management and which in effect operates the whole management information cycle.
- a unit to help management to improve the profitability of the company.

The Helpers or the Innovators?

If we examine these we begin to see there are two schools of opinion about the true role and function of Management Services.

1. The innovators. The people who want to stir things up, work on the frontiers; 'if it works its obsolescent' approach.

2. The helpers. Those who see themselves in a slightly subservient role to management. The fact gatherers, the fact processors and interpreters, but only indirectly the innovators; helping management to manage.

Which of these two roles truly represents the purpose and aims of Management Services? I am sure that any answer to this would inevitably start with the well known Joadian qualification - 'it all depends'.

Frustrations of Management Services

One could open up a whole new subject here about the possible frustrations of the Management Services set up, leading to the nest of highly intelligent malcontents. It is possible, that because the power to implement lies with management and so, if the management servant sees failure to implement, or implementation with which he disagrees, then we get trouble.

How many people in our line of business have we met who seem to be obsessed with an anti-management fixation?

Sectarianism and Management Services

If there are going to be a number of separate information manipulators, each with his own particular contribution to management aid, it seems common sense to make for co-ordination between them. Hence the umbrella of 'Management Services' and a growing unification despite the lingering inter-specialisation jealousies and rivalries. Of course this increasingly demands the 'rounded' man - because if there is to be integration then someone must be responsible to see that (a) it happens and (b) the results of it are made increasingly valuable to management.

The many facets of BSI

The increasing significance of the work of the British Standards Institution in our industrial and commercial life has led to the Institution preparing a modern portable exhibition which covers the scope of its activities.

Beyond its national and international commitments in the preparation of standards and codes of practice, BSI has taken on a number of added national responsibilities - the industrial change to metric, the Burghard Scheme for electronic components, Technical Help to Exporters Service, etc. - and all this work is summarised.

Companies, technical colleges, universities are invited to write to Rohn Hopper, Chief Press and Publicity Officer, BSI, 2 Park Street, London, W.1, for the display, which is free. It is self-lit, free-standing and occupies a space of approximately 6 m in length, 3.3 m high and 1 m deep.

From Pitman...

Value Analysis & Value Engineering

Frederick Oughton, F.R.S.A., F.R.H.S.

This book introduces the nature and the function of the subject, and covers the organization of the value analysis department. It will prove an indispensable text for both students and management.

The survey includes: the classification of information; programme planning; work flow; creation of an overall plan for the execution of each specific phase; and a detailed analysis from pre-design to the marketing stage.

Sir Isaac Pitman & Sons Ltd

The Pitman Publishing Group

Value Engineering, June 1969
Developing and Organising an Effective Value Engineering Programme—Part 3: A Case History on the Largest Scale

by B. G. Matossian, B.Sc., D.R.T.C.*

Value Engineering has been extensively applied by the United States Department of Defense, and the author, outlines the history of the use of V.E. in the U.S. Department of Defense since it began as a ‘grass roots’ movement in the U.S. Navy’s Bureau of Ships in 1954. Reporting the V.E. goals and accomplishments, describing the V.E. Programme Specifications, and elaborating upon the side effects of V.E. the author concludes by saying: ‘Full benefits of V.E. cannot be achieved without a well-planned programme of introduction, education and development.’

Value Engineering in the United States Department of Defense

Value Engineering has been extensively applied by governments essentially in the United States where it has emerged as a top-level management function in the U.S. Department of Defense (DoD). Since it received DoD recognition and acceptance in 1962, V.E. has played a key role in the drive to reduce defense costs without impairing defense capability. It is now a mandatory activity in the Department of the Army, Navy, Air Force and the Defense Supply Agency. As a consequence, the function has defined objectives that are to be achieved by an organisation that reports at the highest level. Discussion of this American experience has been made easier and more fruitful because DoD has made it generally available in a number of detailed and analytical publications. The author is also grateful to the members of the DoD Value Engineering Directorate for the useful guidance and information he has received during his discussions at the Pentagon in Washington, which has made it possible to present this case-study of V.E. application on the largest scale.

History and Development

Value Engineering activities of the U.S. Department of Defense dates back to the early 1950's. It began essentially as a ‘grass roots’ movement in the U.S. Navy’s Bureau of Ships in 1954. The Bureau, faced with ever-increasing costs and dissatisfied with the partial economies of traditional cost-cutting methods, was the first military body to recognise the potential of V.E. as an effective discipline for improving cost-effectiveness. Encouraged by spectacular savings reported by certain large U.S. companies, the Bureau introduced the application of V.E. under the training and guidance of Lawrence D. Miles of the General Electric Company.

It is reported that the Bureau saved over 35 million dollars during the first two years of V.E. application. This encouraged other branches of the armed services to consider this technique. The Army followed the Navy by applying V.E. first in the arsenals, followed later by its introduction in procurement contracts. Official Army recognition was announced in 1958. Similarly the U.S. Air Force formally introduced its own Value Engineering activities in 1960.

It was in this time sequence that the Office of the Secretary of Defense noted the growth and character of this new management tool. Although most of the programmes undertaken by the services had been on a part-time voluntary basis, isolated and sporadic in nature, nevertheless the evidence of well-documented results accomplished had established an awareness of V.E. effectiveness. The DoD considered that this discipline had far greater potential and should be supported and co-ordinated.

Top DoD recognition of V.E. was formally established by the U.S. Secretary of Defense in July 1962. As one element of the DoD Cost Reduction Programme he announced DoD support for V.E. as a means for achieving annual savings of at least $100 million. In a subsequent report in 1963, upon assessment of progress made, the Secretary of Defense referred to V.E. as ‘one of the best management tools that we know to place performance, schedule and cost in proper relationship’.

DoD Value Engineering Organisation

Priority attention was given to the revision and enlargement of V.E. coverage. A Value Engineering organisation was established to co-ordinate the activities of the various military services and to develop an organised programme that would extend throughout the whole range of DoD facilities, installation and procurement.

The location of this organisation in the DoD structure is shown in Figure 5. Management support and direction for Value Engineering programme implementation has been provided by the Office of the Assistant Secretary of Defense for Installation and Logistics.

The Directorate of Value Engineering and Productivity, a responsibility of the Deputy Assistant Secretary of Defense (Equipment, Maintenance and Readiness) serves as a focal point for policies, procedures and programme development.

A Value Engineering Council chaired by the Deputy Assistant Secretary of Defense (Equipment, Maintenance and Readiness) has been established. The Departments of the Army, Navy, Air

*The author is founder of the firm of B. G. Matossian and Associates, Consultants to Management, of 114 St. Vincent Street, Glasgow C.2, Scotland. He previously was engaged in America with RCA, Barker and Williamson Inc., General Mills Inc. This is the third part of a three-part paper which Mr Matossian delivered in March 1968 to The Institute of Marine Engineers. Parts 1 and 2 appeared in the February and March issues of the journal.

Value Engineering, June 1969
Force and the Defense Supply Agency (DSA) are represented on the Council by their responsible Value Engineering Offices. The Council is able to identify urgent V.E. projects, set priorities and provide co-ordinated guidance for effective action and implementation.

In addition, the DoD Value Engineering Services Office was formed to strengthen and accelerate the DoD Value Engineering Programme which is now regarded as the most fruitful area in the DoD Cost Reduction Programme in terms of growth potential. The Services Office has a staff of highly qualified full-time V.E. personnel with a balanced combination of government and industry experience. The Office is an augmentation of existing Programme which is now regarded as the most fruitful area in the DoD.

A Priority Programme
The DoD Value Engineering Organisation has been responsible for integrating V.E. into the mainstream of the DoD management process. A priority programme was drawn to accelerate the expansion of V.E. application in the DoD. It set forth the following organisational, administrative and operational requirements:

1. issuing of a Value Engineering policy to be applicable throughout the DoD;
2. establishment of a DoD-Industry Advisory Group to assess new ideas on incentives, policies and opportunities for expanding the application of V.E. and to establish a Value Engineering specification;
3. drafting and issuing a Value Engineering manual for use throughout the DoD;
4. broadening of the Value Engineering provisions of the Armed Services Procurement Regulations (ASPR) and establishing standard Value Engineering incentive clauses;
5. introduction of unified and comprehensive Army, Navy and Air Force training programmes and courses in:
   (i) the principles and application of Value Analysis and Value Engineering techniques;
   (ii) the management and administration of Value Engineering programmes in defense contracts;
6. drafting of requirement for the expansion of 'In-House' (for DoD and all Departments of the Armed Services) Value Engineering effort;

All objectives of the programme have since been met, approved and implemented – covering:

Value Engineering Policy
This policy establishes specific cost reduction objectives and the administrative process for progress measurement and accurate auditing of results and net savings achieved. Figures 6 and 7 show progress and accomplishments to date.

Value Engineering Programme Specification
A specification was prepared in co-operation with the defense industry. It was finalised and issued as MIL-V-38352. It sets forth the minimum requirements for a contractor Value Engineering programme – when such a programme clause is included in a contract – and is mandatory for use by all Departments. MIL-V-38352 also establishes applicable definitions in which:

Value Engineering is defined as an organised effort directed at analysing the function of systems, equipment, facilities and supplies for the purpose of achieving the required function at the lowest overall cost, consistent with requirements for performance, including reliability, maintainability and delivery.

Overall Costs are defined as a combination of ‘Initial Purchase’ and ‘User Supporting’ costs. The initial purchase cost is the total price of a complete production item, including royalties, packaging, maintenance parts, accessories, drawings and technical manuals. User supporting costs are those which represent the installation, operating, maintenance and logistics expense to the user throughout the useful life of the equipment.

DoD Handbook ‘Value Engineering’
This manual provides guidance in V.E. to both Government and industry. It is non-directive in nature.

Value Engineering Contractual Clauses
These were drawn up, repeatedly revised with the co-operation of industry, finalised and issued as a Defense Procurement Circular (DPC-11). It provides effective V.E. incentives to contractors and is mandatory for use by all departments and agencies of the Armed Services and the Defense Supply Agency.

Value Engineering Training Programmes
Intensive training programmes and courses are now in progress within all Departments of the Armed Services supported by films and other visual and educational aids. Formal courses have also
In summary some of the important provisions contained in this circular are:

1. It is the policy of the DoD that contractors shall fully utilise V.E. techniques to reduce the cost of systems, equipment, and material being designed, developed, procured, constructed, maintained, modified, and stored.

2. Accordingly, provisions, which encourage or require V.E. shall be incorporated in all contracts of sufficient size and duration to offer reasonable likelihood for cost reduction.

3. A Value Engineering incentive clause shall be included in most (only five exceptions given) contracts in excess of $100,000 in value. Such a clause may be included in a contract of less than $100,000 at the discretion of the contracting officer.

4. Value Engineering contract provisions are of two kinds:
   (i) Value Engineering incentives, which provide for the contractor to benefit from cost reductions that ensue from change proposals he submits on his own initiative;
   (ii) Value Engineering programme requirements, which obligate the contractor to undertake V.E. effort in accordance with an agreed programme, it provides for contractor sharing in cost reductions ensuing from change proposals (VECP) he submits.
5. Value Engineering incentive provisions provide the machinery and the incentive for a contractor’s effort to propose savings which can be achieved only by changing specifications or contractual requirements.

6. The main objective of a Value Engineering programme requirement clause is to realise earlier results, i.e. 'in the initial stages of the design, development, or production, so that specifications, drawings, and production methods will reflect the full benefit of V.E.'.

7. The Government will bear a reasonable share (allocated in each case) of the cost of contractor Value Engineering programme requirement.

8. The cost of a contract with a Value Engineering programme requirement clause may include 'an amount specifically to cover a required Value Engineering programme'.

9. According to the provisions of a Value Engineering incentive clause, a contractor’s share in cost reduction may vary from a minimum of 25 per cent to a maximum of 75 per cent depending upon the terms and type of contract.

10. According to the provisions of a Value Engineering programme requirement, which may be paid for by the Government, a contractor’s share in cost reduction ensuing from change proposals he submits, may vary from a minimum of 5 per cent to a maximum of 20 per cent depending upon the terms and type of contract.

11. Contractor incentive sharing extends to include Value Engineering savings realised in Follow-On Contracts (for a maximum period of three years) even if awarded to another contractor.

12. Contractor sharing also extends to savings resulting from V.E. changes affecting operation maintenance, logistics support, and government furnished property (termed 'Collateral Savings').

13. The scope of the Value Engineering programme extends to include sub-contractor efforts, with recognition of V.E. incentives awarded to the sub-contractor as part of the prime contractor’s cost to implement a V.E. change.

In addition, DPC-11 provides methods and procedures for preparing and submitting Value Engineering change proposals, for providing cost and cost-reduction information, and other relevant data so that change proposals can be processed in an effective and efficient manner.

In support of its aggressive programme, the DoD took other actions to appeal to different motives. A variety of speeches, commands, directives, instructions and regulations have been issued requesting or directing full utilisation of V.E. techniques by DoD staff and defense contractors. For example, the Secretary of Defense specifically mentioned Value Engineering in his letter on cost reduction mailed to 7,500 contractors in December 1963.

1963 to almost $500 million in Fiscal Year 1966. These figures represent net saving to DoD, that is, after deductions of all implementation costs including incentive payments to contractors. Thus the DoD objective of one-half billion dollars of V.E. savings has been met a year ahead of schedule. During Fiscal Year 1966 nearly 1,000 contractor Value Engineering change proposals (VECP) were approved as compared to 300 in 1964 (see Figure 8).

**Side Effects of Value Engineering**

In reply to fears that V.E. might have unfortunate side-effects, an investigation was initiated to check this. The survey, which was carried out by the American Ordinance Association in 1964, considered and evaluated a random sample of over 120 V.E. case studies and changes which had been implemented for some time. Side effects in terms of such factors as reliability, performance, maintainability, and others were investigated and findings classified in the categories of 'Advantage' (improvement), 'No Effect' and 'Disadvantage' ( consequential).

**Progress and Accomplishments**

Value Engineering is now considered to be one of the most promising growth elements in the DoD cost reduction programme. Accomplishments in the period 1962 to 1967 have exceeded all expectations. As a result of contractual incentives introduced in 1964, it can be seen from Figures 6 and 8 (extracted from DoD documents) that there has been a marked increase in cost reduction achieved through active contractor participation. Audited savings have increased from $72 million in Fiscal Year 1963 to almost $500 million in Fiscal Year 1966. These figures represent net saving to DoD, that is, after deductions of all implementation costs including incentive payments to contractors. Thus the DoD objective of one-half billion dollars of V.E. savings has been met a year ahead of schedule. During Fiscal Year 1966 nearly 1,000 contractor Value Engineering change proposals (VECP) were approved as compared to 300 in 1964 (see Figure 8).

**Fig. 8. Number of contractor-originated V.E. change proposals approved.**

1963 to almost $500 million in Fiscal Year 1966. These figures represent net saving to DoD, that is, after deductions of all implementation costs including incentive payments to contractors. Thus the DoD objective of one-half billion dollars of V.E. savings has been met a year ahead of schedule. During Fiscal Year 1966 nearly 1,000 contractor Value Engineering change proposals (VECP) were approved as compared to 300 in 1964 (see Figure 8).

**Side Effects of Value Engineering**

In reply to fears that V.E. might have unfortunate side-effects, an investigation was initiated to check this. The survey, which was carried out by the American Ordinance Association in 1964, considered and evaluated a random sample of over 120 V.E. case studies and changes which had been implemented for some time. Side effects in terms of such factors as reliability, performance, maintainability, and others were investigated and findings classified in the categories of 'Advantage' (improvement), 'No Effect' and 'Disadvantage' (consequential).

**Fig. 9. Fringe effects of Value Engineering.**

Figure 9, reproduced from the American Ordinance Association Report, summarises the findings of this survey. It can be seen that the side effects were in fact overwhelmingly beneficial in all measured areas and any unfortunate consequences were so small as to be almost negligible. The cost-savings linked to these side effect improvements are quoted to be over $10 million.
Definitions

Reliability —ability to meet performance requirements for a determined number of times.
Maintainability —relative ease of repair or replacement.
Productibility —relative ease of repeatable manufacture.
Human factors —acceptability of change related to necessary education or dexterity.
Parts availability —relative ease in obtaining or manufacturing simplified or standard parts.
Production lead time —elimination, standardisation or simplification of operations or materials.
Quality —characteristic of parts to meet everything specified consistently.
Weight —lighter in weight.
Logistics —quantity and complexity of parts needed for field support of end items.
Performance —ability of the change to carry out the intended function at time of initial test or qualification.
Packaging —relative ease of protecting parts until ready for use.

Concluded Expansion

The U.S. Department of Defense Value Engineering Programme, now in its sixth year of operation, has proven that results have surpassed the expectations at the time of its formal launching in 1962. Despite the gains to date, DoD considers the overall potential of Value Engineering to be many times as great as actual achievement. To help capture this potential, the Secretary of Defense in 1965 saw fit to increase the organisation of the Value Engineering function by 265 personnel in three Military Departments and the Defense Supply Agency. Other actions taken were to include representatives from the National Aeronautical and Space Administration and the Federal Aviation Agency on the DoD Value Engineering Council, and to further increase organised training programmes for DoD personnel.

Value Engineering effort now accounts for one-third of the DoD cost reduction programme. The DoD claims that it has created a highly effective environment for cost-effectiveness which has penetrated all levels of management, both in the DoD and in defence industry. It also considers that by introducing imaginative incentive procedures and by fostering an effective DoD-Industry team concept it has laid the foundations for continued development and success of its value engineering programme.

Conclusions

Experience has demonstrated the effectiveness of V.E. for increased efficiency and economy in achieving desired objectives without compromising on necessary performance and reliability. There is also every evidence that more than often the side-benefits from V.E. application represent a more important contribution to overall product-effectiveness than the associated cost reduction.

Value Engineering is not an end in itself — it is a means to an end. Industry and government organisations are all subject to budgetary limitations in an environment of escalating costs and as such are compelled to place greater emphasis on function, cost and value. There is no point in paying for design features and materials that are not needed to accomplish the essential function. In the same sense, in an environment of rapid technological change, the procurement of unnecessary quality — due to tradition and outdated beliefs — is just as wasteful as procurement of excessive quantity. Government and industry are therefore committed to the V.E. approach with greater respect for the taxpayer's and customer's pounds, shillings and pence.

In the forefront of V.E. today is the consideration of the procedures and methods that can be used to maximise cost-avoidance early in the product's design cycle — the stage where cost-effective performance can be most readily and economically influenced.

Manufacturers have sometimes turned aside from V.E. on the ground that they cannot afford to add to their overheads. This criticism shows only a failure to comprehend the inner meaning of V.E. It is a profit consideration and not an overhead. It need not add anything to costs or overheads after the initial installation. The financial rewards of a successful programme may, in the first year, compensate for the cost of installation as many as twenty times over. Reduction in the costs of manufacture of particular products are frequently as high as 25 per cent and in many instances have risen to 75 per cent.

Apart from the direct financial economies it yields, V.E. tones up the whole organisation. It qualifies the attitudes of all the staff. Operations that were formerly clumsily performed are streamlined. The indirect financial gains following upon improved all-round efficiency and a higher standard of co-operativeness, not only between departments in a company but also with suppliers and customers may not be as easily measurable as the cost-reduction aspect of the programme but must, none the less for that, be considerable. V.E. is a management tool that strengthens effective communications, improves human relations and utilises natural creativeness. It enables management to meet the challenge of change constructively instead of being surprised and overwhelmed by it. In fact, it copes with some of the most nagging of the problems that beset management in these days; the problems that are raised by the increasing scale, complexity and specialisation of modern industry. It has emerged in response to a need.

Managements conceiving V.E. as an overhead or an extra activity or function added on to an organisation would be well advised to forget about it: their misunderstanding is so deep that they could never practise V.E. effectively and would probably damage the structure of their organisation in the process of trying. It is an approach, a method, an instrument and a system of techniques that existing staff in all departments assimilate and use. It is a new, more cost-conscious and efficient way of doing what they have done before. Indeed, until as recently as four years ago, distinguished consultants in this country were talking of it as no more than the magniloquent verbiage of the American management schools, disguising but not elucidating or improving upon what good consultants have always done. In a sense they were right. Looking at V.E. in retrospect it is, like most great innovations, simple applied common sense. Managements everywhere have always wanted the results it gives and have often devoted their best endeavours to obtaining them. Now an organised creative way has been developed to meet today's needs and there can be no question that this in itself has been a breakthrough of major importance. It was not a device of the schools but was hammered out among the harsh realities of highly competitive conditions. In the author's personal experience it has been those managements that have in the past most directed their minds and their energies towards the objectives of V.E. who now have the warmest welcome for it, not only as a means of reducing unnecessary cost, but also as a technique for stimulating an attitude of constructive 'challenge'.

Full benefits of V.E. cannot be achieved without a well-planned programme of introduction, education and development. Like any new and emerging activity there are problems which have to be identified and overcome. Recognition of problems and their complexity does not preclude efforts for their solution; it rather indicates that each problem, in itself, presents yet another opportunity for improvement. This is progress.

Value Engineering, June 1969
The Ideal Management Structure
Mr P. G. Forrester, Director, Cranfield School of Management, Cranfield, Bedfordshire, England, writes:

1. Increasing specialisation means that many subordinates know much more about their jobs than their managers can be expected to do. They will only feel themselves committed to their tasks if they participate in setting targets and have adequate freedom of action in attaining them. This underlines the 'management by objectives' philosophy.

2. The basis relationship between a man and his job is of such subtlety that it can only be negotiated by a manager with a close understanding of both. This implies skilled managers with adequate authority and a reasonably small 'span of control' at all levels. (The common use of the term 'labour' implying as it does an amorphous mass of morons, is a denial of this principle as well as an affront to humanity.)

3. The 'right to manage' rests on the sanction of the managed. The securing of this sanction is far too intricate a matter to be left entirely to the blunderbuss of national negotiation. Shop and plant-level negotiation are essential (as the Donovan report left entirely to the blunderbuss of national negotiation. Shop and plant-level negotiation are essential (as the Donovan report left entirely to the blunderbuss of national negotiation. Shop and plant-level negotiation are essential (as the Donovan report left entirely to the blunderbuss of national negotiation. Shop and plant-level negotiation are essential (as the Donovan report left entirely to the blunderbuss of national negotiation. Shop and plant-level negotiation are essential (as the Donovan report left entirely to the blunderbuss of national negotiation. Shop and plant-level negotiation are essential (as the Donovan report left entirely to the blunderbuss of national negotiation. Shop and plant-level negotiation are essential (as the Donovan report left entirel

These principles emerged clearly from the Glacier project, the lessons from which have still not been adequately learned. They are however becoming implicit in the policies of a number of successful companies. The need is for a greatly increased recognition and application.

* * *

An Unusual Menu
A nice, long, civilised lunch at that estimable French restaurant, Genevieve, in London's Thayer Street, will help smooth away your business worries.

Or will it?
Before your eyes have even alighted on the paté de canard a l'aill their menu addresses you thus:

'Congratulations, you are supporting the following good causes: Company Tax, Corporation Tax, Customs and Excise Tax, Income Tax|PAYE, Graduated Pension Contribution, Licence Duty, Import Duty, National Health Contribution.

* * *


'Did we mention: Shortfall Tax, Distribution Tax (Schedule F), Short Terms Gains Tax, Capital Tax, Betterment Levy, Redundancy Fund Contribution, Special Charge (Schedule D), Increase in SET?

'And us.'

Notes on Some of the Circumstances that give Rise to Faults in Office Procedures
1. Too many stages in procedure, causing slowing down possibly due to:

(a) Too many persons on one procedure, or too may specialised operations.

(b) Unnecessary stages, over-control, or excessive check for accuracy in detail.

2. Back tracking of operations by returning to the same point, probably caused by bad grouping of related operations.

3. Failure to adopt a standard procedure and so making a number of subsidiary procedures, often becoming complicated.

4. Too many movements; probably to consult records; not necessarily due to faulty layout so much as to bad method.

5. Too many records required for reference or noting, and thus slowing down procedure.

6. Too many documents travelling along the line of procedure. Too numerous because:

(a) Batch movement too big or complicated at each stage, and taking too long for action.

(b) Too many related documents moving separately. Failure to link up related subsidiary procedures at the earlier stages.

7. Duplication of Records, that is, records kept at two points in procedure.

8. Too much control either for accuracy of detail or for security. These points should be kept in mind when making an examination or analysis.

Value Engineering, June 1969
Theoretical Evaluation of Function

by Arthur Garratt*

The author of this article, Arthur Garratt, presented a significant paper to the First European Value Conference held in 1966 of which the editor of this journal in reviewing the Conference Proceedings (Vol. 1, No. 1, page 57) wrote:

'Mr Arthur Garratt's preliminary treatment of the "Theoretical Evaluation of Function" presents an important advance in the development of V.E. method, and one if incorporated with other thinking on the subject could lead to an important breakthrough in the problem of building useful, practical Value Standards.'

Since that time the editor has been seeking a further article on the subject from Mr Garratt. After stressing the great utility of a method of establishing the cost of functions the writer goes on to show how, by a mixture of mathematics and costing, the cost of transmitting torque may be determined. He then refers to the added 'power' which value engineers may acquire through the application of the computer to their more sophisticated value problems.

Taking another example, finding the lowest cost material capable of withstanding a given tensile load, the distinction between the fixed and variable parameters of the problem is first made. After tabulating the results of investigations into this aspect of the problem then the author deals with the evaluation of the secondary function — resist corrosion. Finally, he deals with an electrical example — finding the lowest cost conductor.

The establishing of measurable quantities

It seems obvious to a practising value engineer that some means of establishing the cost of simple functions would be of immense value in his work. When we want to decide which is the lowest cost way of meeting a functional requirement some basic yardstick of cost would immediately show whether our costs are reasonable or whether we are grossly overestimating them.

It is basic science to want to establish measurable quantities. About a century ago, one of the greatest of our physicists, Lord Kelvin said: 'I often say that when you can measure what you are speaking about and express it in numbers, you know something about it; when you cannot express it in numbers, your knowledge is of a meagre and unsatisfactory kind.' Every value engineer should take those words to heart, they express exactly what he should always do if he has the chance. However, it is not always so simple. We are usually faced with something quite new — how can we cost it when we have never made one?

The cost of transmitting torque

This is where a simple logical approach can help. Now it is possible to establish the cost of any function by a mixture of mathematics and engineering cost knowledge. For example, the cost of transmitting torque can easily be shown to be:

\[ C = \frac{\pi}{4} \cdot P \left( \frac{16}{S_t} \right) \frac{T}{\rho} \]

Where
- \( C \) = cost per unit length
- \( \rho \) = density
- \( P \) = price of material (say pennies per pound)
- \( S_t \) = permissible torsional shear stress
- \( T \) = torque

Such an equation is valuable and can be solved in graphical form and similar equations can be set up for other functions. Usually one has a mixture of functions to satisfy, and the mathematics then becomes so complex that a computer is needed to find an optimum solution. But once a computer has been programmed for a series of functions, it can be used to give optimum solutions to highly complex problems. In these days of Computer Aided Design such programs at a central computer would be of immense value. Engineering could then call up the program using a Teletype Terminal, fill in their own parameters, and get back within seconds a true optimum cost of satisfying complex requirements. Technically this could be done today, practically it needs a demand from sufficient value engineers to make it economic.

The theoretical evaluation of function

In the meantime there are other forms of simplified Theoretical Evaluation of Function which every value engineer could, and should, practise. It needs no computer, very simple mathematics, a few constants from a book, some cost information and a slide rule. Each problem is a separate one so the simplest way of explaining the principles is to work through some examples. Suppose we start with a very simple problem to avoid heavy algebra, the problem of finding the lowest cost material to withstand a given tensile load. We will suppose that the component is a rod from which a heavy component is suspended. Assuming a heavy component enables us to ignore the weight of the rod in our calculations, which simplifies the algebra. And because we are committed to the metric system in 1975, we will use metric units to get some practice in them. However, because the equations are effectively non-dimensional, we can use any units and even mix units providing we are consistent.

The basic function of our component is to support weight, and we can neglect the secondary functions at this stage and pick them up later on. We will assume certain fixed parameters and, because this is a simple example, we will not use real cost information, but put imaginary costs in which are in round numbers.

Fixed parameters
- Length of rod (assumed set by the geometry of the device).
- Load to be carried (this can include the safety factor).
Variable parameters

Diameter of rod.

Material to be used for the rod.

The material can then be subdivided into three unknowns: its tensile strength, its density and the cost per unit weight. Note that this is a problem which is tensile dominated, so we can ignore at this stage the other mechanical properties of the rod like compressive strength, bulk modulus and so on. Now we will write down our symbols:

Length = \( l \)

Load to be suspended = \( W \)

Diameter of rod = \( d \)

Tensile strength = \( T \)

Density = \( \rho \)

Price per unit weight of rod material = \( C \)

Constants = \( K_1, K_2 \ldots \)

Our first equation is the simple one relating load to tensile strength:

\[ W = K_1 T d^2 \]  

(1)

here \( K_1 \) includes the \( \pi/4 \) and the safety factor.

The second equation is one for the total weight of the rod,

\[ \text{Weight of rod} = K_2 \rho d^3 \]  

(2)

then by our definitions, the total cost of the material in the component is the weight multiplied by \( C \), or

\[ \text{Total cost} = C K_3 \rho d^3 \]  

(3)

Now we combine equations (1) and (3) to eliminate \( d \),

\[ \text{Total cost} = \frac{C K_4}{K_1} \frac{W}{T} \]  

(4)

In equation (4) we have several constants we can bunch together as one constant, \( K \). Then our total cost of material becomes

\[ \frac{K C \rho}{T} \]

All very simple, but the result is of immense use because all we have to do is to make the value of \( \frac{C \rho}{T} \) a minimum.

To do this we set up a table, obtain our strength and other mechanical properties from a book of constants and get the cost of various materials from the Purchasing Department. We can then run through a dozen possible materials in half an hour or so – a slide rule is quite accurate enough for the calculations. The table might look like this:

<table>
<thead>
<tr>
<th>Material</th>
<th>Density (gm/cm(^3))</th>
<th>Tensile strength (kg/mm(^2))</th>
<th>Cost (per kilo)</th>
<th>( \frac{C \rho}{T} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steel</td>
<td>8</td>
<td>64</td>
<td>10</td>
<td>1.25</td>
</tr>
<tr>
<td>Aluminium</td>
<td>2.7</td>
<td>16</td>
<td>30</td>
<td>5.0</td>
</tr>
<tr>
<td>Aluminium alloy</td>
<td>2.7</td>
<td>16</td>
<td>30</td>
<td>1.7</td>
</tr>
<tr>
<td>High tensile steel</td>
<td>8</td>
<td>160</td>
<td>50</td>
<td>2.5</td>
</tr>
<tr>
<td>Soft iron</td>
<td>1.3</td>
<td>16</td>
<td>50</td>
<td>2.5</td>
</tr>
<tr>
<td>Nylon</td>
<td></td>
<td></td>
<td>100</td>
<td>8.1</td>
</tr>
</tbody>
</table>

And, of course, other materials can be worked out if required. From this imaginary table we see that the lowest cost material to use to satisfy the basic function, support weight, is ordinary steel. It is now we can have a look at some of the secondary functions which must also be satisfied. We may also wish to provide rigidity, that is to prevent the suspended weight from swaying from side to side. We can fill in figures and see if this requirement is met by our lowest cost material, steel. Probably it will be, but it might not have been if the high tensile solution had come out cheapest.

### The evaluation of secondary functions

A probable secondary function is to resist corrosion. Assuming there is no esteem function to satisfy in terms of the looks of the component, we can now take a look at various methods of resisting corrosion. If we make the assumption, a very reasonable one, that the cost of resisting corrosion for a given material will be independent of its diameter, we can compare the various materials in corrosion-resistant form. All the assumption means is that the cost of treating ordinary steel, high tensile steel and iron will be the same, even though the diameters of the rods are different.

Suppose we say the lowest cost anti-corrosion treatment for the ferrous examples is \( K_1 \). We can then add \( K_1 \) to the costs of the first, fourth and fifth components. We will probably find that aluminium alloy, untreated, is then the lowest cost solution. We then decide if untreated aluminium alloy will be satisfactory, depending on exposure and local conditions. If not, then we must add a figure for treating the aluminium examples. This may or may not be the same cost as treating steel. If the cheapest anti-corrosion treatment for each is painting, it will be the same. But it might well be that ferrous objects are most economically treated chemically, while aluminium objects will be anodised. So we will assume a different cost of anti-corrosion treatment for aluminium and call this \( K_2 \). Our material plus treatment costs for the examples are now:

- Steel: \( 1.25 + K_1 \)
- Aluminium: \( 5.0 + K_2 \)
- Aluminium alloy: \( 1.7 + K_2 \)
- HT steel: \( 2.5 + K_1 \)
- Soft iron: \( 2.5 + K_1 \)
- Nylon: \( 8.1 + 0 \) (assuming nylon needs no protection)

Now we can compare these costs and this may alter our decision, it could even prove that the apparently expensive plastic comes out cheapest in the end.

This example works not only for a rod from which a weight is suspended. It also works for any tensile dominated component, such as an infinitely long pipe to withstand pressure. So, simple though it is, it can be valuable.

### A further structural example

Suppose we now take another structural example, this time a uniformly loaded beam supported at its ends. This could be a bookshelf with brackets at each end or part of a more sophisticated structure. We will assume that the weight of the beam is negligible compared with the load that it supports and we will fix the length, breadth and permissible deflection at the centre point and find what material is the lowest cost for the purpose.

First the symbols we shall use:

Length of beam = \( l \)

Breadth of beam = \( b \)

Thickness of beam = \( h \)

Maximum displacement at centre = \( y \)

Young's modulus = \( E \)

Moment of inertia about a neutral section = \( I \)

Density of material used = \( \rho \)

Price per unit weight of material = \( C \)

Load to be supported = \( w \)

Assuming a rectangular cross-section for the beam, any engineering text-book will give us the following expressions:

\[ y = \frac{5wL^4}{384EI} \]  

(1)

and \[ I = \frac{bh^3}{12} \]  

(2)

Value Engineering, June 1969
Now \( w, l, \) and \( b \) are fixed by definition, so we have \( EI = \text{constant} \) which means \( Eh^3 = \text{constant} \).

Now the total weight of the beam is \( bhlr \), or \( khb \)

where \( k \) is a constant.

So the total material cost is \( kC_p h \)

but \( h = \frac{\text{constant}}{E^{1/2}} \)

therefore the total material cost is \( \frac{k' C_p}{E^{1/2}} \)

and this is what we wish to minimise. So once more we can prepare a table:

<table>
<thead>
<tr>
<th>Material</th>
<th>( \rho ) (gm/cm³)</th>
<th>( E ) (dyn/cm²) ( \times 10^10 )</th>
<th>( C_p ) (C/1cm²) ( \times 10^5 )</th>
<th>( C ) (gm/cm²) ( \times 10^6 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aluminium</td>
<td>2.7</td>
<td>7 \times 10¹¹</td>
<td>8.88</td>
<td>1.1</td>
</tr>
<tr>
<td>Mild steel</td>
<td>8</td>
<td>22</td>
<td>13.0</td>
<td>0.77</td>
</tr>
<tr>
<td>Wood (oak)</td>
<td>0.8</td>
<td>1.3</td>
<td>5.1</td>
<td>2.0</td>
</tr>
</tbody>
</table>

In which case we see that the traditional material is the cheapest. Of course the metals would win if we took advantage of the extra stiffness that could be obtained by profiling the cross-section. It is interesting to note that because the cost is proportional to the cube root of the modulus, little advantage is gained by increasing this.

**Application to an electrical problem**

These two examples are both mechanical, but the technique can be applied equally well to electrical problems. Suppose we want to find the lowest cost conductor to carry electricity from one place to another. Note that this is not the lowest cost to provide a magnetic field, this is a different problem.

We will use the following symbols:

- Length of conductor = \( l \)
- Cross-sectional area of conductor = \( A \)
- Density of conductor = \( \rho \)
- Permitted maximum resistance of conductor = \( R \)
- Resistivity = \( \sigma \)
- Total weight of conductor = \( m \)
- Cost per unit weight of conductor = \( C \)

In a cable design we must choose a maximum permitted resistance and design the conductor to have this resistance – this is the most economic solution. So we have as fixed parameters for any real problem, \( l, R \) and variables, \( A, \rho, \sigma, m, \) and \( C \).

The resistivity, \( \sigma \), is defined as the ohmic resistance across a unit cube. This is equivalent to saying that the resistivity is the resistance multiplied by the cross-sectional area and divided by the length. So we have the following equations:

\[
\sigma = \frac{RA}{l} \quad \text{or} \quad A = \frac{\sigma l}{R} \quad (1)
\]

\[
\text{and} \quad m = Al = \frac{\sigma l^3}{R} \quad (2)
\]

But \( R \) and \( l \) are constants, so the total cost is \( Ck\sigma \) where \( K \) is a constant

So once more we can prepare a table. This time the costs are real ones, albeit somewhat out of date in terms of copper.

<table>
<thead>
<tr>
<th>Material</th>
<th>Resistivity (( \mu \Omega ) cm)</th>
<th>Density (gm/cm³)</th>
<th>( C_p ) (C/1cm²) ( \times 10^5 )</th>
<th>( C ) (gm/cm²) ( \times 10^6 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Copper</td>
<td>1.72</td>
<td>8.9</td>
<td>15.3</td>
<td>43</td>
</tr>
<tr>
<td>Aluminium</td>
<td>2.82</td>
<td>2.7</td>
<td>7.62</td>
<td>31</td>
</tr>
<tr>
<td><em>Iron</em></td>
<td>9.8</td>
<td>7.9</td>
<td>77.5</td>
<td>10</td>
</tr>
<tr>
<td>Silver</td>
<td>1.62</td>
<td>10.5</td>
<td>17.0</td>
<td>1,900</td>
</tr>
<tr>
<td>Sodium</td>
<td>4.3</td>
<td>0.97</td>
<td>4.17</td>
<td>17</td>
</tr>
</tbody>
</table>

* For d.c. only because of reactance.

Several interesting points emerge from this table. The first is that copper is an uneconomic material to use as a conductor, although it is the traditional one. Aluminium turns out to cost approximately a third as much. Iron, cheap though it is, is expensive for this purpose, even if one is conducting d.c. and the reactance term is of no importance. Silver has been calculated because this is the material with the lowest resistivity apart from gold. However its resistivity is only marginally lower than copper, its density is high and its price ridiculous.

Sodium is a fascinating possibility. This wins handsomely over the other materials from a cost point of view, but it looks at first sight a very unprepossessing material to try. However a good value engineer does not let initial difficulties influence him if the cost looks right – he tries to overcome them at a still economic price. So let us follow the drill and set up a Good/Bad T-chart. A first attempt might look like this:

<table>
<thead>
<tr>
<th>Good (1)</th>
<th>Bad (2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cheap</td>
<td>Reacts violently with water</td>
</tr>
<tr>
<td>Plentiful</td>
<td>Oxidises readily</td>
</tr>
<tr>
<td>Flexible</td>
<td>Weak</td>
</tr>
<tr>
<td>Low melting point (97°C)</td>
<td></td>
</tr>
</tbody>
</table>

(2) 'plentiful' is important. Designers should realise that certain materials are in plentiful supply in the foreseeable future, materials like iron, aluminium, magnesium and sodium: while materials like copper, zinc and tin are scarce and will probably become scarcer. So, given the choice, these scarce materials should be avoided.

But now let us look at the bad features and see if we can use our creative ability to eliminate them or transfer them to the good side of the chart. Obviously (4), (5) and (6) could be eliminated if we surrounded the conductor with a strong, airtight and compatible sheath. An obvious material for the sheath is plastic. Polythene is cheap, does not react with sodium and actually bonds to it. So we can overcome the first three bad points, because we can make the cheap polythene as thick as we like to provide the necessary mechanical strength.

But encasing the sodium introduces another problem – how can we connect our conductor? Polythene makes us think of the stoppers in serum bottles which a doctor pierces with a hypodermic needle, pulls out the needle when he has filled his syringe, and the polythene then re-seals. So all we need at each end is a corkscrew, and the connection problem is solved.

Now, what about the low melting point? Obviously the conductor will not be used in an ambient temperature near the boiling point of water and the only time such a temperature could be reached is in the case of gross overload, a short circuit in fact. What happens to a cable under short-circuit conditions? Take a normal plastic coated copper cable, heat is generated due to the resistance of the cable (proportional to \( \rho R \)) and the temperature rises. If the covering is polythene, when the temperature reaches about 120°C the cable fails because the insulation melts away. Unless the circuit breakers come out before this, the cable is ruined and often catches fire. As a fast circuit breaker takes some 20 m/sec to trip, a short-circuit on a power line usually means disaster. But a sodium cable behaves very differently, as soon as its melting point is reached the sodium liquefies and its resistivity suddenly rises sharply. We have in effect a current-limiting device and the temperature will not climb significantly above 97°C, so the insulation is not affected. On cooling, the sodium re-bonds to the polythene and the cable is as good as new. So in fact the low melting point is a positive advantage and should be moved to the good side of the chart.

Sodium filled cables were announced by Union Carbide in July 1966 and have proved successful. There are other advantages which they have. Holes up to 6 mm dia, are self-sealing because of the rapid oxidation of sodium, again 'oxidises readily' should really be on the good side of the table. It also helps if a
cable under load is ruptured, a copper cable will catch fire and continue burning, a sodium cable catches fire but the oxide soon extinguishes it. Flexibility is four times as good as copper with an additional bonus, copper cables have to be stranded to attain adequate flexibility. Coronary discharge, which breaks down the insulation, sets in at a lower working voltage because of the reduced radius of the separate strands, so sodium cables can be operated at much higher voltages. Sodium cable is much less fragile, the conductor is very ductile and a coated cable can be stretched up to 25 per cent after which it will return to its original length without ill effect.

What is interesting to note is that this kind of analysis could have produced a sodium cable over 30 years ago, polythene was discovered in the mid-thirties and no special techniques are needed to make the cable. This gives some idea of the power of such simple analysis if intelligently used.

**Challenge and Change**

In tomorrow's well-managed corporation, managers may be deliberately restrained from mastering their jobs. Moreover, top management increasingly will lay more stress on challenge and change than on perfection of execution. So say the behavioural scientists.

The major new factor in their calculations is the worker himself.

Science and technology, mass higher education, and the information fallout from the media explosion are reshaping the attitudes of the managed as well as the manager. Gone are the days when an employee's behaviour was based largely on impressions gained with a day's drive of home.

Efforts to challenge employees through direct involvement are going on in many companies.

**From Errors to Success**

Companies are sophisticated in using errors to attain success— which is another way of saying they are research-oriented.

'In many companies, managers are so committed to not making errors that they lose a lot of successes,' says Saul W. Gellerman, a management consultant with a behaviouralist orientation, and author of a new book called *Management by Motivation.* Gellerman maintains that in order to motivate the new employee, management must take a calculated risk.

**Maintain Need to Learn**

'The most important thing management can do is deliberately maintain the necessity to learn,' he says.

The name of the motivation game, then, is 'challenge'. 'The stress of having change forced upon you is a huge advantage,' Gellerman believes. In the corporation of tomorrow, he sees enforced job change and added responsibility as ways to achieving that edge, for the manager and for the employee.

**Tolerance of Error**

But central to it all, he warns, is a growth in top management's tolerance of error. If management is to motivate through challenge, it must insist on risk, which involves the distinct possibility of failure.

'Call your men in and ask them to tell you about a good error they made this week,' Gellerman advises.

**Growing use of Magnets in Industry**

The use of permanent magnets in industry is increasing rapidly. Last year James Neill & Co. (Sheffield) Ltd. produced nearly one million pot, button and power magnets in a variety of shapes and sizes. This compared with under two hundred thousand in those same categories ten years ago.

The majority of these are finding their way into factories and workshops all over the world, where they are used to make simple and inexpensive gadgets to help production and cut costs.

Typical examples of applications are:

1. Clips screwed to power magnets facilitate the holding of a coolant hose.
2. Button magnets used with a metal backed panel can form an ideal magnetic planning board.
3. A pot magnet on the end of a length of flexible cable can be used to retrieve metal objects from inaccessible places.
4. A cluster of pot magnets can be used to form a simple welding jib.
5. Pot magnets ground to height can act as distance pieces for machining operations.
6. A pocket magnet can be used for checking ferrous scrap.
7. Two power magnets screwed to a wooden base will form a paint dipping jig.
8. Three shallow pot magnets will hold a portable light in any position on metal.
9. A power magnet can be used for removing metal clips from a blind hole.
10. Pot magnets inserted into a steel plate can provide a practical drilling fixture for printed circuit production.
11. A magnet will hold a plastic guard on a ground or any other metal surface.

**Summing Up**

To sum up, theoretical evaluation of function has a real place in Value Engineering. Firms in sophisticated engineering with access to a computer can establish equations for the cost of each function and then combine several of these to achieve a true optimum solution. And the value engineer in any business can set up simple equations, solve them and build up a comparative cost chart to lead him to the lowest cost material to do the job. Coupled with know-how about processing costs, all of which appears in a book like the Value Control Design Guide, many components can be designed and the method of manufacture decided without even marking vellum. Surely this is a technique everyone should use.

**Miscellany**

### Heard About any Errors You’ve made Lately?

#### Challenge and Change

In tomorrow's well-managed corporation, managers may be deliberately restrained from mastering their jobs. Moreover, top management increasingly will lay more stress on challenge and change than on perfection of execution. So say the behavioural scientists.

The major new factor in their calculations is the worker himself.

Science and technology, mass higher education, and the information fallout from the media explosion are reshaping the attitudes of the managed as well as the manager. Gone are the days when an employee's behaviour was based largely on impressions gained with a day's drive of home.

Efforts to challenge employees through direct involvement are going on in many companies.

#### From Errors to Success

Companies are sophisticated in using errors to attain success— which is another way of saying they are research-oriented.

'In many companies, managers are so committed to not making errors that they lose a lot of successes,' says Saul W. Gellerman, a management consultant with a behaviouralist orientation, and author of a new book called *Management by Motivation.* Gellerman maintains that in order to motivate the new employee, management must take a calculated risk.

#### Maintain Need to Learn

'The most important thing management can do is deliberately maintain the necessity to learn,' he says.

The name of the motivation game, then, is 'challenge'. 'The stress of having change forced upon you is a huge advantage,' Gellerman believes. In the corporation of tomorrow, he sees enforced job change and added responsibility as ways to achieving that edge, for the manager and for the employee.

**Value Engineering, June 1969**
Dealing with a purchase price control system the author points to the need to establish purchase price objectives. To do this involves consideration of the material cost content, the method of manufacture and the cost of manufacture. Scrap allowances, special tooling and development costs, all need to be taken in to account as well as the packaging and delivery costs before the profit margin is fixed. Purchase price objectives for the buyer are also dealt with in the article.

A forecast of the anticipated effect on purchase prices of changes in wages and materials costs should be made and periodic checks will then reveal the overall effects these will have on the annual budget.

'The fact (says the author) that several major industrial organisations in the country (England) have well established purchase price control systems in operation is a good indication that their potentialities have been realised.'

The purchasing of manufactured articles from any source, whether they are individual components or complete assemblies, should be investigated to ensure that these articles are obtained at the most economic price and the best delivery, at the same time maintaining the required standard of quality and performance laid down by the design staff. It is imperative, therefore, that the purchasing organisation of a company is aware of the man techniques available to them, to ensure that the procurement is obtained as advantageously as possible.

In a company with a large purchasing budget, a large portion of such a company's costs are determined by purchase prices and consequently the profit performance is influenced by the movement of these prices. It is essential, therefore, that high volume purchases be controlled by a purchase cost estimating and analysis activity and be subject to management techniques for maintaining or improving purchase prices. These techniques are commonly known as Purchase Price Control Systems and Negotiated Savings Programmes. Like most management techniques the programme consists of establishing purchase and savings objectives and measuring performance against these objectives.

The first essential of a purchase price control system is to be able to establish accurate purchase price objectives or targets. In many companies the buyer is not usually qualified to the standard that would enable him to establish his own purchase price objectives, so an engineer with the necessary production and costing experience should be employed to carry out the required studies. Thus a measure of control over the area of purchase prices can be provided through the establishing of purchase price objectives. The use of these targets permits analysis of price changes of production materials over main casual factors and a measure of purchase efficiency can be obtained. They also provide guidance to the buyers in price negotiations. This guidance can be backed up where the buyer wishes with the services of valuation engineers and price analysis.

Establishing purchase price objectives

When the design of a proposed purchased component or assembly has been finalised, the specification and drawings, with all other relevant information, are released to purchasing so that quotations can be invited from suppliers.

At this point, the buyer should request a purchase price objective from the estimating department, including all relevant drawings and specifications and ordering quantities with the request; in fact a set of information as would be supplied to a company being invited to submit a quotation.

The buyer may also request a purchase price objective or a revision to an existing target for any of the following reasons:

(a) a design modification to an item.
(b) an economic change which may be an increase or decrease in raw material prices or a national wage award claimed by the supplier.
(c) a change in the sourcing pattern for particular items. This can involve an order being awarded to a new supplier or an existing supplier's share of an order being changed where more than one source is being used.

Again the buyer would be expected to provide full information to support his request.

The valuation engineer will then work through the following processes in order to arrive at a purchase price objective.

Material cost content

Using the material specification provided, e.g. a British Standard Specification or a manufacturer's material trade name and drawings, the engineer will assess the raw material content of the component by estimating the volume, including all manufacturing allowances, and convert this into a weight which will be the gross amount of material required to produce the item.

Bearing in mind the order quantity required, the engineer will then work out the raw material price using material producers' price lists for the various materials, such as ferrous and non-ferrous bar stock, sheet or strip, and thus convert the weight into a monetary value. The buyer can be of assistance at this time by obtaining check quotations for these raw materials and also quotations for the various items that a potential supplier would...
be expected to sub-contract, e.g. hardware items or proprietary components such as seals and 'O' rings.

Some companies state their terms of compensation if an order were to be cancelled. For example, they will perhaps compensate for one month's finished components and one month's raw material in stock. This fact should be borne in mind when assessing a potential supplier's raw material ordering quantity for an order. The quantity can greatly affect a raw material price.

The implication is that the engineer should be as factual and accurate as possible when assessing the material cost content of a component or assembly.

**Method of manufacture**

This part of the exercise is a pure production engineering function but generally makes up the largest part of the cost. It is desirable that the engineer is fully conversant with the particular trade he encounters in his work. He should be familiar with the equipment normally used in the trade, i.e. types of machine tools, grades of labour, whether skilled or semi-skilled or female, and the organisation of particular companies within that trade. Since the buyer is also very interested in the capabilities of various companies, it is very useful for the buyer and valuation engineer to make periodic 'good-will' visits to existing and potential suppliers. In this way the purchasing organisation is able to keep in touch with the personnel changes and technical innovations which are proceeding at an ever increasing pace.

In order to assess the method of manufacture of any type of component, the engineer must pay particular attention to the quantity involved in the order, as this is highly likely to affect the method chosen. For example, when dealing with turned parts, multi-spindle automatic lathes, single spindle automatic lathes or capstan and centre lathes can be used. For the same component, each lathe will give a very different cycle time. In sheet metalwork various types of press tools have the same effects; similarly, the number of impressions in moulds, for plastic work.

The method of manufacture chosen will be one based on an efficient supplier using modern existing equipment and production methods. The engineer will break down the method of manufacture into a sequence of operations and then estimate a floor-to-floor time for each of these operations, using normal process planning techniques and standard time data. Each operational time will be further extended to reduce it from 100 per cent efficiency down to, say, 80 per cent efficiency. This further allowance is to cover an operator's personal time and to make allowance for fatigue.

These time values for the various operations must now be converted to a monetary figure in order to arrive at the total labour cost involved.

Where small quantity orders are involved it is usual practice to allow for machine tool set-up. It will be appreciated that, in some ways, it may take longer to set up a particular machine tool than it does to process the components. This set-up time will be estimated in a similar manner to the manufacturing operations and is expressed as a time per piece and then converted to a monetary value.

**Cost of manufacture**

In order to convert the various operational times into a monetary value a factual labour and overhead structure is required. Many companies when building up a selling price, will arrive at the direct labour content, which is the product of the time taken to produce the component and the direct labour rate per hour and extend this by a percentage to cover all indirect or overhead expenses. For example:

<table>
<thead>
<tr>
<th>Manufacturing time</th>
<th>2 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct labour rate</td>
<td>10/- per hour</td>
</tr>
<tr>
<td>Direct labour cost</td>
<td>20/-</td>
</tr>
<tr>
<td>Overhead rate, 250 per cent of direct labour cost</td>
<td>50/-</td>
</tr>
<tr>
<td>Total cost</td>
<td>50/- + 20/- = 70/-</td>
</tr>
</tbody>
</table>

Since many companies allocate and apportion their indirect expenses by a product, department or cost centre basis, etc., this percentage should adequately cover all such expenses. It is probably true to say, that in many cases, the percentage will also hide certain inefficiencies. When discussing costs with a supplier, they will probably state that it is difficult for them to justify this 250 per cent due to lack of detailed information.

However a purchase cost analysis system that is aiming to find the true value of a component based on efficient and modern equipment and production methods must use a labour and overhead structure that can be backed up by detailed factual cost information. Such a structure is detailed as follows and can be split into two main groups, the first dealing with the labour portion and the second with the machine overhead portion:

**Group One**

Assuming that a double shift system is in operation

| (i) direct labour | 120d. per hour |
| (ii) double shift premium at 10 per cent of direct labour | 12d. per hour |
| (iii) indirect labour including foreman, storeman, personnel directly attached to production but not production workers at 55 per cent of direct labour | 66d. per hour |
| (iv) Salaries to staff not directly attached to production, including designer, buyer, etc. at 20 per cent of direct labour | 24d. per hour |
| (v) Fringe costs, including National Insurance, pensions, unemployment insurance, etc. at 18 per cent of direct labour | 22d. per hour |
| Total rate | 244d. per hour |

This rate would apply to a male skilled operator but a rate for a semi-skilled operator can be calculated in a similar manner. Using different base figures, rates can be built up for skilled and semi-skilled male and female operators based on a single shift system.

The base figures for the labour rate are determined from various Government publications that analyse and report on employment figure and average earning throughout the country and known trade conditions. Any national wage awards or changes in social benefits must be incorporated in the rate structure, as and when they occur, in order to maintain an up-to-date picture.

**Group Two**

Taking as an example for this section a typical vertical boring mill costing £7500, with a 25 h.p. electric motor and occupying 180 ft² gross of floor space would have the following expenses allocated and apportioned to it:

(a) Depreciation of the machine is based a write-off period of 10 years, at 3900 hr year, which is the average number of hours the engineering industry works per year.

Depreciation = £7500 \times 240
= 10 \times 3900
= 46d. per hour

(b) The power cost for the machine is based on the mean cost of power per productive hours worked.

Power cost = 25 h.p. \times 1.66/h.p./hr
= 42d. per hour

Value Engineering, June 1969
To calculate the floor space cost, take the floor space occupied by the machine, plus gangways and aisles, plus 40 per cent for non-productive floor space and office space.

Therefore a whole series of machine overhead rates can be built on. The total overhead rate = 164d. per hour.

(a), (b)
Total overhead rate for this machine is the total of items (a), (b) and (c).

The total labour and overhead rate for this particular machine is the total of groups one and two. Total rate = 244 + 164 = 408d. per hour.

Using such a labour and overhead structure enables the manufacturing cost of a component to be generally estimated to within close limits of accuracy.

It is still possible to express this composite rate of 408d. per hour, or 34/- per hour, in the same language that a potential supplier will probably use. This is achieved by extracting the direct labour portion and expressing the remainder as a percentage of that portion. Thus it can be quickly seen that 34/- per hour can also be expressed as 10/- per hour direct labour plus 240 per cent of direct labour overhead cost per hour. Thus the total cost of labour involved in manufacture can be determined. To this is added the total material cost and, therefore, the total cost of manufacture is obtained. Now further allowances need to be assessed in order to establish a purchase price objective.

Manufacturing scrap allowance
In most forms of engineering a certain level of scrap is virtually unavoidable, but this obviously must be kept to an acceptable level at all times. Investigations should be undertaken if these levels get out of hand. Allowance is, therefore, made in the purchase price objective to cover normal manufacturing scrap. An acceptable level that any company should expect to be compensated for, when dealing with sheet metalwork, machined parts and forgings, is 3 per cent of total manufacturing cost. In general, for castings, an allowance of between 5 per cent and 10 per cent is felt to be necessary. This depends on the type of complexity of the castings. However, for certain plastic and rubber components and where strict limits of quality are called for, such as crack detection or accurate electro-plating, a much higher percentage may be necessary. Such cases should be evaluated individually on their own merits.

Special production tooling
As stated in previous sections, the purchase price objective is based on an efficient supplier using modern existing equipment and production methods, so many studies will involve the use of special tooling, such, as press tools, machine jigs and fixtures and special inspection equipment. The supplier can be paid for this tooling by one of several methods. The supplier can receive the full cost of the tooling, in the form of a cash payment, where the buyer usually retains ownership of the tooling involved. A part payment can be made as a contribution towards the cost of the tooling. This can be assessed from a sliding scale, dependent on the value of the order, or the cost of tooling.

In the case of tooling that has a limited life, such as, foundry tooling, hot and cold forging tooling and in some cases injection moulding dies, it is a general rule to amortise the full tool cost into the price of the part, over the full order or part of it.

The cost of such special tooling is estimated in much the same way as is used to determine the purchase price objective. The material and labour content are calculated and the normal allowances added, which usually include an amount to cover the design work involved.

Here again the buyer can provide check quotations and at the same time build up a good knowledge of reliable toolmaking sources and thus assist many of his suppliers by recommending companies that can provide the required quality, price and delivery of tools.

Storage, administration and development allowances
When a company is purchasing 'spares' items they will possibly not require the full quantity of the order at one time. Therefore, the vendor will possibly have to store part of the order for a period of time. The buyer must then expect to make some allowance for this vendor. Dependent on the size of the order or its value, this allowance could be between 10 and 20 per cent of the total manufacturing cost.

When dealing with some of the larger organisations, who maintain large marketing and sales departments, or need to maintain a large head office, an allowance of again between 10 and 20 per cent of the total manufacturing cost could be allowed in the purchase price objective.

However, neither of these allowances should be added into the purchase price objective as a matter of general policy. The buyer should negotiate satisfactory allowances with particular suppliers for individual orders, or certain types of order, based on value and size.

In a similar way, any development expenses incurred by the vendor, should be negotiated by the buyer before any inclusion is made in the purchase price objective.

Profit Margin
The profit margin, that a company feels its suppliers' should find satisfactory, should be a decision of senior purchasing management. This rate is calculated to provide a fair return to the supplier on assets employed. The buyer and the valuation engineer should make every effort to see that suppliers do not exceed this figure.

From an analysis of figures in the general engineering industry in this country, a profit margin of between 10 and 15 per cent of the total manufacturing cost is felt to be adequate and to give this fair return.

This percentage is, of course, nett profit, as it can be seen, up to this section, all the direct and indirect costs of manufacture have been allowed for in the purchase price objective.

Packaging and carriage cost
The cost of packaging is assessed, taking each item on its own merit. The usual problems will be:

What sort of protection will be required, due to surface finish or the fragility of components. Components may need to be protected from extremes of heat, damp or dust.
On the other hand, simple packaging on pallets may suffice. Packaging costs can be determined by the usual estimating procedure of determining the material and labour cost involved. However, it is felt that the cost of packaging components and assemblies that do not require any special treatment should be recovered in general overhead expenses. Only items that require some special treatment should have packaging costed as a separate issue.

The carriage cost is the cost a supplier incurs when delivering orders to the buyer's premises. A reliable basis for these costs can be the British Road Services' rates from the Midlands. Examples of typical transport rates are:

For a 5-ton load - 70/- per ton.
For a 10-ton load - 50/- per ton.

Items such as forgings, castings, bar machined parts or small pressings and assemblies can be estimated by weight. For such items as large assemblies, rolled sections and sheet metal, carriage cost can be calculated on a volume basis, using a conversion factor that 1-ton weight is equivalent to eighty cubic feet.

In a similar manner the cost of returning containers can be assessed on the above rates.

**Purchase Price Objectives and the Buyer**

By taking the total material cost and total labour cost we have the total manufacturing cost. To this is added the manufacturing scrap allowance and the amortised tooling cost where applicable, also any storage, administration or development allowance. Finally the profit margin and carriage cost are included and any special packaging. Thus we have the purchase price objective for the particular item.

As emphasised throughout the previous sections this price target is a fully processed, detailed price estimate for parts which meet current design and quality specifications and is based on the cost of production at current economics, of an efficient supplier, using modern existing equipment and production methods, the competitive costing of raw materials, sub-contracted items, direct labour minutes and rates, overheads, administration and commercial expenses and a profit margin reflecting a reasonable return on investment. For these reasons it should be known as the absolute or optimum purchase price objective. Therefore, by definition this objective is a target that does not allow for under-loaded workshops making higher charges for items to help make up for the lack of work or inefficient working of any description.

This objective is a target set to control and measure price movements and to assist buyers in making price settlements.

It is to be expected that the buyer will often find difficulties in placing orders at prices compatible with the absolute purchase price objective, therefore, it is usual to allow the buyer a purchasing bracket with the provision, however, that the buyer must still make every effort, in the future, to reach the optimum target.

This purchasing bracket can be achieved in one of two ways. The first method is applicable where a component of new design is to be purchased and this item is of similar design or concept to an existing purchased item. For example:

(i) Existing take-off item:

| Absolute price objective | 600d. |
| Actual price             | 620d. |

(ii) New item:

| Absolute price objective | 700d. |
| Current price objective  | 720d. |

The above figures show that the new item is worth 1000d. more than the existing item (600d. to 700d.). This design variance is then added to the actual price of the existing take-off item to give a current purchase price objective of 720d. (620d. + 100d.). From this information the buyer has an immediate or current price target of 720d. and an absolute price target of 700d. to be achieved as soon as possible.

The current purchase price objective is, therefore, a target based on the same level of buying efficiency as an existing similar item, adjusted for design differences or economic variances.

The second method can be applied to any purchased components or assemblies. By this method, the absolute purchase price objective is expressed in terms of direct materials, direct labour and all additional allowances, except profit, are expressed as a percentage of direct labour. An example will fully illustrate this:

(a) Normal method of cost breakdown:

| Total material cost | 60d. |
| Total labour cost: 30 min. at 40/- per hour | 240d. |
| Total manufacturing cost | 300d. |
| Scrap allowance 3 per cent | 9d. |
| Amortised tool cost | 30d. |
| Storage allowance 20 per cent | 60d. |
| Profit margin 10 per cent | 399d. |
| Carriage cost | 5d. |
| Absolute purchase price objective | 444d. |

(b) This can be expressed as:

| Total material cost | 60d. |
| Direct labour cost: 30 min. at 10/- per hour | 60d. |
| Overheads expressed as a percentage of direct labour cost (475 per cent) | 284d. |
| Profit margin 10 per cent | 40d. |
| Absolute purchase price objective | 444d. |

(c) The overhead percentage of 475 per cent is now increased by a figure of, say, 150 per cent to 625 per cent, this will allow for any under loading of workshops or any other inefficient working.

This will now give the following breakdown:

| Total material cost | 60d. |
| Direct labour cost | 60d. |
| Overheads expressed as a percentage of direct labour cost (625 per cent) | 275d. |
| Profit margin 10 per cent | 49d. |
| Current purchase price objective | 544d. |

However, this 100d. increase in the target price, which represents an increase of 150 per cent in overheads, is still capable of analysis and once again the buyer is expected to use the higher figure as a guide only and to make every effort to reach the optimum target.

The buyer is now in a position to challenge the price of any potential supplier knowing that the target figures supplied by the valuation engineer are backed up by full technological proof. That is, proof of labour, type and rates, material cost and usage, process method and timings, correct overhead evaluation, tooling cost and life, setting and down time, scrap rate and back scrap allowance, profit margin and carriage allowance, in fact every element of a selling price.

The technique of purchase cost estimating will not only show where a company, by intention of otherwise, is over-charging, but also where by design or error it is under-charging.

It may seem good policy and evidence of a good buy to be able to show that orders have been placed for components at a figure which is under the absolute purchase price objective but in the end it may prove disastrous. Quality of products must be maintained and no company can go on producing at a figure that is not economic. Hence, any quotation for a component at less than the optimum target, should at once start an investigation into both...
the purchase price objective and with the quoting company to check their quotations. Particularly with long runs it would be fatal to production lines if suppliers were stopped because the supplier had run into financial difficulties because of under quoting. Some firms will under quote to 'get in', ignoring the fact that they may get into difficulties.

The valuation engineer should always be available to assist the buyer in obtaining the most economical price. Some of the problems that arise can only be resolved by mutual discussion with the supplier. The buyer should encourage his suppliers to discuss the breakdown of their prices and, of course, assure the supplier that any information that is disclosed will be treated as strictly confidential. Many companies will agree that there are mutual benefits to be gained by both buyer and seller, in such an atmosphere, where one of the buyer's aims is to pay a fair and reasonable price for a term, or at least analyse and understand why this may not be the case.

In a price negotiation with a potential supplier there should be little variance that cannot be easily resolved in the material cost content. The raw material prices, when backed up by the buyer should be beyond dispute. The usual manufacturing allowances for machining castings and forgings, the allowances on sheet metalwork, for example, are standard throughout industry and, therefore, should cause little dispute.

However the method and cost of manufacture are the areas where most disagreement occurs. In the first instance, the knowledge and experience of machine tools and other equipment. When a satisfactory measure of agreement is reached on the method of manufacture, the valuation engineering with his experience and the vast amount of production data available to him on machining speeds and feeds, press rates, horsepower required, etc. should then be able to agree machining and operation times, perhaps with concessions made by both sides.

The type of labour to be used is then the next area of negotiation. This can range from female at six shillings per hour to skilled male labour at ten shillings per hour, so it is very important. Even where this can be determined quite accurately, the type of labour finally agreed upon will depend very much on the supplier's policy of employment. The type of labour agreed will determine the direct labour rate and this can be checked against trade union district rates and thus any differences may be resolved.

The final area of discussion in this section is overheads, which include all support labour, equipment and materials. Here the valuation engineer needs his knowledge of accountancy and costing to be able to assess the supplier's overhead allowances against his own overhead costing structure. Again by mutual discussion many of the unreasonable costs and areas of inefficiency can be high-lighted and thus the supplier can take corrective action.

The remaining allowances such as manufacturing scrap, special tooling, storage, administration, development costs, profit, carriage and packing, may have been the subject of prior negotiation and settlement by the buyer, so will need little discussion. If not, agreement is attempted in the usual manner, again backed up by knowledge of current trade conditions.

In this manner technical assistance can be given to the buyer to help to obtain a purchase price as near the absolute purchase price objective as possible and also identify and variance. These variances can be then analysed to show their effects on company costs.

Establishing savings objectives

In most companies the various functions are required to prepare and present an annual profit budget to senior management. The purchase contribution to company cost reduction can be focussed in a systematic plan to reduce the level of purchase prices by achieving negotiated savings. The purchase cost analysis estimates of purchase price changes due to economics and their commitments for negotiated savings are integral parts of such a profit plan. They may be developed as follows:

Budget estimates – economics

The purchase cost analysis activity should establish a forecast prior to the beginning of the budget year of the anticipated effect on purchase prices, of increases or decreases in supplier wages and/or supplier raw material costs. This estimate should be based on a knowledge of supplier wage rates, the labour and material content of purchased parts and industry, Government or other commodity forecasts.

The buying activities should review and agree the forecast and undertake a programme to resist a portion of the estimated increase, through negotiation. The portion of the forecast which the buying committee is willing to sacrifice shall become the 'resisted economics' portion of the total negotiated savings objective for the coming year. This resisted portion is the amount by which paid economic increases are less than requested or allowable economic increases.

This can be achieved, in part, by the buyer encouraging his suppliers to absorb a part of the increases in wages and raw materials, if not indefinitely at least for some period of time.

Budget estimates – negotiated savings

In a similar manner it should be the responsibility of the buying activity, together with purchase cost analysis to establish a realistic and adequate negotiated savings programme.

Negotiation is a cause in price change attributable to a buyer's action. Therefore, a negotiated saving can be classified as the difference between the buyer's price settlement and the purchase cost analysis current purchase price objective, where it is favourable and the price change is not due to a design modification or economic increase/decrease. Similarly, a negative negotiation is the difference between the buyer's price settlement and the current purchase price objective, where it is favourable, and the price change is not due to a design modification or economic increase/decrease. In his efforts to achieve negotiated savings, the buyer relies on his knowledge of trade conditions to re-source particular commodities with other suppliers or change the sourcing pattern where he is buying the same item from more than one source. The absolute purchase price objective not only provides the buying activity with an effective negotiating tool but also an effective guide for the estimation of potential savings.

Purchase price analysis

The proper evaluation of buying performance and efficiency requires a continuous and efficient reporting system. The degree to which buying performance either increases or decreases the level of purchase prices in relation to the purchase cost analysis budgets of economic and negotiated savings, needs to be evaluated as a measure of buying efficiency. Therefore, to realise the full effectiveness of a negotiated savings programme and purchase price control system and price action records should be maintained on an individual buyer or buyer activity. To establish a permanent record for individual components or commodities of purchase price action a price history should be maintained.

After concluding pricing arrangements with the supplier the buyer should record the price action and in those cases where the final price exceeds the objectives or targets, the buyer should provide an explanation of the resulting variance.

The price history is maintained by purchase cost analysis in order that price changes can be recorded and analysed over a period of time. These price changes can be due to design modifications, economic increases or decreases, the results of negotiations and the effects of sourcing changes. This information provides a library of price data, as the basis of statistical analysis and cost control. These variances can be evaluated and analysed by cause and their effect on company costs reported to senior management. The variances can be identified as follows:

(i) a design variance is a cost variance due to a change in engineering specification on a drawing initiated by the design engineering staff. This may involve the addition or deletion of a part, changes in the size, shape, weight, Cost Engineering, June 1969
material or dimensional tolerances of the part, the addition or deletion of a machining operation, or the improvement in quality and performance of a part.

(ii) A method variance is a cost variance due to adjustments in work standards because of changes in manufacturing methods.

(iii) Re-estimate is a cost variance due to a revision in the original purchase price objective. This may be due to a change in ordering quantity, an error in the original cost targets, or the result of a visit to supplier's plant and installations leading to a change in the original assumptions.

(iv) An economic change is a cost variance due to a movement in general cost levels and may be due to a national wage award or an increase or decrease in the prices of raw materials.

(v) Negotiation is a cost variance not accountable to the previous four but is due to the buyer's action.

To obtain the maximum benefit from the system with a minimum investment in manpower, purchase cost estimating and analysis should be limited to parts and materials of major importance, either in terms of annual value purchased or for other reasons. The parts selected should be representative of the various items purchased such as forgings, castings, sheet metalwork or machined components. The geographical distribution of suppliers should be considered and also the various types of raw materials such as copper, aluminium, rubber or plastic.

**Future project cost control**

Where any future design project contains any components or materials that are to be purchased outside the company, the buying and purchase cost analysis activity can be involved in the earliest stages. Purchase price objectives can be determined by the usual methods if detailed information is available. If not, they may be determined by basing the objectives on the known price of existing purchases. In this way the cost of proposed purchased parts in a design project can be detailed and used as budgets at an early stage of design. The cost of changes to the original plan can be evaluated and reported to management to give a moving picture of the cost of producing the project. A cost history can be prepared for each item, with the budget estimate as the first entry, with revisions for further design modifications, economic changes or changes in source of procurement.

Periodic reports can then be made to the appropriate senior management concerned on the project costs status and reasons for changes. This confers the advantage of a detailed concept of future purchase costs and the possibility of prompt action to control such costs.

The buyer obtains advantages in that he is aware in the earliest stages of future projects and can, therefore, plan and prepare future sources of supply and also generally assist the design staff with his knowledge of trade conditions when outside sources are needed for possible design and development work.

These systems and techniques can make a real contribution to a company's purchasing performance and efficiency that is reflected in the profitability of an organisation. It has long been established that a saving credited to purchasing reflects a similar increase in profits. The fact that several major industrial organisation in the country have well established purchase price control systems in operation is a good indication that their potentialities have been realised.

---

**How to make a ‘Lubricated-for-Life’ bearing with just 2 V-Rings**

You probably know about V-Rings. They’re those synthetic rubber, cleverly designed seals that are so easy to fit. Our drawing shows two of them in use. This design permits extremely long lubrication intervals to be used, depending on the fact that the bearing housing is virtually air-tight and the oxidising tendency of the grease is therefore reduced to a minimum. In many cases it is therefore possible to treat the bearing as if it is lubricated for life.

Another thing to remember about V-Rings is that they continue to operate satisfactorily even when the shaft has a pendular motion—they are also unaffected by shaft eccentricity and they are probably the only seals which can stand up to shaft misalignment. They are available from stock to fit any shafts, metric or fractional, from 1⁄8" up to 40" diameter. Larger sizes can be made up to orders. All in all a very versatile design component. Why not write us for the latest information on V-Rings? You’ll be interested in some of the applications ideas—and surprised.

---

Headland Engineering Developments Limited
A member of the Headland Organisation  Melon Road, London, S.E.15 Telephone: 01-703 6393

*Value Engineering, June 1969*
Negotiation Checklist

1. Buyer’s knowledge of what he is buying
   (a) Have you reviewed the drawings and the uses of the parts or materials?

2. Proposed sources – vendors and materials
   (a) Are quotations being secured from an adequate number of sources?
   (b) Are there alternate materials or sources?

3. Financial responsibility
   (a) Has the vendor’s financial and credit responsibility been considered in the light of work to be performed?
   (b) Does he seem overextended by current commitments?
   (c) Have you reviewed his cash-flow needs?

4. Facilities
   (a) Do vendors have sufficient area and equipment to perform in accordance with our delivery schedule?
   (b) Do you know exactly what operations the vendor intends to subcontract?
   (c) Is the bidder’s proposed subcontracting advantageous to you, the buyer?
   (d) Does the vendor demonstrate ability to control his own subcontracting?

5. Performance
   (a) Are the proposed sources accustomed to manufacturing this item or similar items?
   (b) Do they demonstrate, on the strength of past performance, ability to meet this schedule?
   (c) Do their past rejection experiences demonstrate ability to meet test and quality requirements?
   (d) Is a performance bond advisable?
   (e) Should you obtain the right to use or acquire tooling, designs, materials to manufacture this item in case of default?

6. Tooling
   (a) Is special tooling being purchased separately?
   (b) Are there any mating or interchangeability problems requiring special action?
   (c) Is it advisable to have tooling coded with your code numbers?
   (d) Have we distinguished between special tooling required for the contract and facility items?

7. Patents, royalties and development
   (a) Is this a patented item?
   (b) Can the article be reproduced through other sources without infringing on patent rights?
   (c) Are research and development costs set up as a separate item so that future procurements will not be affected?
   (d) Does the buyer have the right to acquire any patents resulting from research and development?

8. Planning and scheduling
   (a) Have you analysed the vendor’s proposed sequence of work or operations?
   (b) Are all necessary activities included?
   (c) Has he established realistic control points and flow-times, by activity or operation, consistent with the demands of this contract?
   (d) Has he balanced loads among activities so that production will proceed without delay?
   (e) Are there any special handling, packaging or shipping requirements that may delay delivery?
   (f) Are spares involved, and are they allowed for in the vendor’s plans and schedules?

9. Technical requirements
   (a) Are all inspection, test, and engineering requirements fully understood?
   (b) Is the item adequately described on the blueprints, specification, purchase order, etc., so that no doubt exists as to what is ordered?
   (c) Are there any special test or quality control requirements the vendor must meet? Does he fully understand them, and does he have the time, facilities, and know-how to comply?

10. Price and cost analysis
    (a) Have you sufficient information by specific cost element to know the reasonableness of price quoted?
    (b) Have you considered learning curve application?
    (c) Does the price breakdown jibe with the statement of work, or vendor plans and schedules?
    (d) Should you seek internal estimates?
    (e) Might past termination or redetermination data be helpful in analysing this procurement?
    (f) Is the price reasonable in terms of competition?
STRENGTHS AND WEAKNESSES OF NEGOTIATORS

A. Factors influencing the seller's position

1. Number of sellers, their size, location, degree of competition — the fewer the sellers' the more widespread and diverse their operations; the less price competitive their markets, the stronger is the negotiating position of any seller. Conversely, the more numerous the sellers, the more localised their operation, the more responsive they are to supply and demand changes, the weaker is their bargaining position.

2. Relative exclusiveness of seller offerings — the more unique the technology, product, process or know how of production, the more prohibitive the entry for newcomers into the field; the more 'preferred' the seller is within the industry or the buyer organisation, the stronger is his negotiating position. Conversely, the more commonly available the offering, and equivalent or comparable the source, the weaker is the negotiating position of the seller.

3. The economics of the seller's position — the more fully utilised the vendor's capacity, the more he has other business available; the greater his backlogs of future business, the stronger his market as a whole; the stronger is the negotiating position of any seller. Conversely, the more idle his capacity, the more he relies on limited accounts, the smaller his backlogs, the weaker the market as a whole, the weaker is his bargaining position.

4. Seller's knowledge of the market and the buyer's position — this is a factor that can either weaken or strengthen the seller's negotiating posture. There are times when knowing in detail the buyer's requirements, future demands, competitive prices, market trends, may enhance the seller's bargaining position. There are times when the seller is stronger because of ignorance, so that it would be 'folly' for him to be wise. An illustration of this is the vendor's knowledge of a competitive quote received by the buyer. Such knowledge could panic the seller, or make him more adamant.

B. Factors influencing the buyer's position

1. Pressure of schedules or urgency of the requirement — It has been said that necessity never made a good buyer, and this is obvious to any industrial buyer. The more pressed he is to make a commitment, the less he is able to negotiate from strength. Conversely, the longer he can withhold from committing himself, the more he negotiates from strength.

2. Availability of alternates — The more sources the buyer has who are equal or comparable, the stronger is his negotiating position with any one source. So, too, if he has available alternative materials, parts or internal manufacturing. Conversely, the more he is tied down to one supplier, or restricted to proprietary products, the weaker is his negotiating position.

3. General economic conditions — The more the buyer is dealing in a depressed market, or buying at relatively depressed times, the stronger his bargaining position on any one transaction. Conversely, when he deals in tight markets, or in times of scarcity, his bargaining position is obviously weak.

4. Buyer's knowledge of the seller's position — As a general matter, the more the buyer knows about the seller the stronger his negotiating position. The more he has available vendor data such as financial statements, price breakdowns, cost experience, learning curves, progress reports, the more he can negotiate from strength. The less he knows, the more he can be taken advantage of. Here ignorance is not a source of bliss.
Although negotiation is a complex and delicate process, there are tried and proved principles which the buyer can learn and apply. Such principles — or tactics — have been successful in all types of negotiation — labor-management, diplomatic, as well as business. The following are some key do's and don’ts of negotiation:

A. Know what you want — your major and minor objectives of the transaction — Although this seems like such an obvious point, it is surprising how frequently it is ignored. Too often buyers enter into negotiation on the basis of 'playing it by ear'. They treat individual items of discussion as they come up.

B. Know what the seller would be satisfied in achieving — Here it is important to distinguish between what the seller says he wants and what he would be satisfied in getting. There is a world of difference in the two. Invariably, where complex and protracted negotiations are involved, the seller has established ranges of agreement, minimum and maximum demands, bargaining issues with which he is prepared to discuss — and if necessary compromise on.

C. Open up negotiations by a discussion of mutual interests — Negotiation tends to be smoother if there is a mutual bond rather than barrier between buyer and seller. By emphasizing common advantages to both parties in the successful consummation of the agreement, further discussion begins on a positive note.

D. Avoid making first demands, proposals, or even positive assertions and claims — If there is any semblance of parity in the bargaining positions of the negotiators, the one who makes the first proposals is the one who is put on the defensive to substantiate it. This leaves him open to contradiction, refutation, qualification, denial. It puts him in the position of either conceding or accepting the onus of an impasse.

E. Negotiation is in a very real sense a test of strength; so that the buyer should strive to avoid a pattern of concession — As in military combat, the more the buyer can turn back an attack ('attack' being analogous to vendor demands, proposals, claims, assertions), the more reluctant the seller will be to pursue such 'attacks' vigorously later. Again, the less able he will be to resist buyer demands or proposals when they are made.

F. Introduce trading points at the outset — Negotiation is a process of compromise, so the buyer should act in anticipation of compromise. He should introduce quite early points that he is prepared to concede on later. He should even argue strongly for them.

G. Never give anything away — When the buyer is prepared to concede on a point, he should seek a counter concession in exchange. By being sensitive to the climate and tempo of the negotiations, the buyer can frequently propose a quid pro quo for what he has already decided to concede.

H. Know what limitations are imposed on the seller-negotiator — It is poor negotiating tactics to seek a decision or commitment from one who lacks the authority to make one. This causes him to 'lose face' and thereby deprives the buyer of a potential ally.

I. Seek technical assistance and support where necessary — Many negotiations have resulted in failure because the buyer was unwilling to admit his own shortcomings and seek technical assistance from others. In the same vein the buyer should avoid being intimidated by the vendor's technical experts who seek to 'stack the cards' in their favor by virtue of superior knowledge, expertise or reputation.

J. If negotiations are conducted by a team, make sure that all members are on the same team — A disconcerting thing about team negotiations is the tendency for buyer, seller, experts or specialists to break off into side discussions. Sometimes this results in members of the buyer's team siding with the seller's point of view. When team negotiations are conducted there should be a team leader (preferably the buyer). There should be an overall plan or strategy of negotiation. There should always be a dry run.

K. Be sensitive to the emotional temperature of the negotiation — Successful negotiations are not conducted in an emotionally charged atmosphere. Hence when things look like they might explode, the buyer should lower the pressure by a light touch, a facetious remark, a pun. Sometimes it is effective for him to poke fun at himself. However, the buyer should size up the seller carefully. The seller may take offense at this attitude.

L. To minimise the emotional involvement stick to the facts — The buyer should avoid personal opinion and heresy. He should avoid saddling the seller-negotiator with personal responsibility for debatable difficulties. He should never size up his opposite number in moral, ethical or sentimental terms. Successful negotiation is not a social exercise of winning friends.

M. Be ever conscious of the psychology of negotiation —

(1) Surround the buyer with prestige and importance. Don't have him appear as some 'janitor's assistant'. Negotiation that is mutually advantageous can only take place between equals.

(2) Never argue — be calm, cool and calculating. The buyer should size up his opposite number as an individual. He should know what makes him think and act as he does, and use the proper stimulus to motivate him.

(3) Keep your eyes and ears open. Watch facial expressions, hands and eyes. Listen for hints of the seller's unsaid thoughts — questions, tone of voice, direction of discussion. Recognize that there is a time to listen, a time to question, and a time to act.

Value Engineering, June 1969
Purchasing – Checklist

A SURVEY OF VENDOR’S CAPABILITY

When sources of supply need to be qualified in terms of capability, the buyer should seek and obtain satisfying answers to the following questions:

1. Who are the key people in the vendor’s organisation? What are their titles and describe their functions. What is the average experience and educational level in each department or group?

2. What are the vendor’s design and development procedures? How does he incorporate design changes? How does he integrate tooling and manufacturing techniques with research and development activities?

3. Will he comply with the buyer’s engineering standards and procedures for items made to buyer design, and will he produce drawings on buyer format when he requests it?

4. What are the vendor’s inspection procedures and controls? How frequently does he calibrate tools, gauges, and test equipment for meeting primary engineering standards? How does he control test equipment furnished to subcontractors?

5. Does he have a separate Reliability Engineering or Quality Control function? Where does it report, and how is it organised. What is the scope of its activity?

6. What is the nature of his planning, scheduling, and inventory control systems? How are requirements released – by job, by lot, by forecast?

7. How is production performance reports? (That is, actual versus scheduled?) By whom? How frequently?

8. How does the vendor control and incorporate engineering changes?

9. Who is responsible for machine and manpower loading? Does the vendor forecast loads, and is there a procedure for comparing current loads against forecast?

10. What is his system of stock and material control? How does he identify and separate discrepant materials? How does he dispose of scrap, surplus and obsolete materials?

11. What are his procedures of in-process inspection and quality control? What is his procedure of receiving inspection? Does he require certifications or test approvals from his suppliers? If so, for what items of purchase?

12. What is his current financial position as shown in the most recent balance sheet and profit and loss statements?

13. What is his current and projected volume of business? What is the breakdown of that business – military, commercial, sub-contract?

14. What is his cash flow forecast for the balance of the current accounting period? Does he have additional sources of capital, if they are needed? If so, what are they?

15. What type of accounting system does he employ – job cost? Standard cost? Other?

16. Will he furnish price breakdowns by cost element on fixed price contracts? Does he have any objection to contracting on other than a fixed price basis?

17. Does he accumulate cost by lot release, and how does he estimate initial production costs?


19. How does he account for labour costs? Are operations covered by time standards? If so, how are they established?

20. Does he employ learning curves in projecting labour costs? If so, what rate of learning does he employ?

21. Are his employees unionised? If so, when do his union contracts expire?

22. Will he designate specific individuals in his engineering, production, and financial organisations from whom the buyer can obtain pertinent information and data as he requires it?

These are not intended to represent a standard form questionnaire submitted to every vendor with whom the buyer might consider doing business. Rather, they are suggestive of the type of questions the buyers should be posing when Vendor Capability is important to his requirements.
FACTORS INFLUENCING VALUE TRADE-OFFS

Mr. A. D. Zappacosto, writing in the I.RE. Transactions on Product Engineering and Production (P.E.P. 5 November 1961, pp. 10-16), gives the following lists of factors which can influence value trade-off decisions:

A. DESIGN ENGINEERING CONSIDERATIONS INFLUENCING VALUE TRADE-OFFS

1. Contract Award
   End-use objectives of the equipment and of the overall system.
   The real operating environment.
   Experience level of the user's of the equipment.
   System Specifications.
   Security requirements.
   Availability of government-furnished equipment.
   The equipment specifications.
   Reliability MTBF* goals and component specifications.
   Field feedback on similar equipments.
   Product assurance specifications.
   Human factors specifications.
   Engineering and manufacturing schedules and cost.

2. Preprototype Model (Breadboard)
   Preliminary schematics
   Preliminary material lists and drawings.
   MTBF* goals.
   System specifications.
   Equipment specifications.
   Manufacturing methods: fabrication, tools, assembly, test and quality control.
   Maintainability methods and field test equipment.
   Communications with all personnel assigned to program.
   Cost and schedules.
   Customer changes.

3. Prototype Model (Manufacturing Model)
   Final schematic, detail, and assembly drawings.
   Final material lists and documentation of non-standard parts.
   Final system specifications.
   Equipment performance specifications.
   Manufacturing processes, tools and test equipment, quality control standards specifications.
   Maintainability, field test equipment specification.
   Operator training material.
   Maintenance procedures.
   Spare parts lists.
   Environmental tests.
   Patent disclosures and approvals.
   Predicted reliability MTBF* specification.
   Packing design.
   Communications with all personnel on program.
   Cost and schedules.
   Customer changes.

4. Environmental and Field Service Tests
   Product performance vs tolerances.
   System changes as necessary.
   Design changes as necessary.

Maintainability changes.
Reliability MTBF* results.
Human factors design changes as necessary.
Final operation manuals.
Maintenance manuals.
Final bill of materials.
Manufacturing drawings.
Assembly, test and quality control specifications.
Communications with all personnel.
Release for production.
Program for engineering design changes.
Cost and schedules.
Customer changes.

5. Manufacturing Support
   Specifications for subcontractors.
   Quality assurance standards.
   Use of nonstandard parts.
   Special assembly methods.
   Test process.
   Special test equipment.
   Production tests.
   Quality acceptance of product.
   Environmental tests.
   Reliability MTBF* data.
   Control of engineering changes.
   Cost and schedules.

6. Logistic Support and Installation
   Equipment spare parts provisioning list.
   Installation spare parts.
   Final instruction books.
   Installation engineering.
   Site surveys.
   Installation drawings.
   Installation and test specifications.
   Training of operators.
   Customer changes.

7. Operational Field Tests
   Over-all system performance vs specifications.
   Acceptance tests with armed services personnel.
   Reliability MTBF* data.
   Product improvements.

8. Positive and Negative Feedback Data from Tactical Operations
   Comments from armed services operating personnel.
   Note areas for product improvement.
   Note areas for new system concepts.
   Note maintainability and logistic support problems.
   Product improvement program for customer.

* MTBF – mean time between failures.
B. PRODUCT ENGINEERING CONSIDERATIONS INFLUENCING VALUE TRADE-OFFS

1. Business Management
   - Security.
   - Customer relations.
   - Negotiations and Renegotiations.
   - Contract administration.
   - Specifications.
   - Availability of government-furnished equipments.

2. Project Schedule
   - Engineering releases.
   - Manufacturing target dates.
   - Environmental test dates.
   - Installation schedule.
   - Training schedule for user's of equipment.
   - Over-all completion target dates.

3. Fund Allocation and Control
   - Appropriations.
   - Disposition of funds.
   - Cost estimates.
   - Control of expenditures.
   - Deviation approvals.
   - Engineering changes.

4. Selection of Subcontractors
   - Subcontracting administration.
   - Subcontracting cost control.
   - Subcontracting engineering and manufacturing liaison.

5. Engineering Responsibilities
   - Systems, development, design and reliability specifications.
   - Human factors specifications.
   - Systems integration.
   - Test equipment design.
   - Patent approval.
   - Technical documentation.

6. Manufacturing Requirements
   - Engineering releases.
   - Factory follow-up.
   - Test and inspection specifications.
   - Quality control specifications.
   - Equipment acceptance test specifications.
   - Packing design.
   - Shipping instructions.
   - Authorisation of engineering changes.

7. Field Operations
   - Maintenance and operational manuals.
   - Site installation.
   - Operational tests.
   - Spare parts.

8. Manpower
   - Proper balance of talents.
   - Morale.

9. Customer Relationship
   - Approval of program and changes.
   - Status reports.
   - Final acceptance.
   - New business.

Notes:
(1) 'Value Engineering - An Engineer's Heritage and Discipline.'

(2) Value Engineering to be effective requires the engineer to assess value constantly in each design decision as the product progresses from concept to finished equipment.

Each engineer at the start of a new product design must understand and evaluate the influence of his decisions on the ultimate cost of the product.

Armed with a real knowledge of all the factors which influence end cost, he can make effective decisions and trade-offs as the design progresses.

Here is a typical trade-off checklist prepared by Mr Zappacosta of R.C.A., Camden, New Jersey, U.S.A. As he says 'Such a list can be for guidance only; it is not a substitute for a free and inquiring mind necessary for the solution of difficult problems.'

(3) The project engineer must maintain effective communications with all members of the company assigned to a product-design team from the contract award to the end-life of the equipment.

He sets the competitive pace and spirit of the product team.

The project engineer complements the effectiveness of design engineers by providing daily assistance - coordinating and expediting all technical, financial and customer activities.

His need for a working knowledge of cost factors is as great as the design engineer's.

A typical value trade-off checklist for the project engineer is given above.

(4) No table of cost trade-off factors or organisational procedures can substitute for the engineer's inventiveness, initiative and perseverance in creating a new product. Creativity and sweat has to be applied to all the above checklisted items.
Checklist – Specifications

CHECKLIST OF ITEMS WHICH MAY BE INCLUDED IN A SPECIFICATION

An ad hoc committee of the National Council for Quality and Reliability with the secretarial assistance of the British Standards Institution prepared a ‘Guide to the Preparation of Specifications’ (PD 6112, May 1967, obtainable for 5/- from the British Standards Institution, 2 Park Street, London, W.1, England).

A specification is essentially a means of communicating the needs or intentions of one party to another. It may be a user’s description, to a designer, of his requirements for purpose or duty; or it may be a designer’s description, to a manufacturer, of an embodiment of these requirements; or it may be a manufacturer’s detailed description, to his operator, of the components, materials, methods, etc., necessary to achieve that embodiment; or it may be a statement, by a seller, describing suitability for a purpose to satisfy a need or even a potential need, of a user or a possible user. It may, of course, be some or all of these in one.

The attached list of items which may be used in a specification has been drawn up as widely as possible so that those writing specifications may be reminded of the headings under which requirements may be drafted in a comprehensive form.

The requirements of the specification should be written in terms of describing the optimum quality for the job, not necessarily the highest quality. It is usually unwise to overspecify and introduce requirements beyond, or properties higher than, those necessary to state the suitability for a specified purpose. It is costly and restrictive to seek a higher quality (i.e. more refinements) than necessary to perform the function required. The aim should always be the minimum statement of optimum (not highest) quality in order not to increase cost unnecessarily; not to restrict processes of manufacture; not to limit the use of possible alternative materials.

The following checklist has been compiled from the above ‘Guide’:

1. Title of specification
   Care should be exercised when choosing a title for a specification so that no ambiguity can arise.

2. List of contents

3. Foreword
   3.1 History and background information
   The Foreword should state, as appropriate, any background information, the reason why the specification has been written, the authority for its preparation and the name of the issuing authority.

4. Scope of the specification
   4.1 The extent and limitations of the subject matter to be covered in the specification.

5. The role of the equipment or material
   Information in the clause may be valuable to the designer in interpreting the user’s requirements, to the manufacturer in interpreting the designer’s requirements, etc.

6. Definitions
   Attention is drawn to the fact that authoritative information on terminology, symbols, abbreviations and measuring systems exist in British and other Standards and reference should be made to these wherever possible.
   6.1 Terminology
   In order to avoid possible misunderstanding of the meanings of terms used in the specification it is often necessary to define the terms.
   6.2 Symbols and abbreviations
   Precise meaning of any symbols and abbreviations used should be given.
   6.3 Measuring systems
   Besides laying down the units of measurement used in the specification, e.g. metric (SI units) or inch, it may be necessary to refer to other conventions such as first or third angle projections in drawings, etc.
   6.4 Language
   Where the specification is the concern of different countries it may be necessary to specify the language of the document or related documents to which reference is made.

7. Relevant authorities to be consulted
   Attention should be drawn to any other authorities which may need to be consulted in relation to the equipment or material. For example in the case of a manufacturing specification it may be necessary to obtain the clearance of a safety officer before proceeding with a particular process.
8. Related documents and references
8.1 Reference to user/design/manufacturing specification
8.2 Statutory regulations or other legal conditions
8.3 British and other Standards and Codes of Practice
8.4 Standards issued by other bodies, e.g. nationalised industries, trade associations
8.5 Other regulations/documents applicable
   The extent of the applicability of related documents and references should be made clear.

9. Conditions in which the item or material is to be installed, used, manufactured or stored
9.1 Environmental features including for example:
   temperature; pressure; humidity; altitude; shock;
   vibration; terrain; atmosphere; noise; dust;
   infestation; radiation; fluid; chemicals; electrical inference
   The duration of exposure to environment is important as also is any cycle of environmental conditions.
9.2 Relation to associated equipment, e.g. compatibility with other items in an assembly, influence on environment
9.3 Conditions of use, power requirements, supply services
   An indication should be given of the conditions and the personnel operating the equipment, as it may be necessary
   for the supplier to make special provisions for operation by unskilled labour, or even for a certain amount of abuse.
9.4 Servicing requirements including access
   Difficulties should be stated regarding accessibility for servicing or other limitations which might affect the design
   of the product.

10. Characteristics
10.1 Design, samples, drawings, models, preliminary tests or investigations
   The user may only be able to indicate his requirements in a very general way, i.e. by stating purpose or function.
   A designer will give adequate instructions for a design which he considers will embody the user's requirements.
   The manufacturing specification meets these requirements in terms of the final product. Consultation is necessary
   at all stages.
10.2 Properties, e.g. strength, dimensions, weight, safety, degree of purity, taste, etc., with tolerances where appropriate
   It may be necessary to indicate those properties which are critical and those which are not critical.
10.3 Interchangeability (functional, dimensional)
10.4 Materials and their properties (including permissible variability), approved or excluded materials, effect of repair
   Alternative materials should be included where possible; variability refers to acceptable tolerances on supplies
   of raw materials, etc.
10.5 Requirements for a manufacturing process
   A manufacturing process, e.g. heat treatment or forging, should be specified only when it is critical to design
   considerations.
10.6 Appearance, texture, finish, including colour, protection, etc.
10.7 Identification marks, operating symbols on controls, weight of items, safety indications, etc.
10.8 Method of marking
   The following details are typical:
   (1) The name, trademark or other means of identifying the manufacturer.
   (2) The date of manufacture, or batch and, where possible, identification to machine or operator.
   (3) The nominal size, rating, or other relevant particulars of any coding of the materials.
   (4) The reference number of the specification to which the product is supplied.
   The position of such marks and their method of application should also be detailed.

11. Performance
11.1 Performance under specified conditions
   The user should describe in his specification the stipulated requirements. Some may not be possible or economic.
   The designer may, therefore, wish to make some adjusting statements in accordance with the practicability of the
   design.
11.2 Test methods and equipment for assessing performance; where, how and by whom carried out; reference to
   correlation with behaviour in operation
11.3 Criteria for passing tests, including accuracy of results and interpretation of results
11.4 Acceptance conditions
11.5 Certification and/or reporting
   Details should be given of any reports, test schedules or certificates required.
12. Life
12.1 Period of useful life
The period of useful life is that period over which the performance does not drop below a tolerable level, having regard to reliability.

12.2 Life between overhauls
'Overhaul' is used in the context of a significant operation rather than routine servicing, but what exactly is involved should be clearly defined.

12.3 Total life
Total life is the period over which some performance can be obtained; it usually exceeds the useful life of a product by a period in which it is accepted that performance levels may be falling.

12.4 Test methods and equipment for assessing life
12.5 Criteria including accuracy and interpretation of results of tests
12.6 Acceptance conditions
12.7 Certification and/or reporting

13. Reliability
13.1 Reliability under stipulated conditions
13.2 Control procedures, test methods and equipment for assessing reliability, bases for claims
13.3 Criteria including accuracy and interpretation of results of tests, confidence levels
13.4 Acceptance conditions
13.5 Certification and/or reporting
Details should be given of any reports, test schedules or certificates required. It may also be necessary to refer here to any arrangements for feedback of information to the manufacturer of operational experience or data obtained by the user.

14. Control of quality checking for compliance with specification
This is one of the most important sections of the specification. Any process of control of quality which is considered necessary to maintain the uniformity of quality of the product should be stipulated. In particular, sampling procedure and interpretation should be introduced where appropriate. Any declaration of quality made by the seller should be related to the detailed methods of control of quality set out in the specification clauses.

14.1 Method of checking compliance
14.2 Production tests on raw materials, components, sub-assemblies and assemblies; records to be kept by the manufacturer
14.3 Assurance of compliance e.g. by supplier's certificates or independent certification schemes
14.4 Inspection facilities required by the user/designer or offered by the manufacturer/supplier
14.5 Instructions regarding reject material or items
14.6 Instructions in regard to modifications of process
14.7 Applicability of requirements of 14.1 to 14.6 to sub-contractors, etc.
14.8 Acceptance conditions

15. Packaging and protection
15.1 Specification of packaging, including any special conditions in transit
Reference may be made to tests required for the package, the British and other Standard Packaging Codes and other relevant packaging specifications.
15.2 Conditions in which required/supplied
15.3 Period of storage
15.4 Marking of packaging
Any special marks or other coding details required on the packaging in addition to those marked on the component or material itself should be stipulated.

16. Information from the supplier to the user
This section deals with the information which the user may ask to be given by the supplier, or alternatively, information which, without any specific request for it, the supplier will give to the user. It is important that information on maintenance frequency and any limitations should be clearly set out by the supplier as this will have a bearing on the performance, reliability and life to be expected from the product.

16.1 Instructions for storage, taking into use, advise on installation, operation and maintenance
16.2 Service facilities and access, lubricants to be used, fuels, replacement parts, etc.
16.3 Maintenance details, frequency and limitations
16.4 Relevant literature, e.g. handbooks of operations, spare parts manuals, codes of practice

17. After sales service
17.1 Facilities available or required
17.2 Guarantees and warranties
17.3 Complaints and compensation procedure

Value Engineering, June 1969
Zero Defect – an Experiment in Responsibility

The zero defect concept is a program which emphasises error-free performance from operatives. It is based on the principle that prevention is better than cure and suggests that each worker acts as his own quality inspector. The ZD concept being successfully applied in a Scottish factory. Hewlett-Packard Limited, of South Queensferry, Edinburgh.

The company’s present production embraces over 1,800 instruments, systems and accessories – one of the largest ranges in the industry. It includes oscillators, volt meters, oscilloscopes, pulse generators, graphic recorders, data acquisition systems, wave guide test equipment, signal generators, and electronic counters.

These instruments are, of course, manufactured to the highest specifications and it was, therefore, a calculated management decision to introduce the Zero Defect concept as a basic philosophy within the company. The usual objection to such an innovation is that operatives are not sufficiently responsible to be entrusted with control of the product’s quality. The answer lies in the correct selection of personnel and the correct allocation of their duties.

In addition to training for their specific duties personnel are given an introduction to the philosophy of Zero Defect and its effect on the company’s output. The concept can be summed up in the simple phrase, ‘do it right the first time’, and the whole basis of the management approach is directed to creating this atmosphere. Work people are instructed in a four-step approach to achieving Zero Defect:

1. identify the causes of errors
2. instruct in error-free work habits
3. inspect work as it is being done
4. inspire and motivate employees.

The methods used to achieve these aims include posters, charts and, most important of all, frequent meetings with the operatives and supervisory staff concerned.

The Scope for Productivity Bargains

If productivity bargains are to succeed in their aim of eliminating the inflationary element in wage agreements in Britain, they must be genuine. They must achieve an identifiable and measurable increase in labour productivity. The pay increases given must be no greater than the increase in productivity actually achieved. The application of the bargain should certainly not increase unit labour costs; in many cases it should reduce them.

Within this framework, there are plenty of matters which can properly and usefully come within the scope of a productivity agreement. Among the many impediments to increased productivity there are:

1. Inappropriate and uneconomic manning of machines, processes, production lines or departments.
2. Inappropriate and uneconomic use of skilled and semi-skilled labour.
3. Lack of flexibility in the deployment of labour.
4. Resistance in principle to the introduction of shiftworking.
5. Resistance to the planned use of working hours.
6. Waiting time and other non-productive time.

Increased productivity or efficiency of work may arise from one or more of the following:

1. A change in the quantity of work produced by, for example, greater physical effort under existing conditions, or by the elimination or reduction of tea-breaks and other working time allowances.
2. A change in the manner of performing the work brought about by the acceptance of a greater degree of flexibility or mobility of labour.

The following are examples of this:

Skilled men on related work to be interchangeable as far as is practicable.

A skilled man, carrying out the major part of a job, to perform, as far as is practicable, the associated or ancillary work at present done by skilled men of other trades.

A skilled man, in carrying out the major part of the job, to perform the associated or ancillary work at present done by mates and assistants where this can be shown to be in the overall interest of cost or time saving.

Where it is necessary, because of the work involved, to employ mates or assistants, then these men should carry out as wide a range of duties as possible, particularly any non-skilled work currently carried out by the skilled man as part of his job.

Workers to be mobile between different jobs and different departments of the same establishment where ability to carry out the work in the department concerned is not in question. Simple maintenance work on a machine to be carried out by the operator.

3. Other changes in manning arrangements involving a reduction in the total numbers employed in a department or section through, for example, the elimination or reduction of the number of craftsmen’s assistants, the manning of a number of machines by a single operator, etc.

The above examples are taken from criteria put forward by the Engineering Employers’ Federation in their discussions with the Confederation of Shipbuilding and Engineering Unions. They are, however, included here as a matter of general interest, since they apply to many other industries.

Zip . . . in 8 Minutes Flat!

Reporting on his experience, Mr Peter Thew, of I.T.T. Europe, Inc., says:

‘The time for implementation varies enormously. The shortest on record being eight minutes from the idea to the actual implementation on the shop floor. The longest may well be many months due to environmental testing requirements.

‘Cost of analysis and implementation has varied from virtually nothing on a small item to £5,000 for a major equipment change, where the savings potential is in the order of £20,000 per annum. Technical ability required has ranged from removing two spacers to redesigning a complex piece of electronic equipment. Production quantities analysed have varied from 250,000 per annum to a one-off special.

‘In all cases it has been proved that savings are possible and, in most cases, they have been implemented. There have been instances where in theory a change is very desirable, but, in practice, it has not been implemented due to high stock of existing parts or lack of interchangeability.’

Value Engineering, June 1969
An Introduction to Value Management
by D. I. Speirs, B.Sc.(Eng.), M.I.M.C., A.M.I.Prod.E.*

Value Management is the term used to define the application of the Value Analysis techniques to the operation of a company. The team concept used in product Value Analysis is retained. The composition of the Value Management team is defined and the role of the team chairman explained. A Value Management project is divided into six clearly defined phases – Organisation, Evaluation, Speculation, Investigation, Decision and Implementation. The action required at each phase is discussed and the underlying reasons explained.

In the final section of the article the benefits that a company may expect from Value Management study are examined.

Introduction
The techniques of Value Analysis and Value Engineering are designed primarily to examine all direct costs associated with a product. There is, however, a close similarity between a company and a product. A company is made up of many component activities each of which must function correctly within its own sphere and each of which must be capable of assembly with other activities to form the corporate whole. We have, therefore, the familiar pattern of components, sub-assemblies and main assembly that we associate with a product. The chief designer in the case of a company is the Managing Director.

It is inevitable that value analysts should turn their attention to the way in which the proven ideas underlying product Value Analysis can be applied to examining the operation of a company. The main objective is the same, namely to achieve all essential functions at least cost. The body of knowledge required to apply Value Analysis in this new field is, of course, quite different. For this reason the new term Value Management has been adopted to describe the techniques and methods employed.

The team
Fundamental to the application of product Value Analysis is the team of senior men representing the main functions that control and affect the cost. There are several important reasons why the team concept is adopted. It would be wholly wrong to divide responsibility in line functions in important areas such as design. Setting up a separate activity would duplicate many functions and create additional overheads. Discussion of irrelevant alternatives is unlikely with senior men present. Decisions can be taken and implemented more rapidly. Facilities can be made available more readily for exploring and testing ideas.

Similarly the team is a vital component of a Value Management study. The whole operation of the company is going to be subjected to a critical review and this can only be done by senior management. The team will comprise, therefore, the Managing Director and the chief executives of the main functions, i.e. design, marketing, accounting, production and personnel.

The Value Management team can only afford to spend a limited number of hours per month on the project so that the full time team chairman is as important as in a Value Analysis study. His job is to gather and prepare all the facts for presenting to the team, to apply the critical questioning techniques at the team meetings, the preparation of action minutes and to co-ordinate activities between team meetings. He is the focal point around which the whole exercise revolves leaving the team of senior executives the function of taking decisions against a background of carefully prepared facts.

Obviously the team chairman must be of a calibre that will command the respect of the high level team. He should have a wide experience of all aspects of management and be trained in the critical analysis of data. This role is most commonly filled by a senior outside consultant although such a person may be available amongst the men being groomed for succession to one of the top management positions. The frequency with which the team will meet may be dictated by the availability of the senior men involved. It is advisable, however, to fix the dates of meetings well in advance to ensure that a full complement is achieved. It is essential that there should be continuity of thought and discussion, so that the sending of deputies to meetings should be discouraged. The meetings are likely to be held every two or three weeks, they should be held in the morning and are likely to take about three hours.

The main phases
The main phases of a Value Management study are similar to those for a Value Analysis project, namely:

- Organisation
- Evaluation
- Speculation
- Investigation
- Decision
- Implementation

Some of the main points affecting each of these phases are discussed below.

* Mr D. I. Speirs is an executive of Harold Whitehead & Partners Ltd., a British management consulting company, and is responsible for their work in the Value Management field. His first industrial appointment was as Director and General Manager of a foundry and engineering company. For the past sixteen years he has practised as a management consultant, directing projects in major British companies. He was one of the pioneers of Value Analysis into Britain in 1959 and has lectured extensively on this subject throughout Europe. During the past five years he has specialised in developing the 'value' concept to the broader aspects of company management. His address is: Harold Whitehead & Partners Ltd., 21 Wigmore Street, London, W.1, England.
Organisation
The Value Management study is going to embrace the total operation of the company. This is a major exercise and the first step is, therefore, for the Managing Director to obtain the willing support of the main executive board of the company. This may not be easy. All the arguments used in the early days of Value Analysis are likely to be raised. Executives will claim that they have not the time to devote to the study, that this type of investigation will cut across their normal functional responsibilities, that they are doing this sort of thing all the time, that the work is already covered by existing O & M personnel, and so on.

One obstacle that has to be overcome is that of fear. The executives may feel that a detailed study of their departments may reveal deficiencies for which they will be held responsible. It must be made clear by the Managing Director that all activities are going to receive an equal share of scrutiny, that the object of the exercise is to reveal weaknesses and that there will be no recriminations if the recommendations are not followed. One must stress that the sole aim is to strengthen the competitive position of the company and thereby to ensure the long term future of the enterprise.

The objection that the exercise will take up too much time of the top executives is spurious when viewed against the background of the cost reductions that can be expected and the permanent benefit that the company will derive from the project. In fact, if the team chairman does his job properly, the involvement of the senior men on the team is not much greater than attendance at the meetings.

The main problem of getting acceptance of a Value Management study, as with Value Analysis, is that it appears that the techniques are simple and that there is a lack of novelty in the disciplines involved. One of the most important features, however, is that the senior executives are presented, often for the first time, with all the detailed aspects of the company operation and, even in their own departments, they may find that what is actually happening at lower levels is quite different to what is imagined.

Once a decision has been taken to proceed the first step is to appoint the team chairman. If an outside consultant, arranged by the Managing Director, is to be used, arrangements will have to be made with the company concerned. If the appointment is internal the person selected must be freed from all other responsibilities for the duration of the project, which may extend for more than a year in the larger company. The team chairman will not require a full time secretary but will require a confidential typing service from time to time. A suitably equipped private office is essential.

All levels of management and supervision must be informed as to the nature of the project and the method by which it will be conducted. Similarly the craft and clerical unions should be informed and any other representative bodies such as Works Committees. Reductions in staffing are almost certainly going to result unless the company is undergoing rapid expansion. An early decision is required as to the method of dealing with redundancies and the Unions informed. The maximum use should be made of natural wastage and it is recommended that recruitment is halted as soon as it is decided to proceed with the project.

Evaluation
Before any part of the organisation is examined by the team all the relevant facts in considerable detail must be assembled. This is a major task, requiring considerable experience and skill, and is one of the main functions of the team chairman.

The first step in preparing the Evaluation Data is to build up a special organisation chart of the whole company showing the occupations of all the personnel employed. A typical form used for this purpose is shown at Fig. 1.

At the lowest level of reporting the type of operative employed and the numbers of that type are shown, e.g. reporting to the Foundry Foreman we have:

- Foundry Foreman (1)
- Machine Shop Foreman (1)
- Press Shop Foreman (1)
- Assembly Foreman (1)

At the highest level reporting to the Managing Director we have:

- Production Director (1)
- Marketing Director (1)
- Chief Buyer (1)
- Chief Production Controller (1)

Those reporting directly to the Managing Director who have persons reporting to them are coded 1.00, 2.00, 3.00, etc., e.g.

- Production Director (1.00)
- Design Director (2.00)
- Marketing Director (3.00)

Those reporting at the next level down are coded -01, -02, etc., e.g.

- Works Manager (1.01)
- Works Engineer (1.02)
- Chief Buyer (1.03)
- Chief Production Controller (1.04)

Those reporting at subsequent levels down are coded by the addition of -01, -02, -03 etc., e.g. reporting to the Works Manager (1.01) we have:

- Foundry Foreman (1.01.01)
- Machine Shop Foreman (1.01.02)
- Press Shop Foreman (1.01.03)
- Assembly Foreman (1.01.04)

Using the completed forms it is now possible to draw up an organisation chart for the whole company. Each major supervisory level is coded according to the following rules.

The forms should show all the persons on the payroll at a specified date, the first day of a new pay week being the best date to select. The first form to be completed is that for the Managing Director. On this form all the persons reporting to him are shown including secretaries, personal assistants, etc. Each of those on this form who have persons reporting to him or her then make out a form showing their immediate subordinates and so on until the whole company is listed. Persons absent but still on the payroll must be included and if a position is temporarily vacant the word 'Vacant' should be inserted under 'Name' and the description of duties shown.

Fig. 1. Form used for preparation of organisation chart.
Part of the organisation chart described above is illustrated in Fig. 2.

Fig. 2. Section of typical organisation chart.

The number shown on the right of the box in the case of the supervisory levels is the number in the section including the supervisor himself. For example, in the case illustrated, there are twenty-nine persons in the foundry including the Foundry Foreman. These totals can be carried up to Managing Director level to give the total number employed in the company, which can then be checked against the payroll total. If vacancies have been included in the chart these should be deducted before making the payroll comparison. The organisation chart described has several important functions. A considerable amount of convenience is gained by opening project files for each section using the coding shown, e.g. file 1.01.01 would contain all the information concerning numbers and categories of persons employed. The inclusion of similar activities located elsewhere in the company and to see the foreman to whom to contact if further information is required. In fact, the organisation chart acts as a general background reference throughout the project.

Once the organisation chart has been completed and checked the next step is for the team chairman to commence building up the files of data for each of the activities in the company. The initial gathering of facts must be carried out by the team chairman since he must be able to talk with some authority about each activity in the company when these are reviewed at the team meetings. The best and quickest way of doing this is by means of interview. The team chairman should have brief courtesy discussions with intermediate levels of management but should have his first main fact finding interviews with the lowest level of management, e.g. section leaders, foremen, etc. More formalised fact finding interviews with middle and senior management are likely to be more valuable when the basic detail is known.

The best way of starting the interview is to ask the section leader/foreman to describe what each of the groups of persons shown on the organisation chart do and broadly how they allocate their time. Flow charts should be prepared showing the flow of paperwork procedures within the section. Wherever possible a quantitative measure of the work done should be obtained, e.g. number of invoices processed, number of persons paid, etc. An estimate of time required to complete each transaction should be made. The total floor space occupied by each section should be noted and the percentage of useful occupations estimated. A sketch plan should be drawn. Details of plant or equipment used should be noted together with the percentage utilisation. Samples of any forms should be obtained.

A skilled analyst would obtain most of the information required in about two hours per section, although a subsequent brief ‘back-up’ visit may be required to obtain further information not readily available at the first interview. The average section is likely to contain some 15–20 persons, so that the team chairman should cover the collection of the evaluation data at the rate of about 120 employees per week. An approximate timetable for the collection of evaluation data in a company employing 1,000 persons would be:

<table>
<thead>
<tr>
<th>Task</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Completion of forms</td>
<td>2 weeks</td>
</tr>
<tr>
<td>Preparation and checking of organisation charts</td>
<td>2 weeks</td>
</tr>
<tr>
<td>Collection of evaluation data</td>
<td>9 weeks</td>
</tr>
<tr>
<td>Total</td>
<td>13 weeks</td>
</tr>
</tbody>
</table>

Since the collection of data takes only three months in this size of company, the first working meeting of the team would probably be deferred until all the evaluation data has been collected. In a larger company it may be felt that waiting for all the evaluation data to be collected would unduly delay the implementation of the improvements, in which case it may be necessary to give the team chairman an assistant to carry out special investigations resulting from the team’s deliberations whilst the team chairman continues with the collection of data.

Speculation

The speculation phase takes place at the team meeting. The role of the team chairman is first of all to place all the facts regarding a specific activity before the meeting and to define clearly the function or functions that are being performed. Certain specific questions should then be asked, namely:

1. Is the function performed essential to the carrying on of the business?
2. Is the function correctly placed in the organisation structure?
3. Is the method of achieving the function effective?
4. Would the function be less costly to perform or more effective if combined with another activity?
5. Does the staffing level and space occupied appear reasonable in relation to the function performed?
6. Is the function physically located in the best place?
7. Is there any alternative method of achieving the same function that would be less costly or more effective?

In some instances the team will be able to take a firm decision as a result of the discussion. More often than not, however, further investigation will be required as detailed below.

Investigation

In most cases resulting from the discussion at the team meetings further investigation along specific lines will be required. It is the task of the team chairman to prepare action minutes after each meeting stating exactly what further facts are required and who should be responsible for their collection.

In general the collection of any additional data will be the responsibility of line management and will be arranged by the head of the relevant function who is sitting on the team. The team chairman is, however, likely to be involved in some special aspects of the investigation due to his wider knowledge of the total company operation or because of his specialist knowledge in certain fields. It is important, however, to obtain the maximum involvement of line management at this stage both to attract the maximum number of ideas and also to help in the acceptance of change resulting from the investigations.
Decision
The results of investigations are reported at the team meetings in order to keep all members of the team informed. It is the task of the team chairman to ensure that all investigations are pursued until finality is reached and presented in such a way that a decision can be taken.

It is not specifically the role of the team to take decisions. The Managing Director would wish to take all decisions of a major policy nature or may have to refer a point to the main board. Decisions relating specifically to functional areas may be delegated to the executive in charge. In other words the normal decision making mechanism of the company would operate. Once a decision has been taken it should be reported to the team and minuted.

Implementation
Since the team is made up of the senior executives of the company it is useful to report progress on implementation to the team. This is a simple means of ensuring that implementation is not delayed and will assist in getting action when more than one function is involved.

These major studies, particularly in the larger companies, often result in substantial organisation changes. If it seems likely that this will be the case it may well be advisable to devote the first one or two team meetings to this aspect. It is absolutely essential that all organisation changes are completed before any more detailed improvements are made. This is because it is of critical importance that the management who will have to operate any new procedures should have been a party to and in agreement with the change.

The anticipated benefits
It is not possible to state in general terms what level of savings can be expected in any specific company as the result of carrying out a Value Management study. This will obviously depend on how effective the management has been. The writer has, however, carried out four major studies in first class companies using this technique involving a total of some 13,800 employees. The savings resulting have amounted to approximately £4,200,000 per year for the companies concerned or about £300,000 per year for every 1,000 employees studied. The turnover of these companies is in excess of £80,000,000 per year, so that the savings represent a reduction of about 5 per cent on this figure.

It is not claimed that all companies would achieve a saving equal to 5 per cent of turnover. Some could achieve more some less. What does seem apparent is that a substantial improvement is possible in all companies and that the carrying out of a Value Management study will certainly improve the effectiveness of management at all levels and the competitive position of the majority of companies.

Miscellany

Roadblocks for Powerplant Manufacturers
1. It's highly stressed.
2. Aerodynamics won't buy it.
3. What about flight safety.
4. It will increase the weight.
5. The F.A.A. would never buy it.
6. It's a high speed rotating component.
7. We don't want to touch the hot end.
8. Interchangeability will be affected.
9. We will have to re-substantiate.
10. Substantiation cost will be too high.
11. The customer won't go for it.
12. It's source approved.
13. Stress won't buy it.
14. This is engineering's prerogative.
15. Are you qualified to make such statements.
17. It's too late in the game.
18. It has nothing to do with Development Engineering.
19. It has nothing to do with Design Engineering.
20. It's none of your business.
22. Our way works.
23. Why?
24. Who says so?
25. What for?
26. It could be a fire hazard.
27. You are out of your cotton pickin' mind.
28. Impossible - it's my bowling night.
29. Where's your ring?
30. It's subject to fretting.
31. We have to allow for expansion.
32. We have to allow for contraction.
33. We have to allow for radial growth.
34. We have to allow for axial growth.
35. What!!
36. It will affect the Gas Path.
37. Yes - but . . .
38. It's too dicey.
39. There's a temperature differential.
40. P.W.A. don't do it that way.
41. It's Corporate Policy.
42. Hold it for some future design.
43. That area is pressurised.
44. Have you considered the grain structure.
45. What about the noise level.
46. What competition!!
47. Cost! We're designers not accountants.
48. When I was with . . . ?
49. Did you consider Specific Fuel Consumption?
50. What do you know about S.F.C.

'Eureka, eureka!'
Trimming specific weights from odd-shaped workpieces has always been a matter of guesswork for machinists. Now, Hamco Machine and Electronics Corp. has turned to a law of physics as old as Archimedes' legendary bath – during which he discovered water displacement – to come up with a saw that can trim to nearly exact weights. The workpiece to be cut is lowered into a water displacement – to come up with a saw that can trim to nearly exact weights. The workpiece to be cut is lowered into a water chamber that is connected to a visible measuring tube. As the waterline, lifted from the tub, and trimmed. The saw, which costs about $22,000, is available through Navan, Inc., special products subsidiary of North American Rockwell Corp.

Value Engineering, June 1969
An Analysis of the Method of Value Analysis
by C. F. Graham, B.Sc., A.R.C.S.T., F.I.W.S.P.*

Making no claim to be a value engineer, the author describes his experience of V.E. training. Basing his remarks on the British Standards Institution’s Glossary of Terms in Work Study, he leads the reader to a six-point statement of ‘Job Methodology’ which he reduces to the familiar Select, Record, Examine, Develop, Install and Maintain.

Work Measurement he maintains, however, is not a methodology but a technique which attempts to ‘establish the time for a qualified worker to carry out a specified job at a defined level of performance’.

Mr Graham holds that the nearest thing to a technique in Value Analysis (if there is one) is brainstorming which he considers to be a very bad technique. ‘Its strength (he says) is reputed to be that by allowing freedom of mind, many solutions will be generated. In my view haphazard thinking produces haphazard solutions…’. Later he goes on to say this about ‘value’: ‘This jumble of non-mathematical, pseudo-economic, meaningless non-quantification leaves me to the conclusion that you would do better to leave the word ‘value’ in the hands of the theoretical economist.’

It is good for the ‘the converted’ to be faced with heresy!

Credentials — real and assumed
Now let us be quite clear about one thing right from the beginning. I am not a value engineer, nor a value analyst. I have never consciously known that I was engineering value or analysing it at all. I am not a value engineer, nor a value analyst. I have never committed myself to training courses or seminars in your field of interest. To the personal direct experience.

A little bit of history
Now it is all very well for me just to announce that there might be areas of potential improvement in your world without being specific about them, so let us without further ado, and before you have time to protest, get down to the occasion when it first struck me that maybe all was not well. I was on the second of the two courses mentioned earlier and we were being very systematic. The course had been earlier split into ten smaller groups of about five each, and each group had been confronted with a piece of engineering gubbins to which we were applying our scientific logic. We had defined all the functions and we had written down all readily available facts about volumes, prices, life, customers, fashion and so forth, and we were about to indulge in some free thought. And at that point the course instructors did something which seemed unremarkable at the time, but which later forcibly drew me up with a jerk. They moved some of the course members about, from one group to another. Yes they did! As luck would have it, I found myself moved from a rough old pipeline and valve assembly to a small, intricate, precision-made lock mechanism, about which I have absolutely no knowledge. If I get locked in the bathroom, it is a Fire Brigade job.

But Revelation was not yet with me. So off we went, brainstorming our merry way through the next part of the systematic procedure, and producing a long list of items, individually unexamined and uncriticised, when it suddenly occurred to me that all this should have been far from being a logical progressive path we were taking, it was instead an interrupted path, and that all the carefully-collated facts (garnered previously with such loving care by the chap over there wrestling with the valve, the fellow now on the clutch assembly and my new group’s three oldest inhabitants) were not being used at all.

I suppose now, looking back, that all this should have been pretty obvious, but up till that instant, it had not been obvious to me. My next uncharitable thought was to wonder whether we would ever use the earlier work again, because if it were not to be used in idea-generation nor in the evaluation of alternatives, then really the early steps were altogether unnecessary. Further, if the generation of alternatives were to be done by brainstorming as an immutable part of the procedure — as was happening in this case — then what had been ably described by the lecturers as a systematic logical investigation of a total system would be reduced to a heap of unrelated guesses of uncertain relevance and validity.

Much to my consternation, this is the way it turned out. All the evaluations were on a pretty subjective basis, and were entirely cost-based as opposed to value-based. So what this particular...
course boiled down to was a brainstorming session to produce alternatives which were evaluated on their cost-reducing potential. We might just as well have had an old-fashioned cost-reduction session. Yet all of this was carried out with panache. We were all suitably solemn, pompous and serious in our efforts, sitting there in our best suits with a faint trace of mothballs in the air, and indeed even I, with my little niggling doubts, sublimated my treacherous thoughts till later. Each and every one of us was convinced by the solemnity and trappings of the occasion that we were blazing new logical frontiers. Now I do not know how typical or atypical of the real thing this was. But I do know that technique and procedure in cold reality are almost inevitably water down from the classroom, so that being a suspicious sort of a guy. I would not care to make book on the existence in harsh practice of a truly logical progressive procedure and of quantifiable decision-taking, based on a real and precise quantification of value, in its nicest semantic sense.

After the destruction, the reconstruction. Well, you might very well ask, what do you suggest then, Clever Dick, at which point I can only mumble in my whiskers that maybe we can learn a little by looking at the way investigation procedure in method study has progressed over the years, has criticised itself and evolved, and has tried to remove some of its undoubtedly historical limitations.

Methods study
According to the British Standards Institution's Glossary of Terms in Work Study, we may define method study as the systematic recording and critical examination of existing and proposed ways of doing work, as a means of developing and applying easier and more effective methods and reducing costs.

Now all definitions of a non-mathematical nature are wide open to some kind of semantic criticism, and this one is no exception. Firstly, we may not want 'easier work' - we may prefer a more marketable product. Secondly, we may not want to have a 'more effective' method - some methods produce results which are already too effective for the market concerned. Thirdly, we may not want to 'reduce costs', inasmuch as there are occasions when an increase in the cost of one aspect has a by-product effect which increases the total profit or the return on capital. Finally, it may even be said, with some truth that in the phrases there is a tacit implication that the work has to be done in any case - which is at variance with 'Eliminate'.

So here is a basic definition which is perhaps best if it is operated in spirit rather than to rule, and yet this is one of our long-cherished foundations, our second B.S.I, definition, coming second only to the utterly fundamental definition of Work Study - that generic term for a complex of techniques which together amount to the systematic application of constructive dissatisfaction.

It might, then, be a rather better start to our consideration of method study if we initially put aside any pre-conceived notions about our intent, and adopt the approach of the pure researcher. In work measurement (which is frequently described as the other half of work Study) the pure and sensible approach is to consider the subject for what it is - a means of measuring work, within a set of techniques and definitions - but to banish from our initial thoughts the materialistic uses to which our results are later applied, and use them for the systematic application of constructive dissatisfaction.

Like this) and decision making.

You could: (a) Ignore it, and hope no one falls in, or (b) Put a fence around it, with red lamps at night, or (c) Post a security man, or (d) If the plan continues to be an acceptable solution to our problem, continue it as necessary until the need disappears.

For example, if you happen to be the foreman in charge of civil maintenance in your factory, the following sequence of events might easily befall you:

(i) The telephone rings and Fred Wibble, foreman in the bodging shop, says 'There's a big hole in our floor.' A job has materialised out of nowhere, and in this case that job is to investigate Fred's complaint and to take the correct action.

(ii) You take a walk to the bodging shop and survey Fred's alleged hole in the floor. In the light of your vast experience in these matters you diagnose the symptoms, confirm his suspicions, agree that it is a hole, and mentally measure it up.

(iii) Several alternatives spring to your highly-trained mind. You could: (a) Ignore it, and hope no one falls in, or (b) Put a fence around it, with red lamps at night, or (c) Post a security man, or (d) Fill it in, or (e) Close down the bodging shop.

(iv) All in all, solution (d) seems best, although (b) might be the solution. You calculate the materials needed and instruct your men accordingly.

(v) They go there and fill the hole in.

(vi) You take a look at their completed work and check that Fred is once again his cheery happy self. If all is well, the job is finished.
Now if we take this pattern of the events in a non-routine job, and call this our 'Job Methodology', we may simplify it a lot by reducing it to:

1. Find the problem.
2. Get to know its characteristics.
3. Think about it, critically.
4. Decide on the action to take.
5. Take this action.
6. Check the result and keep it going as necessary.

This in its turn may be reduced to six convenient words, such as: Select, Record, Examine, Develop, Install, Maintain.

Now the lynx-eyed reader will doubtlessly remember having seen this list before. These six steps are traditionally taught as being the six steps of method study. Yet clearly they are also the six steps of doing any non-routine job – that is, they represent the logical methodology. So here we have an example of the part claiming it is the whole. It is quite true to say that these are the five steps of method study, but this is only because method study, if it is to be done in a logical and orderly fashion, must perforce adhere to the rules of doing any other job logically. All dogs are animals, but all animals are not dogs. Even routine jobs of category (a) are only Step 6 repeated over and over after the first five have been done at some earlier time.

What is the real meaning of this? It means that the classical six steps are not, after all, the proud heritage of the method study practitioner, and they have no special relevance for him, any more than they have relevance for the manager, the accountant, the foreman, the fitter, the labourer, the grocer, the policeman, the clergyman, the politician and the pop singer. Method study, then, as it is traditionally taught in the United Kingdom (but less so elsewhere) as six steps, does not exist in isolation at all as a separate subject, because absolutely everyone follows – or ought to follow – these steps if he is performing his non-routine tasks in a logical way.

The reiterative process

One of the biggest problems in recruiting men to the position of method study engineer – or call it what you will – is that it is very, very difficult to find any man who has really done any. Certainly many could be found who have worked in the field of method design (because someone must be doing this, well or badly as it might be) but in general people tend not to apply method study in the way which they were taught from the text books. Even such experience as can be found is usually confined to a limited area – for example, a man might be allowed considerable freedom in re-arranging an assembly but not be allowed to change the design. Now some infuriated reader outside the ranks of Value Analysis will immediately leap to his indignant pen and declare this to be untrue in his case, and no doubt his objection will be valid, but in the general run of things work study men in the field do not carry out method study on textbook lines. Again, if the steps are an utterly integral part of method study, to be practiced completely rigorously, then we might reasonably expect to find in our text books examples of complete method study projects, detailed from Select to Maintain. But these are not in evidence. Plenty of examples exist of one step or other, but not of complete cases. Is it possible that the real situation does not conform to our rules, does not contain the six steps in equal importance, or perhaps even contain them in isolation?

Now this possibility is very odd, because no sooner have we said that the six steps apply than we are saying that they do not strictly apply. Why is this? The reason is that in unshackled method study not only do we in the beginning not know the answer, but we do not even know the question. He is indeed a fortunate (or a restricted) method study man who is able to go from Select to Maintain in one go, because even the act of Selecting needs some kind of Recording, no matter how tiny,

Value Engineering, June 1969
Now there are several ways to tackle this situation. We might, for example, mount a full-scale assault, considering every detail, so that our investigation (with the investigated aspects shown shaded) would be as in Figure 3.

![Fig. 3]

This method guarantees success, because we cannot fail to reach our target. It is however, expensive in terms of investigational resources, and the total use of these resources is measured by the shaded area.

Another approach is to take a blind guess about where the best solution lies, and to investigate only a narrow aspect of the problem, as in Figure 4, reaching with little effort the proven and incorrect conclusion that no improvement is possible. Or we might achieve Figure 5.

![Fig. 4]

![Fig. 5]

It seems, then, that a much better approach to methods engineering is to carry out the reiterative process of Figure 1, such that the pattern is as in Figure 7.

![Fig. 7]

To solve a problem, one must first formulate the problem. To formulate a problem needs an understanding of the next scale up, in less detail. And so on, resulting in the system of Figure 1 and Figure 7, where we start as nearly as we can to the maximum number of possible problems.

### Work Measurement

Work measurement is usually referred to as being additive to method study, and it is averred that their sum equals most of Work Study. How true is this?

We have examined method study in the classical sense and have found that it is not a subject in its own right at all, but that its commonly quoted basic steps comprise the methodology of carrying out any task in a logical fashion. This methodology is such that the expertise and techniques of a large variety of disciplines might be called on in any particular situation depending on its peculiarities and characteristics. Selection, for instance, can be done by the Work Study man, the accountant, the chairman, the matron, the C.O., or by anyone else, depending on the case, and each could contribute his or her own special knowledge. A methodology is a general statement of procedure, and to this procedure we apply specific techniques.

Now work measurement is not a methodology. It is a technique, or group of techniques, which have a distinct sphere of application. As such, work measurement cannot be additive to method...
study, but must fit at some point into our general expression, job methodology, which is equal to method study. Work measurement is a group of techniques which set out to 'establish the time for a qualified worker to carry out a specified job at a defined level of performance'. This time, once established for a specified method, represents a fixed property of that method, in precisely the same way that, say, its mass is a property of a brick, or its volume is a property of a box. It follows that the work measurement techniques which exist to evaluate this property are recording techniques, because they display the fundamental recording characteristic, which is to gather specified information.

Work measurement is therefore not half (or about half) of Work Study. Instead it is only one of the recording techniques available to us. We do not have the traditionally taught picture, as in Figure 8, instead we have the picture as in Figure 9.

**Critical examination – old method**

Our traditional critical examination is based on the idea that a job may be described completely by five attributes – result, method, agent, place and sequence – and that if we query each one of these in turn we will have subjected the total to logical scrutiny. But usually the examples shown are only concerned with the human agent, whereas many other resources may be relevant, and, indeed, the totality may be open to question. Less obvious areas for investigation are:

1. **The achievement – the total job and its necessity**
2. **The resources – tools and equipment**
   - capital
   - direct and indirect materials
   - layout and space utilisation
   - accompanying services
   - power consumption

and although most method study men would probably have some useful thoughts in these directions the classical twenty questions are of lesser help here. Even if we have a manual repetitive job like, say, sorting apples, really the technique is of most use at the last reiteration, and even then it is of little real help in the generation of ideas. In fact, it is a technique so closely aligned with an appraisal of the old method – that old unwanted method – that the most likely outcome is a new method which is only a slicked-up rehashed version of the old. The actual generation of alternatives is left to undisciplined thoughts and haphazard creativity. These twenty questions are, curiously enough, only very locally preached, being less usually found in method study books written in the U.S.A., for instance, where much method improvement has been done.

In the grander scheme of things the twenty questions may be rather harder to answer. If we are, for instance, querying the continuous holding of an eight weeks' stock of raw materials, the 'What' is probably very important, but 'How' may be unimportant, 'Who' is almost meaningless, 'When' is perhaps irrelevant, and 'Where' may be virtually unalterable, so that our approach is variable in the extent to which it is applicable. Even if we consider the 'What' part, when we ask 'What is being achieved?' we may produce many answers, such as:

1. A reserve store is held against the possibility of non-availability of raw materials for eight weeks
2. Production is kept continuous
3. Capital is tied up
4. Useful stockroom space is occupied
5. Raw materials are deteriorating
6. A large number of stock men are employed.

Each of these may be a result, and (a) and (b) are the more obvious achievements. None the less, the important point in question could lie elsewhere.

So here we have a standard technique which is strongly associated with the last reiteration and with manual tasks, which is oriented to the old method and which is not itself designed to generate alternatives. The generation of ideas is completely additive, and is a function of the inventiveness of the practitioner.

**Critical examination – proposed method**

We want to 'Change the Method'. This is the job we will be doing, and it has been described by a noun and a verb. In order to do this we should have a technique which is fundamentally designed to generate alternatives but instead we have a technique which is fundamentally designed to analyse the old method and
which leaves the generation of alternatives to the practitioner's fertile imagination. Our traditional technique, then, is entirely oriented to 'Method' – the noun – and not at all to 'Change' – the verb. Let us instead consider 'Change'.

In how many ways can one change a job? One can change it in three ways:

1. Eliminate it, so that it is no longer there, or
2. Alter it, so that it is still there, but different, or
3. Substitute for it, so that something else is there.

Expanding this:

1. One can eliminate something in two ways:
   (i) Just do not do/have it; (ii) Remove the need for it
2. One can alter two things – quantity and quality (i) If one alters quantity, one can have more or less of it; (ii) If one alters quality, one can have it better or worse
3. One can substitute something entirely different which produces the same result.

This gives seven possible ways to change something. It follows that at every reiteration, for every job of every resource, we should state:

(a) The area, aspect, or resource under review. That is, Select.
(b) The job it does – noun plus verb. That is, Record.
(c) What is the effect of just not doing/having this?
(d) What must we do to remove the need for it?
(e) What the implications of doing/having more of it?
(f) What are the implications of doing/having less of it?
(g) What are the implications of doing the same amount of it in a 'better' or 'nobler' fashion?
(h) What are the implications of doing the same amount of it in a 'worse' or 'more ignoble' fashion?
(i) What entirely different system would produce exactly the same result?

This approach is applicable at all reiterations, holds for the state: that at every reiteration, for every job of every resource, we should

Some solutions make sense, some do not. You probably pick (5). Then you Install – that is you actually re-tie, the lace – and you Maintain by repeating this kind of knot in the future. But if in future the lace continues to come undone, a reiteration is needed.

Dr. David Rockwell, M.D., D.Sc., assistant professor of surgery, Rensselaer Polytechnic Institute, Troy, N.Y., has the double-entry system, chemistry has its elemental symbolism, draughtsmen have their system of two-dimensional representation of three-dimensional objects. All of these techniques are fed into the general procedure at the appropriate point, and this happens in all technologies. Even in seemingly non-investigational technologies this holds. In applied medicine, for instance, surgery is one of the Install techniques – the 'do' which comes after Select, Record, Examine and Develop.

Methodology and technology

So where have we got to? We have decided that Select, Record, Examine, Develop, Install, Maintain is not Method Study. The six steps are the general expression, the methodology of investigational procedure. What, then, would constitute a technology? A technology arises when a group of people acting in some sphere or other develop a technique – or a series of techniques – which may be applied to the general investigational procedure in suitable situations.

Work Study for example becomes a technology when its practitioners produce specific techniques of their own, such as work measurement, critical analysis, certain work sampling procedures, charting systems, and other techniques which are not direct appropriations from another technology. Mathematicians have their own technology (statistics, algebra, calculus, etc.), accountancy has the double-entry system, chemistry has its elemental symbolism, draughtsmen have their system of two-dimensional representation of three-dimensional objects. All of these techniques are fed into the general procedure at the appropriate point, and this happens in all technologies. Even in seemingly non-investigational technologies this holds. In applied medicine, for instance, surgery is one of the Install techniques – the 'do' which comes after Select, Record, Examine and Develop.

Value analysis

Let us see how well Value Analysis fits this pattern. What is its general expression? You may well have your own personal list, but the one I intend to look at is culled straight from the writings of your profession.

A very simple example

You are walking along the road and you trip up. A problem has selected itself. You look down and record that your lace is undone. You record the lace's function, which is to hold the two flaps of the shoe together. You generate seven alternatives with respect to the performance of this function:

1. Don't do. Have no lace. The flaps are allowed to remain open. Maybe the shoe stays on?
2. Remove the need. Always buy shoes which are too small (long-term). Or stuff paper into the shoe (short-term).
3. More. Re-tie, more tightly. Or replace the lace with a material with higher frictional qualities.
4. Less. Re-tie, less tightly. Or replace the lace with a material with lower frictional qualities.

So far so good. The general expression is being adhered to. Good boys! Ah, but wait a moment! What was that bit earlier about the break between 'Information Gathering' and 'Development of Alternatives'? If this is truly happening, then something is amiss. Now I know very well that you are sitting there incensed by my suggestion. I know that you have been told, over and over again, and you have read, over and over again, that you are following a logical progressive developing procedure. But – and this is the 64 dollar question – are you really sure? Because if brainstorming is to be the death-knell of the preconceived idea, if the mind is to be allowed completely free rein, then Step 3 – if it is to consist of brainstorming – must start a new line in the procedure. Certainly it was the case in my forementioned experience, and if this is what we have then we are not adhering to the general procedure for problem-solving.

Value Engineering, June 1969
Further, let us take a look at the techniques of Value Analysis. Yes, let us—if we can find one. The nearest thing to a technique is the brainstorming element, and this method was developed further, let us take a look at the techniques of Value Analysis. This method was developed allowing free rein to the mind, many solutions will be generated. Its strength is reputed to be that by outside Value Analysis. In any case, it does rather seem to me to seriously—how much better to have a technique which restrains the mind within the bounds of inventive sense, which ensures coverage of all areas of possible solution, and which allows us to adhere to the general methodology, if such a technique were available to us?

Well then, there is the concept of Value. This is a theoretical financial concept, well understood by the economists for a long time. Also, let us see what is seriously said by Value Analysts about it, and I have seen it in cold print that value can be categorised, and that four such categories are Use Value, Cost Value, Esteem Value and Exchange Value. Only the second was allocated a quantifying unit, and this unit was cost, expressed in money. Then we had ‘The sum or total real value of a product probably organised, and that four such categories are Use Value, Cost Value, Esteem Value and Exchange Value. Only the second was allocated a quantifying unit, and this unit was cost, expressed in money. Then we had ‘The sum or total real value of a product probably embodies all of the preceding factors and more. The mathematical formula can be expressed as:

\[
\text{Value} = \frac{\text{Function}}{\text{Cost}}
\]

Now you cannot add apples and pears meaningfully, and since Cost Value was expressed in money, so must have been the other values. Value, then, was expressed in money. Also Cost—the denominator above—is usually expressed in money. It follows from elementary mathematics that ‘Function’ had a size expressed value, but really, can we even begin to take this kind of solution seriously? How much better to have a technique which restrains the mind within the bounds of inventive sense, which ensures coverage of all areas of possible solution, and which allows us to adhere to the general methodology, if such a technique were available to us?

Please stop beating me

Not that this really matters a jot as long as the job you are doing is useful and gets desirable results, and this is not in question. It is just that it would probably be a lot better if you adhered to the general procedure in order to close the loopholes—loopholes which seem to have been caused by your choice of the word ‘value’ and your adoption of the brainstorming approach. Yet you are oh! so close to another way of tackling it. You have completed Step 2 successfully. That is, you have described the value, and you have done it with a noun and a verb. Right then—generate seven alternatives, and evaluate these honestly on the sizes of the additional income and of the additional expenditure and not in terms of nebulous value. Start with the whole assembly, reiterate with the sub-assemblies and finally turn to the components. Then you will have your own technique, admittedly borrowed from Work Study, but now applied to a new area, and you will link up Steps 2 and 3, and be on beam with problem-solving methodology. The simple case of the shoe-lace which was given earlier as an example of problem-solving and the generation of ideas is, in fact, also a simple example of what could conventionally be called Value Analysis. But it is up to one of you undoubtedly bright chaps to develop this approach, to install it and maintain it. I have only examined my recording of my selected problem area and have produced one of the seven alternatives, and I am unable to put an accurately quantified value on this. Like I say, I am no Value Analyst. Are you?
Crystal Size of Sugar Loaf Stores
1,000 Pictures

Using a Crystal of Lithium Niobate
A promising method of storing pictorial information in a highly compact form has been developed by scientists at the Bell Telephone Laboratories. They claim that as many as 1,000 different holograms — images formed with the help of lasers — can be stored in a crystal of lithium niobate no larger than a sugar lump.

Conventional holograms are made by illuminating the object to be recorded with light from a laser. Light scattered from the object is mixed with a reference beam from the same laser, and the mixed beam, recorded on a photographic plate, is known as a hologram.

By illuminating the hologram with the reference beam, the original beam scattered by the object is automatically reproduced and from the two-dimensional record the three-dimensional appearance of the original scene is recreated.

How the Hologram Image is Stored
The aspect of holography which interests the Bell Telephone scientists, J. T. Macchia, F. S. Chen and D. B. Fraser, is the capacity of holograms for storing information. In their experiment the information to be recorded is originally on a photographic transparency. Light from the laser is split into two parts, one beam falling directly on the crystal, and the other shining on the crystal through the transparency.

How does the crystal of lithium niobate store the complex hologram image? According to the Bell Telephone scientists, the intense laser light causes changes in the refractive index of the crystal which vary with the brightness of the light. Thus, brightness variations in the combined reference beam and the beam scattered by the object are faithfully recorded.

The refractive index variations alter the reconstructing beam in much the same way as does a conventional hologram plate. Conventional photographic plates record holograms as variations in the opacity of the emulsion, and when the image is reconstructed much of the intensity is lost by absorption. By storing holograms as variations in the refractive index of lithium niobate crystals, less powerful lasers are needed to recreate the image than when conventional plates are used.

Heat Erases the Pictures
The new technique enables a crystal of lithium niobate smaller than a lump of sugar to store as many as 1,000 different holograms. This is achieved by rotating the crystal a fraction of a degree before each new hologram is stored.

To reconstruct the image the laser light must be directed at the crystal at the same angle as the original reference beam. Information held in this ‘memory’ can be erased simply by heating the crystal to 170°C.

Blast – don’t Nibble
Another example of Blast... Create... Refine which calls for a positive approach in the Creative Phase:

Take each item and consider its function. Make out a list of every other way this function could possibly be performed. It is vitally important that really creative thinking is done at this point.

Don’t rule out any ideas at this stage, as one ridiculous idea may trigger off the final solution. Blast, don’t nibble — a slight modification is not what to look for, a completely new approach is the aim.

For example, during the war there were not enough tankers to take fuel to France after the invasion. The idea of a pipe-line was eventually developed into a very practical solution to the problem. In fact, this is a good example of the use of the functional approach.

A similar case arose in Canada when a cable was to be laid across a large lake. No boats suitable for cable laying were available. After much thought and sifting through many ideas the solution was found. The operation was delayed until the lake froze. Lorries took the cable over and laid it on the frozen surface. When the spring came, the ice thawed and the cable dropped through to the bottom.

Among the obstacles to creative thinking are the reserved stiff upper-lip attitude; the need to conform or be laughed at; contentment with ‘status quo’; and the belief that anything new is full of danger and unknown.

But it does not stop here. The Creative Phase is followed by the Analytical Phase. In this Phase take every creative suggestion and put a price on it. Do not discuss any idea without putting a price on it. Check the disadvantages. Are they serious? If so, how can they be overcome and what is the cost? List all the good points, followed by the bad points. Maximise the good, minimise the bad.

*  *  *

British Experience of Value Engineering
Value Engineering is a systematic and disciplined approach to cost reduction which embraces close study not only of the method of manufacture but also of the design and function of the product and materials used. The purpose of Value Engineering is to achieve the best balance between function, reliability and cost, in order to manufacture a product which reliably fulfils a specified function or service at lowest cost.

The technique is being used with marked success by more and more firms in British industry, and can be applied with equal benefit by large and small firms. It is not restricted to engineering production but can be applied in any factory where raw materials are converted into a finished product. Firms already employing Value Engineering techniques have reduced costs by more than 80 per cent in some instances, and reductions of 50 per cent are commonplace. (For example, the average saving on ten typical components and assemblies in one company exceeded 45 per cent.)

The following authoritative statements further emphasise the extremely attractive financial returns on investment in Value Engineering:

‘On average, the return per annum in investment in Value Engineering is between ten and twelve times, that is, for every £1 spent on Value Engineering, costs will be reduced by £10-£12.’

P. F. Thew, Manager, Industrial Engineering Standard Telephones and Cables Ltd.

‘A return on investment of 1,000 per cent is not unusual with Value Engineering.’

P. D. Scott-Maxwell, Deputy General Manager, Vickers Armstrongs (Engineers) Ltd.

Value Engineering, June 1969
Change is a Challenge
by K. R. Whyles*

INTRODUCTION
In this paper the author endeavours to discuss the complex subject of 'man's resistance to change'. It is intended to be a non-technical discussion since we are not yet able to talk scientifically about man's behaviour. Although the opinions of professional people have been considered the article does largely portray the views of the writer based on his experience in industry.

The subject is one which we all tend to 'sweep under the carpet' although it affects our daily lives, sometimes quite drastically. We have ample evidence in this country today of resistance to change on a national scale but to discuss the subject as it affects the whole community would not achieve the author's objective. Sufficient to say that most of the major disputes in this country today have as their basis, resistance to change.

To a greater or lesser degree human beings of all levels of intelligence appear to have a 'built in' resistance to change. The reasons for it can be varied and very complex and therefore difficult to recognise, let alone understand, and most of us certainly do not consider change to be a challenge. In fact quite the opposite in most cases.

Since we are living in a world where, if we are to survive, changes must constantly be introduced it would seem to be of the utmost importance that we make some attempt to understand resistance to change.

We have already mentioned resistance on a national scale, but to keep the discussion at a personal level as far as we can, let us think about the subject as it might apply in our own working environment.

Recognising Resistance
How then can we go about recognising resistance to change?

Let us start by asking ourselves several fundamental questions.

Firstly, do we understand what is meant by resistance to change and, as individuals, do we recognise that it exists in ourselves as well as in others?

Secondly, do we know what circumstances are likely to create it?

Thirdly, have we any idea how we might overcome it?

It would be true to say that resistance to change is essentially an act of self preservation, or protection, whereby our emotions lead us to resist when we think there is a threat to our status, our security or peace of mind.

Very often there would appear to be no logical reasons for the resistance and therefore we do not necessarily consider our behaviour to be unreasonable.

It is perhaps true to say that we all have a tendency to think the other person is the one who cannot accept change, whilst we of course are quite willing to do so. But are we willing to do so?

Let us be quite honest with ourselves, and we need not be afraid to do this, since no one can 'listen in'. How many times have we opposed or rejected a perfectly good suggestion simply because it would have necessitated changing our own ideas on the subject.

Similarly, over a period of time, how many hours have we wasted in argument over particular situations without having any sound objections, but simply because we have not liked to change our own views.

Effect upon Meetings
Would the meetings we have attended in the past have been more fruitful, and of shorter duration, had we confined our contribution to constructive statements that were not biased by our own somewhat illogical emotionally based ideas.

To some extent we can all plead guilty to this sort of attitude, the important thing is to recognise the thought processes surrounding it.

To help us do this let us run through some typical kinds of thought that may serve as pointers in this direction.

He's right, but I spent hours developing it and I am not changing it now if I can help it.'

This chaps trying to off-load the job onto me, I will suggest so and so, that should get me out of it.'

I don't trust that so and so, I'll stall him a bit.'

If I agree to that it will reduce my authority.'

If he doesn't like it, he can lump it.'

It has given good service for years, I'll get one like it if I have my way.'

We had none of these fancy theories in my day.'

Why look at that job it's never given us any trouble.'

'It is easier the way it is for me, I must stop this chap making his point if I can.'

'I will tell him it's company policy, he can't argue with that.'

'Tell him, I agree, but I can't get my boss to see it my way yet.'

'I shall have to draw the line somewhere or I shall never cope.'

And so on.

Do we recognise any of these thoughts? Perhaps we could add some to the list that may fit us better.

Try doing this, it can always be torn up afterwards, if what we have written disturbs us.

We may find it difficult at first to mentally recover some of these innermost thoughts, however, I am sure, with a little effort, we can revive some which resulted in our being resistant to change.

Emotions
To what then, do we attribute these thoughts?
Perhaps we accept the notion that it is a natural defence mechanism at work.

If this is so, what emotions make up the working parts of the mechanism?

Is it Egoism?
Are we Afraid of something?
or Are we Suspicious of something?

It could, I suppose, be any or all of these things.

Egoism
Let's take egoism first, and define it as,

The habit of valuing everything only in reference to one's personal interest.

This might be said to be the biggest single factor contributing to our resistance to change. It is an emotion which is by far the most difficult to recognize in oneself and even more difficult to control. Since it is not a very tangible part of our mental faculty we must exercise great honesty of mind if we are to recognize it and very strict self discipline if we are to control it.

To enable us to achieve both of these things it is quite obvious that we must wage a continuous and private battle with our emotions. Some appear to be more successful than others in this and the results are quite noticeable in their approach or attitude to a given situation.

We can all quite easily pick out the man who puts his own selfish motives first. What we must do, however, is to make sure we are not that man.

In other words, we must put our own house in order first.

Let us look again at our definition 'The habit of valuing everything only in reference to one's personal interest.'

Our personal interest can take many forms, such as:

For monetary reasons.

Hoping to gain recognition by forcing one's ideas through.

To retain or increase one's 'empire'.

Trying to create a 'foolproof' shell in which to survive.

Or perhaps trying to 'keep up with the Jones'.'

If the proposed change does not readily fall into line with one of these or similar categories, then we look for ways of making the change fit the pattern we desire.

It is at this point that our egoism becomes mentally recognisable and it is also at this point that we should commence the private battle.

It is not suggested for one moment that there are never occasions when one's own personal interest cannot be the basis for our reaction to a situation, it quite obviously can. What we are suggesting is that at this point we should make an honest appraisal of our thoughts before making a decision. It is only by this honest appraisal or, if you like, self discipline, that we can start to control our egoism and thereby take the first and most important step towards overcoming our own resistance to change.

Fear
The second emotion in the mechanism we mentioned was Fear. Unlike egoism, fear is a more tangible or recognisable emotion and in many instances we can enlist outside aid to help us overcome it.

One might think that to use the word fear is over-playing the situation, but in this case, by fear, we mean anxiety to a greater or lesser degree.

The way in which we interpret the facts at our disposal in a given situation, will determine the degree of anxiety we feel.

We must make sure then that we have made a correct interpretation by challenging the facts to see if they logically add up to the situation causing our anxiety.

Very often we would find that there are insufficient facts to allay or support our fears, and here we should enlist outside aid by a further discussion of the subject in hand.

There is a good chance that this further discussion will reveal a weak link in the chain of facts, a link which, when isolated, can be seen to be the real crux of the matter that has influenced the manner in which we made our interpretation.

By attacking this weak link we are now taking the first step towards logical discussion in place of emotionally based resistance to change.

This process does in no way guarantee that in every case our anxiety can be eliminated, but it will serve to reduce the number of times that we are resistant to change because our anxiety was based on insecure foundations.

In some instances we may use our authority in such a manner as to create anxiety to achieve our purpose.

Our approach may be something like this,

'Have it your way old chap, but if anything goes wrong you will have to answer for it.'

'If I have to take the responsibility for it we will do it my way, unless you are willing to give me a written guarantee of success.'

'If it should fail to work, the loss to the company doesn't bear thinking about.'

'I have to decide next week, and I can't take a chance on your scheme.'

'There are a number of people waiting to jump into your shoes, so its up to you.'

'I shall need a lot more to convince me of its likely success, before I agree.'

And so on.

If we do not wish to breed resistance to change, we must use our authority wisely. Create enthusiasm, not fear.

Suspicion
Our third emotion in the mechanism of defence is Suspicion and here again, like fear, it is a tangible emotion and easily recognisable in oneself.

Basically suspicion is a result of our mistrust either of the spoken word or the written word, and the degree of suspicion is usually decided by history.
That is to say we mentally review our past dealings with the person or persons we are at present faced with and react accordingly. Whilst suspicion is easily recognisable in oneself it is not always a simple matter to overcome it, since we are usually dealing with a situation where there are insufficient reliable facts to assist us. The tendency then is to reach a conclusion almost completely biased by history resulting in our being resistant to protect ourselves.

There is then a very important lesson to be learned here. The more we realise how mistrust of someones words or actions increases our own resistance to change the clearer it becomes that only by being honest in our dealings with others can we expect them to be less resistant to change.

Let us reflect for a moment and bring to mind a few people we would have no hesitation in helping where a change was being considered. Reflect further and bring to mind some that we would have great hesitation before helping.

Now compare these two groups and we would almost certainly find that those in the former group have always been honest in their dealings with us.

Usually we react in a positive manner in dealing with people we trust and in a negative manner with people who create fear and suspicion.

The Final Analysis
Once we have set off on a resistant course our emotions, illogically, tend to keep us on that course.

So, before setting course analyse the three emotions. Egoism, Fear and Suspicion.

If we can successfully recognise and control resistance to change in ourselves then we are the better equipped to help others to do so.

The answers to the problem are not to be found in books. THE ANSWERS ARE WITHIN YOU.

Miscellany

Aids to analysis of organisation and method employed in office work


1. Reason for:
What is done?
What is achieved?
Why is the work done?
What is the effect if any part is not done?
Could a part be merged or eliminated?

2. The person:
Who does the work? (Are grading, qualifications and experience correct?)
Is the individual used on each operation, or part or whole?
Who makes decisions within the procedure?

3. The place:
Where is the work done – centrally or sectionally?
Would reallocation of accommodation or of equipment bring like or related processes together, or tend to reduce movement of staff or papers?
Where could the work be done most conveniently or economically?

4. The time:
When is the work done?
What is the time cycle of procedure?
What is the sequence of procedure?
What checks or inspections are employed for accuracy and quality?
How necessary are they?
Do they occur at the latest stage in the time cycle, without the risk of carrying forward errors within procedure?

5. The method:
How is the work done (the method, movement, equipment and supervision are factors)?
How often is the work done (frequency and load)?
Does it justify mechanisation?
Is there any repetition at any stage?
How much does it cost?
Is it justified by achievement?
How is work supervised?
Is supervision close, remote, visual?

Is work looked at during the course of the procedure, or at what stage, or only at the end of it?
How is supervision distributed?
How many staff to each supervisor, and to what extent does the supervisor guide or train the staff?
How important is the job?
How difficult is the job?

Some notes concerning forms

A. The purpose of a forms chart:
1. To identify where the form comes from.
2. How it is distributed.
3. What rotation it is dealt with.
4. How it is dealt with.
5. What priority of routing it goes through for action.
6. What copies are necessary.
7. What is its final destination and disposal.

B. Points on Essential Features for Form Design:
1. The heading:
   Does the title make for ease of recognition?
   Can it be simplified?
   Can it be improved for style, type or position?

2. The wording:
   Is it suited to all users?
   Is it brief, clear and simple, to avoid doubt or query?
   What words are not essential?
   Is any rewording possible?

3. The layout:
   Is it convenient, economical and attractive?
   Is it simple, and logical in order?
   Has best use of space been made, and congestion avoided?
   Is the size suitable for:
   all operations;
   for other documents and storing;
   for printing?

* * *

The Engineer, June 1969
Is any special layout suggested by working conditions like:
- carbon backing;
- easy carbon movement;
- no carbon system;
- facility for quick entry;
- making up in pads?

4. **The material:**
Is any special material necessary because of peculiar working conditions?
Is material suitable and economical?
If several copies are necessary would different colours assist the work?
Is the quality suitable for:
- writing;
- handling;
- record and life?
Has storage been considered?

5. **The instructions:**
Are they properly located in the best position?
Are they grouped in one place?
Are they the minimum?
Are footnotes eliminated, and turning over avoided?

C. Consider what aids would simplify, reduce or eliminate such operations as:
1. reading
2. filing
3. referencing
4. folding
5. copying
6. sorting
7. progressing
8. punching
9. perforating
10. authorising
11. arithmetic
12. denoting action
13. signing and
14. authorising

* * *

**Yardsticks for Management**
The following seven criteria have been built up by Mr Arnold Weinstock, chief executive of G.E.C., English Electric and A.E.I.:

1. **Profits on capital employed.** This is probably the most widely used financial criterion in the private sector of industry. In the last resort this measures the earning power of capital which is used to make electrical equipment rather than buying gilt-edged, investing abroad or going into another line of business. G.E.C.'s 23 per cent compares with a United Kingdom industrial average of about 15 per cent.

2. **Profits on sales.** This is another widely used test indicating profit margins, but the figure tends to vary markedly between different industries. G.E.C.'s emerges higher than G.E.'s.

3. **Sales as a multiple of capital employed.** This shows the productivity of the company's net capital; comparisons should be made between companies of roughly comparable financial structure and similar capital intensity. G.E. stands out in this comparison, and a broad contrast of British and American companies illustrates, for example, the differences in trade unions' attitudes towards the use of capital equipment.

4. **Sales as a multiple of fixed assets.** This is a major subdivision of the previous criterion. The ability of fixed assets to generate sales is probably the best measure of their real worth, often one of the most difficult problems in analysing company performance. Here again, a basic guide for management is that companies in the same sort of business should tend to show a similar sale/fixed asset ratio. G.E.C. come out well ahead of both G.E. and Texas Instruments.

5. **Sales as a multiple of stocks.** This is one area where both the United States companies show up much better than their British opposite numbers. One reason is the much wider use in America of computer techniques for stock and production control, allied to the higher level of general education among middle management - which means that specialist techniques can be widely employed to control the level of working capital. United States companies also tend to receive better service from their suppliers. Even with an efficient company like G.E.C., the ability to sustain G.E.'s stock/sales ratio would enable it to cut inventories by some £25 m. For United Kingdom industry as a whole, this would imply an inventory saving of perhaps £1,750 m., a massive once-for-all gain for the balance of payments and bank financing. Just under a decade ago the United States achieved a substantial reduction in imports following the introduction of computer control techniques.

6. **Sales per employee.** This is the broad measure of the productivity of a work force, and should indicate the number of non-productive personnel. But both the sales and profit/employee ratios emerge as secondary pieces of evidence. They are essentially a by-product of the other five Weinstock ratios; if those are showing well, then the sales and profit/employee ratios will come right. From the employee's side, this also points to the value of the product generated by each man. An international comparison of sales per employee is thus the first step towards a comparison of relative industrial wealth.

7. **Profits per employee.** This is a closer examination of the previous criterion, to which it is related by the basic profit/sales ratio. The size of profits related to work force remains, after all, the ultimate justification for workers' employment in industry while from the employees' side this sets the area of bargaining for increases in wages. For management, this figure is a fundamental tool in assessing how far, and in which areas, a work force should be expanded.

<table>
<thead>
<tr>
<th>English</th>
<th>General</th>
<th>Texas</th>
</tr>
</thead>
<tbody>
<tr>
<td>G.E.C.</td>
<td>Electric</td>
<td>Instruments</td>
</tr>
<tr>
<td>1. Profits as per cent of capital employed</td>
<td>23</td>
<td>14</td>
</tr>
<tr>
<td>2. Profits as per cent of sales</td>
<td>11</td>
<td>4.8</td>
</tr>
<tr>
<td>3. Sales as a multiple of capital employed</td>
<td>2.1</td>
<td>2.8</td>
</tr>
<tr>
<td>4. Sales as a multiple of fixed assets</td>
<td>6.1</td>
<td>4.1</td>
</tr>
<tr>
<td>5. Sales as a multiple of stocks</td>
<td>3.6</td>
<td>2.8</td>
</tr>
<tr>
<td>6. Sales per employee (£)</td>
<td>3,000</td>
<td>3,285</td>
</tr>
<tr>
<td>7. Profits per employee (£)</td>
<td>330</td>
<td>160</td>
</tr>
</tbody>
</table>

These seven rules form a basic framework for assessing a company or a self-contained division within a company. In general terms, one can only say that if all seven criteria are showing the right results, then the company will be working successfully. In general policy terms - as opposed to a specific situation - no one of the criteria is fundamental to the other.

The seven rules are also valuable for making comparisons between companies which are broadly similar in their operations, in this case the two American electrical companies, G.E. and Texas, along with G.E.C. and English Electric.

An international comparison of these figures brings out one striking contrast between Britain and American industry. While profit margins are roughly the same, British industry uses twice the amount of capital to produce a given quantity of sales or profits. In other words, a British company will tend to spend twice as much on human or real capital to reach the American level of profits - by the same logic, British firms can be said to be working only half as efficiently. This is a measure of United States industrial power, which also highlights the British problem: how to make the best use of human and material capital.

---

Value Engineering, June 1969
Can you read six books a day? When did you last read a book on Value Engineering or one dealing with a related subject? In 1961 over forty new titles of books of interest to value engineers appeared each week. Plan to catch up now by reading these reviews and sending for those books for which you have practical use. One star (*) against the review indicates that although important – the information deals with a subject on the fringe of a value engineer’s interests; two stars (**) that the book is very useful; and three stars (***) that it is particularly significant for value engineers. The number in parenthesis () refers to the publisher’s name and address given on the inside of the back cover.

Communication

**The Art of Communication

Leyton, A. C.

Pitman, 1968 214 pages 35/- (119)

Value engineers will concur with the author’s contention that lack of effective communication (i.e. misunderstanding, misinterpretation and silence) account for a great deal of industrial inefficiency, and they will welcome this most useful book by the Head of the Department of Management at the City University in London.

The reader is reminded that communication does not merely mean talking to people – it also means listening which is as much concerned in the act of communication as talking is.

The chapter on the importance of the meaning of meaning (the title of a book by Ogden and Richards) introduces the reader to such classics on the subject as Susan Stbbing’s Thinking to Some Purpose, S.I. Hayakawa’s Language in Thought and Action, Stuart Chase’s Tyranny of Words, and Rudolf Flesch’s Art of Plain Talk.

There is – as the book says – ample evidence of resistance to information from a management which has not provided for the return flow of information from the shop floor. As a shop steward puts it:

‘We like to hear about Management’s problems and plans for running their job. But we have ideas too, that come out of closer contact with the production process than Management has. And we would like to tell Management about them.

‘If we don’t have the opportunity to get these things off our chest we begin to wonder how blind Management can be to the facts of life on the factory floor, and how much we can count on the information they feed us.

‘So the worker who does not have the chance to tell Management those things is likely to end up by telling Management to go to hell. He does that in many ways, but usually in a polite sort of way, by just not listening when the boss talks.’

Value engineers have not only to express ideas but they have to communicate them. They should remember in their team work as the poet and playwright W. B. Yeats said: ‘Argument, the moment victory is sought, becomes a clash of interests.’

This book of Mr Leyton’s – with its excellent guide to further reading on the subject – will help the value engineer improve his Word-Power.

C.S.F.

Invention – Design – Creativity

*Sir George Cayley 1773-1857

Gibbs-Smith, C. H.

H.M.S.O., 1968 32 pages 3/- (105)

‘The true inventor of the aeroplane’ is how the French historian Dollfus described Sir George Cayley to whom we are also indebted for the invention in 1825 of the caterpillar tractor.

At the age of twenty-three Cayley made his first aeronautical device – a model helicopter with two contra-rotating rotors operated by a bow-string. Three years later, in 1799, Cayley took his first step towards initiating the modern concept of the aeroplane – the separation of the system of lift from the system of thrust. Cayley only gave aerostation (lighter-than-air flight balloons) one look and then turned to devote his attention to the heavier-than-air machine. Until 1808 he continued Leonardo da Vinci’s error of believing that birds flap their wing’s downwards and backwards like a swimmer. In 1804 when Napoleon was assembling his fleet at Boulogne Cayley turned his thoughts to problems of artillery. He designed finned missiles in order to lengthen the range of British guns. The authorities did nothing about these and soon his prophetic designs were forgotten.

It was in Nicholson’s Journal of Natural Philosophy (November 1809) that there appeared Cayley’s paper ‘On Aerial Navigation’ which became the greatest classic in aviation history. Today, Cayley is again taking his rightful place in the history of aviation. His portrait hangs in the National Portrait Gallery, and his name has been inscribed (as Berget says) ‘in letters of gold at the beginning of the history of the aeroplane’. The list of ‘firsts’ at the end of this most interesting booklet attests to Sir George Cayley’s entitlement to this comment.

E.C.
Management accounting – Cost estimating – Discounted cash flow

*Manual of Industrial Project Analysis—Methodology and Case Studies (Vol. 1)
O.E.C.D., 1969 195 pages 20/- (124)

In his Foreword the President of the O.E.C.D. Development Centre, Mr Landre Philip, says:

‘One of the obstacles to a beneficial industrialisation is, undeniably, the lack of knowledge in developing countries of how to formulate a project in such a way that its potential profitability, whether from a private or social viewpoint, can be estimated from as firm a basis as possible.’

This Manual deals with the problems involved in estimating the profitability of a proposed industrial investment from the point of view of the firms. A subsequent volume will deal with ‘social profitability’, that is, the costs and probable benefits of a project from the viewpoint of the economy or community as a whole.

This further aspect of the subject which is of essential interest to Governments and other public authorities should not, however, be allowed to obscure, let alone detract from the importance of simple profitability studies. ‘In general,’ writes Mr Philip, ‘it can be added, and this should be emphasized, that more attention to profitability and a greater ability to estimate it, would help prevent many of the worst mistakes that have been made in developing countries.’

The present Volume consists of a ‘methodological’ part intended to serve as a guide, followed by six case studies.

The methodology covers market research and cost estimation and emphasizes the need to probe alternative scales and techniques of operation. Once estimates of the value of inputs and outputs for the life of the project have been made, profitability is assessed by the discounted cash flow method.

An Annex to Volume I, published separately, presents ‘industrial profiles’ of some twenty manufactures commonly produced in developing countries. The studies include a brief history and technical description of processes, together with the technical input coefficients for small or medium scale manufacture and guidance on where further information or possibly technical assistance may be obtained. C.A.M.

Electronics – Market Research

*Gaps in Technology: Electronics Components
O.E.C.D., 1968 190 pages 21/- (124)

The role of advanced electronics technology in the economy is assessed in a study prepared as part of the study of technological gaps for OECD science ministers and now made public.

The study, prepared by OECD science directorate staff is published under the responsibility of a group of experts, chaired by M. Robert Galley, formerly head of the French 'Plan Calcul' and now Minister for Scientific Research. The group included government experts from Canada, France, Italy, Japan, Sweden the United Kingdom and the United States and experts from industrial firms such as Siemens, Nippon Electric, Elliott Automation, Philips, SGS-Fairchild, Texas Instruments and private research institutes such as Battelle, Quantum Science Corp., and A.D. Little.

In their conclusions, the experts describe disparities in the sector between European Member countries as significant but less substantial than the U.S.-Europe gap. An examination of Japan’s position, second in the sector as a world manufacturer, takes particular note of the early recognition of the gap by the country’s component industry as a whole and of the deliberate and highly innovative effort by Japan’s big electronic firms to bridge it as rapidly as possible.

The study analyses the sector of semi-conductors and integrated circuits as a demonstration of the innovation process in a research-intensive industry.

The experts cite four main facts underlying the lead of certain American firms in the sector; they develop the great majority of main inventions and major new technologies; they appear up to now to be almost alone in granting licences and selling their know-how on the international market; they have a substantial share of the semi-conductor market outside the United States, while no foreign firm occupies a leading position on the American market; finally, they enjoy an important share in the total world exports of components at present and their share in the sector is increasing progressively.

The importance of size and accessibility of markets are stressed as key factors influencing the possibility of maintaining a forward position, particularly in the areas dominated by advanced technologies. In the view of the experts, investments in the U.S. market by foreign firms would be of major significance for the general evolution of the sector in other OECD countries.

However, they also stress that goals, proved to be effective as a stimulus to the U.S. electronic components industry, cannot be directly applied as such elsewhere, and they counsel other Member countries, individually or in cooperation, to define their own goals and purposes, not simply with respect to United States endeavour but in the context of their own capabilities and long-term policies.

The study forecasts that innovation other than in the advanced areas of the sector will not necessarily remain in the future as important a factor as hitherto: the development in many countries besides the United States of large semi-conductor industries all based on the same technology and the stabilisation of the pace of technological change will be giving greater importance to other factors such as production technology, marketing and lower labour costs. The importance of semi-conductors lies in the fact that they have been the source of major technological advances in computers, scientific instruments and telecommunications; a clear assessment of their future developments could be of considerable help in making more effective use of the advanced technologies, and planning for the future of certain science-based industries.

Discussing long-term implications of disparities but without drawing definitive policy conclusions, the study suggests the pursuit of three courses of action; at the level of the firm, at the national level and internationally.

Primarily, the solution, the study points out, lies with firms, for it is in the industrial field that disparities are the really important technological and economic issue.

The role of governments, it notes, can only be to create a more favourable environment and give selective support to projects considered nationally important. Among the many forms of improving the environment, the study examines the case for the free movement of scientists and research workers, a more coordinated science policy, support for creating small companies, and for making a clear assessment of the shortcomings of national legislation, particularly concerning anti-trust, patent, taxation and company laws.

At international level, cooperation between firms, according to the study, is field in which government intervention is highly impractical. The essential role of governments is held to be one of support for actions beyond the reach of companies. ‘One of these,’ the study puts forward, ‘is the creation in Europe of a continent-wide market to help overcome its present fragmentation and the drawbacks of increasing economic nationalism.'
In the military market, disparities are not an economic but a political problem, it says, and should be frankly recognised as such.

The study notes that the military requirements of the individual European countries in terms of computers, radar, aircraft and missiles cannot be compared with those of the two big powers. The study concludes with the view that where politically practicable among European members, many advantages could be gained from internationally coordinating defence and aerospace needs for electronic components, concerning both specifications and supply.

The study includes a specialist report on ‘Technological Trends in the Component Industries’ by a U.S. science research contributor and a history of the Japanese Sony Corporation, leader in the export drive to the U.S., by its President, Masaru Ibuka.

Statistics

*Elementary Statistics—A Workbook
Hope, K.
Pergamon, 1966 101 pages 15/- (102)

This introduction to statistical methods begins at the beginning by assuming no prior knowledge of the subject. After a few basics the author moves on to correlation or measuring the tendency of two things to vary together. Next he analyses variance; then describes matrices and factor analysis.

Statistics, the author holds, is too important to be left to statisticians. There have been handed down statistical words and phrases whose mastery confers upon the novice a satisfying feeling of expertise without the need for any exercise of judgement. Bacon’s phrase for these dead residues of living thought was ‘idola of the market place’. Mr Hope then proceeds to remove these impediments.

Working through the book and comparing your effort at the problems with the answers supplied should give you the facility to carry out the types of analysis covered and to design research projects.

There is, at the end, a very useful list of books and articles including Suedecor’s Statistical Method; the bible of analysis of variance.

G.F.

Marketing—Programmed Learning

*Creating a Market
International Labour Office, 1968. 178 pages 13/6 (120)

Learning Systems Ltd., in association with the I.L.O. have produced this most useful programmed learning text. ‘As the I.L.O. management development programmes have spread across the world it has become increasingly apparent that, unless markets for the products and services of industry exist, or can be created, it is of little value to teach the other techniques of management.’

Creating a market is not within the power of a single firm. A market can be created by:

- Increasing the present volume of sales.
- Waking up a sleeping market.
- Creating a demand that did not exist at all.
- Creating a demand that did not exist at all.

The text covers the areas of—
- Market Research.
- Product Planning.
- Pricing Strategy.
- Advertising and Sales Promotion.
- Distribution Outlets.

Before producing a product, management should know what is the potential market and what is the company’s expected share of that market. They also should know why customers buy the product. This is then followed by considerations connected with Product Planning and Pricing Strategy including differential (or marginal) pricing.

The book explains that advertising brings the customer to the product, whereas sales promotion brings the product to the customer.

As well as the programmed learning text, there is a Glossary of marketing terms, a guide to the Sources of Market Information, a description of sales promotion techniques, and (at the end of each chapter) a list of references to suitable further reading.

J.H.
Electronics

**Electronic Data Library, Vol. 1, Digital Instruments**
Waller, W. F. (ed.)
*Product Journals Ltd., 1968* 108 pages (126)

After dealing with the merits of digital measurement the book outlines the methods for achieving accurate digital measurements of frequency and voltage, with electronic counters, digital data storage, digital converters and digital analysers.

There is a product information section setting out suppliers' details concerning frequency meters, voltmeters, counters and analysers. Data handling equipment is subdivided for convenient reference into collecting, logging and processing units. Then follows the addresses of over 100 suppliers of digital equipments. The publishers are providing an excellent service by regularly issuing such useful reference books as this as their efforts warrant the continued encouragement of those concerned with electronic engineering.

J.L.

Assembly - Finishing

**Design Engineering Handbook—Product Finishing**
*Design Engineering Handbooks, Product Journals Ltd., 124 pages 40/- (126)*

Beginning with a discussion of the cost to industry of corrosion—the legacy of poorly finished products—the handbook, the combined effort of 17 authors, then proceeds to explain prior treatment and finishing processes including:
- Electroplating
- Case-Hardenning
- Metal Spraying
- Vitreous Enamelling
- Galvanising and Sheradising
- Anodising Aluminium Alloys
- Painting
- Plastic coating
- Vacuum Metallising Plastics
- Plating on Plastics
- Printing on Plastics

Preparation prior to treatment described in the book includes Acid Pickling, Degreasing, Alkali Cleaning and Spray Washing. Phosphate coating's for steel, conversion coatings for aluminium, and Retreatment for Electrophoretic Painting are also dealt with and finally there is a list of the suppliers of finishing materials.

C.H.B.

Basic concepts – Cost Reduction

**Defence Management Journals**
Vol. III No. 4 and Vol. IV No. 1 and 2

Published by the Directorate for Cost Reduction and Management Improvement Policy, Office of the Asst. Secretary of Defense (Installations and Logistics) this quarterly journal quotes C.R. ideas.

A recent issue contained this quote:

'I am not a greater believer in "success formulas" — yet it seems to me there is a basic truth which cannot be avoided. It is this. A profitable business must have the ability to turn out better products at competitive costs.

'The job is not an easy one. It requires planning, work, and the conviction that we are the masters of our destiny. This positive attitude is not always easy to maintain, since there are some cost elements which seem beyond our direct control, such as the effects of inflation and the things that are happening in our domestic and international economy. Because of these outside influences, there can be a tendency for people to feel that increased costs are inevitable. This is not always true. It was Mark Twain who observed that, "There are many scapegoats for our sins, but the most popular is providence".

'Excuses are easy to find. They may even be comforting if we let them be. However, our domestic competitors live in a similar environment and if we can be more imaginative than they are in finding answers to problems that are within our control, we should successfully meet competition from them.

'Taking a larger view, America as a whole faces an increasing problem of international competition, involving lower foreign wages. There are several avenues by which we can endeavour to meet this national challenge. First, we can be more efficient in our use of labor and reduction of overhead expenses. Second, we can endeavour to maintain the technological leadership we now enjoy. But research and development take money. And that money must come from profits. I am sure you have heard much about the necessity of our improving our profit margin. It is not greed that spurs us in this objective; it is the realisation that we must invest from today's business profits in order to realise tomorrow's business potential and the jobs that are a part of that tomorrow.

'In such an environment, sloth, waste, duplication of effort and unnecessary effort cannot be tolerated. All too often in the past we have attempted to control or reduce expenses on a crash basis. Sometimes we are forced to do this, but experience has shown that effective cost management is not achieved by directives. Rather, it is a result of the way we do things day by day.

'The Boeing Cost Improvement Program was begun because we realised the need for a continuing long-term effort to foster cost consciousness. The rooting out of all forms of waste and unnecessary expense was and is the program's long-term goal.

'But again, all the program can do is promote — urge — point the way. It cannot create effective cost management. That is up to each one of us.' William M. Allen, President, The Boeing Co.

B.W.

Creativity — System Analysis — Work Study — Decision-making

**Case History in the Use of Algorithms**
Lewis, B. N., Horabin, I. S. and Gane, C. P.
Pergamon, 1968 36 pages 12/- (102)

An algorithm is an orderly sequence of instructions for solving a problem. An algorithm reduces a problem-solving task to a series of simple operations indicating the order in which these should be carried out. The reader of the book is taken through a series of problems beginning with an algorithm for making a local telephone call.

Value Engineering, June 1969
Statistics — Econometrics

**Statistics for Economists**
Sadowski, W. (J. Stadler, translator)
Pergamon, 1968 323 pages 75/- (102)

This book, by the author of The Theory of Decision-Making (Pergamon) is for those who are interested in econometrics—which is the study of economic theories with the aid of mathematical statistics.

Subjects such as Analysis of Variance, Chi-square, distribution, Confidence Bond, Correlation Coefficient, Exponential Distribution, Normal Distribution, Probability, Sampling, Sequential Analysis, Standard Deviation and Tolerance limits will give an indication of the range of the book. Value engineers will recognise the relevance of some of these subjects to their own problems, and they will add to their ‘power’ from a study of the book.

Statistics (by definition) is the methods by which heterogeneous populations may be studied. As the author points out often we are not in a position to study all the units belonging to the statistical universe that is of particular interest to us. We must, therefore, know how far that part of the whole which we can study will reflect that whole. This is demonstrated by considering the methods of investigating the condition of 10,000 tins of meat.

Mathematical Statistics, which seal with methods of inference above the whole statistical population on the basis of the knowledge of only a part, enables us to make this kind of investigation. Finally, Mr Sadowski draws the reader’s attention to the fact that in practical statistical applications the matter of choosing a proper sampling scheme is of utmost importance.

G.K.

Management Techniques — Critical Path — Network Analysis — PERT

**Critical Path Construction and Analysis**
Morris, L. N.
Pergamon, 1968 114 pages 21/- (102)

By adding another useful and well-written book to the growing list of its Commonwealth and Internation library titles, the editors of the Pergamon Press are continuing to perform a very worthwhile service to Management education.

With added emphasis on planning there is an increasing awareness of how fundamental a part resources allocation plays in business success and Critical Path method is one of the ‘tools’ by which this may be achieved. The Critical Path of a network is the longest path in a network from a base or selected time to the end event and completion of objective. Criticality, says the author, is judgement in relativity.

The only rigidity that should be found in CP. is in the objective of the project.

It is pleasing to see the attention given to the important aspect of CP. — the allocation of resources, and the use of the method for smoothing out the work load is clearly shown. From experience, the author warns that commitment of capacity should not be made too far ahead. C.P., he says, ‘is and must remain a dynamic tool’. The only rigidity that should be found in C.P. is in the objective of the project.

The following approaches for reducing the total project time are highlighted:

- (a) Elimination of certain portions of the project.
- (b) Putting activities into tandem or parallel.
- (c) Building in additional resources.

And the author advances these notions as being quite basic to successful C.P.:

1. The only real commitments in business are promised to the customer.
2. A time estimate is not a commitment — it is a communication based on a judgement of a situation.
3. A manage decision on its own does not change the facts.
4. Business is a team effort and tasks should be arranged so as all the qualities and experience of everyone is being used.

This is an excellent book as are many other books in the same series. Some other titles in this sound series are:
- Clerical Methods for Managers.
- Quality Control for Managers.
- Work Measurement and Cost Control (A refreshing and controversial presentation of this subject which has been reviewed at page 245 in the November 1968 issue of this journal.)
- Management Information and Systems.

A Modern View of the law relating to Employment.

T.W.

*Value Engineering, June 1969*

A network is a flow diagram consisting of the activities and events to reach a project objective.

An event is a specific definable accomplishment in a project plan, a milestone recognisable at a particular instance of time. An Activity is an element of a project to which a known quantity of manpower and other resources will be applied. These and some twenty other explanations of C.P. terms appearing at the end of the book provide the reader with a quick review method.

This ‘Who does what’ tool makes ‘buck passing’ more difficult; keeps projects on their true course; and confers clear understanding amongst all participants in a job.

Beginning with setting down the Activities involved in the simple task of erecting a gate post, the author describes how the reader may develop his spatial and numerical powers (using, if necessary, the computer) and stressed the need for verbalability.

The explanation of such terms used in C.P. as tail event, head event and dummies is followed by a 19-step description of a method for setting up a Network. The author’s pictorial representation of ‘float’ in the Glossary and text will help the reader to gain a clear understanding of the subdivisions ‘Total’, ‘Free’ and ‘Independent’ Float.

It is pleasing to see the attention given to the important aspect of C.P. — the allocation of resources, and the use of the method for smoothing out the work load is clearly shown. From experience, the author warns that commitment of capacity should not be made too far ahead. C.P., he says, ‘is and must remain a dynamic tool’. The only rigidity that should be found in C.P. is in the objective of the project.

The following approaches for reducing the total project time are highlighted:

- (a) Elimination of certain portions of the project.
- (b) Putting activities into tandem or parallel.
- (c) Building in additional resources.

And the author advances these notions as being quite basic to successful C.P.:

1. The only real commitments in business are promised to the customer.
2. A time estimate is not a commitment — it is a communication based on a judgement of a situation.
3. A manage decision on its own does not change the facts.
4. Business is a team effort and tasks should be arranged so as all the qualities and experience of everyone is being used.

This is an excellent book as are many other books in the same series. Some other titles in this sound series are:
- Clerical Methods for Managers.
- Quality Control for Managers.
- Work Measurement and Cost Control (A refreshing and controversial presentation of this subject which has been reviewed at page 245 in the November 1968 issue of this journal.)
- Management Information and Systems.

A Modern View of the law relating to Employment.

T.W.

Management Techniques — Value Analysis

**Factory Management**
Lockyer, K. G.
Pitman, 1969 351 pages 35/- (119)

The author who is a well known teacher and consultant in the industrial management field, has also written extensively on the subject of Critical Path Analysis and Production Control. The book on running a factory, he reminds us, is no substitute for good judgement and good luck. In this second edition Mr
Lockyer has added material upon Value Analysis, Material Handling and Critical Path Analysis. It covers the requirements of the 'production' subjects for the various examining bodies.

'As all experienced factory managers know, there are but two simple devices necessary to run a factory - a crystal ball and a magic wand.' The author offers this book in the absence of these two things.

A study of the book's index reveal such matters as the learning Curve, Wright's law, Group technology, line Balancing, and Lorenz and Pareto analysis as well as the more mundane topics of factory management.

The value engineer will be particularly interested in the chapter on Value Analysis ('an organised procedure for the efficient identification of unnecessary cost . . . by analysis of function . . .') Twelve steps (as identified by Mr W. L. Gage) are given for carrying out a V.A. exercise. These are:

1. What is it?
2. What does it cost?
3. How many parts?
4. What does it do?
5. How many required.
6. Which is the primary function?
7. What else will do?
8. What will that cost?
9. Which of the alternative ways of doing the job shows the greatest difference between 'cost' and 'use value'.
10. Which ideas are to be developed?
11. What other functions and specification features must be incorporated?
12. What is needed to sell the ideas and forestall 'roadblocks'. J.K.

---

Basic concepts – Value Standards – Training – Checklist – Methodology

**Value Engineers: DoD Handbook 5010.8-H**


In the introductory note, Mr Thomas D. Morris, Asst. Secretary of Defense (Installations and Logistics), mentions that value engineers will find the book 'a convenient compilation of the extensive developments of the V.E. since 1963'.

V.E. has been applied in the DoD to:

- Construction
- Design mods.
- Maintenance
- Manufacturing processes
- Materials Handling
- Packaging
- Procedures and Reports
- Procurement
- Quality and Reliability
- Specifications
- Testing equipment
- Tooling

V.E. studies of the DoD have had the following main cost reducing effects:

- Fewer parts
- Fewer operations
- Standardisation of parts
- Repeatable manufacture
- Fewer tools, gauges and tests
- Simplified parts

The relationship of V.E. and Cost Effectiveness, Systems Analysis, Configuration Management, Standardisation, Zero Defects, Quality Assurance, etc. if explained, and a chapter is devoted to outlining the 'Contractual Aspects of V.E.' Criteria for applying V.E. and selecting V.E. projects is put forward.

'Although not widely used, value standards are effective when properly derived and applied . . . in spite of the difficulties in obtaining value numbers, value standards can be useful tools . . . when used as relative values rather than absolute values, they can be used to indicate preferable choices among alternatives.'

Pareto's law of Distribution (i.e. a few areas -- generally less than 20 per cent -- represent most -- 80 per cent or more -- of the cost) and the value cost target model are illustrated.

Although the techniques of Brainstorming, Synectics, Morphological analysis and Attribute Listing are described there is no mention of the creative behaviour approach notably developed by Lt.-Col. Bert Decker. There is an interesting illustration of morphological analysis applied to packaging taken from Charles Whiting's 'Creative Thinking' (Reinhold), and a useful Design Checklist.

The book concludes with information about the most important part of the technique -- selling (or marketing) the V.E.P., and there is a summary of the reasons for rejecting ninety V.E. proposals in 1966:

- Performance severely affected 26
- Supporting information inaccurate 20
- Cost Analysis incomplete 20
- Qualification test required 11
- Other reasons 23

Value engineers outside the United States will find the book most interesting as an up-to-date account of development and methods used in V.E. in that country and by its Government.

B.D.W.

---

Work measurement – Indirect labour – O & M

**Clerical Work Measurement**

Harmer, L. C. HMSO, 1968 27 pages 3/6 (105)

Introducing the subject by referring to its age, the writers of this Occasional Paper No. 9 in the C.A.S. series go on to cover basic considerations of W.M., the techniques it uses, and concludes with a most useful set of appendices including:

- (a) A Self Recording Work Form.
- (b) A Predetermined Motion Time Flow Chart.
- (c) An Activity Sampling Nomograph.
- (d) A typical Schedule of Activities.
- (e) An Activity Sampling Observer's Record Sheet.
- (f) A Batch Control Record Form.
- (g) An Outline of the theory of statistical sampling.

A C.W.M. programme does not require that absolute precision of measurement must be achieved is the fact to get across to oft times sceptical management when the idea is first raised. The author described seven basic considerations which need to be taken into account before embarking on a C.W.M. programme.

After describing the technique that may be used in C.W.M., the author points out that the measurement of work is not an end in itself -- the resulting work standards need to be used as a criteria against which to measure the performance of individual workers. C.W.M. is no substitute for efficient management nor can it be introduced smoothly without the understanding and acceptance of those who apply it and those to whom it is to be applied. In this connection it is well to remember that it is not what is said nor how it is said that mainly counts -- it is how it is heard. Infinite care and patience should be expedited to ensure that what is said is heard correctly and understood by all the listeners.

E.G.M.

Value Engineering, June 1969
Selected Abstracts of Recent Literature on Value Analysis/Engineering

Miss C. Maby — Abstracter

‘How can I know what I think till I see what I say?—E. M. Forster

These Abstracts are based on a survey of periodicals and books, supplemented by a selection of abstracts which have already appeared in other Abstract Journals. Permission to reproduce the latter is gratefully acknowledged.

Abstracts [98] to [103]

[98]
Basic concepts – Trade-off
Gioia, R.
The Value Engineer during the Preparation of Proposals
A.S.M.E. Paper 62-WA-278 Nov. 1962 pp. 2-4 (50)

At the study programme stage the Value Engineer must play a most important part, for decisions then made control the total cost of the system. Reliability and maintainability requirements normally dictate the packaging of the system. Reliability offers the mean time to failure relationships that are acceptable to the system.

The cost areas are – Product design and tooling, Product cost, Support costs including test equipment, spares, logistics, facilities and skills required. Normally Support costs far outweigh the Design and Product costs. The trading off of the demands of reliability and maintainability is the objective of the value engineer and to do this he may use point systems, relative worth, mathematical models, and so on.

[99]
Management appreciation
Fram, D.
Administering Value Analysis
Aerospace Management Sept. 1961 pp. 37-39 (49)

Describing how the Sperry Gyroscope Company Division of Sperry Rand administers V.A. the author describes how the programme started with the appointment of a V.A. administrator who reported direct to the Vice-President for Manufacturing. His duties were to aid the Divisions to set up V.A., disseminate the results, formulate the L.R. objectives, compile a procedures manual, keep the programme active, recommend training courses and assist the Divisions in conducting seminars.

V.A. was set up as a full-time activity with the team members drawn (as appropriate) from Engineering, Manufacturing, Purchasing and Quality Control. The teams have no authority to make changes – their job is to make recommendations to those in authority to make changes.

The V.A. team must use vendor assistance for 50 per cent of the sales dollar is spent through the Purchasing Department. The team-effort must be function-oriented in order to get the savings which are known to be possible with this type of approach as opposed to the normal cost reduction investigation. The article concludes with the description of the V.A. of a fan.

[100]
Operations research – Functional worth
Fallon, C.
Value Engineering and Product Engineering

V.E. in the hands of experienced product engineers can grow into a truly profession tool. It applies the precise techniques of science and engineering to those areas of evaluation, programming, and decision-making which have in the past been governed by intuition. In estimating, bidding and scheduling V.E. not only saves money but also time. In design, development and production it seeks the best ratio between desirable qualities and their cost in available resources.

The paper shows how V.E. can be utilised within the conventional engineering disciplines to provide the quantitative data necessary for better balanced specifications, for reducing areas of uncertainty in product planning, and for better decisions in both product design and programme management.

Operations research reduces self-deception to a minimum bringing us face to face with reality. V.E. is a specialised application of O.R. V.E. like the calculus was developed in two different areas at the same time. Larry Miles’ practical, horse-sense terminology vies with the more mathematical terminology of the ‘scientific’ school. The tools which V.E. can use include – mathematical statistics, decision theory, Monte Carlo methods, probability, logic, set theory, queuing theory, matrix theory, linear algebra, calculus and numerical analysis. A useful interpretation of ‘Value’ (Function/Cost) is set out in the article.
**Design – Basic concepts**

**Miles, L. D.**

*Evaluating Design Factors Affecting Costs and Reliability of Systems and Assemblies*


Written when he was Manager, Value Service Staff at General Electric Company, Mr Miles sets out some important aids for getting better results sooner in the design process, in system and assembly selection. The paper shows that by the use of special Value Engineering technology at the inception of most system and assembly design projects a company may get greater reliability in its products, shorter design time, and lower costs.

To bring the seemingly opposite forces of time, reliability and cost into one unidirectional force a form of design logic and V.E. technology may be effectively used. In making design choices there are two controlling sets of criteria: design to meet functional specifications, and design to meet economic specifications.

Three steps need to be taken in this work:

1. Precisely what are the functions required from the system or assembly?
2. Precisely what overall cost is required? This includes operation and maintenance costs.
3. The designer prepares to reject quickly those approaches which do not meet either the cost or the performance factors.

This selection by the designer may be based on a system of design logic. The logic starts with the specific functions to be accomplished by the system and assigns values to these functions. This method produces these advantages:

1. It reduces the problem to one containing only one unknown, i.e. reliable performance of the required functions. Any solution within this framework will meet the required cost.
2. The whole field which would formerly have required study has been reduced so that far less time will be required to study the section or far more time will be available for the study.
3. The opportunity to use highly complex subsystems and assemblies is by nature of the solution logic denied to the designer.
4. Intense problem solving technique will be concentrated in a few ‘performance and reliability gaps’.

The special techniques to assist the designer are – the basic steps, the job plan and specialised techniques. In the process of providing ideas, knowledge and approaches in these performance gaps the designer will find the search systems and quick rejection systems of V.A. of great help.

**Basic concepts – Target-costs**

**Van Vechten, C. C.**

*Getting the Most Out of Value Engineering*


V.A. and V.E. are terms which distinguish 'a functionally organised attack on costs'. The words 'function' and 'organised' are what distinguish V.A./V.E. from cost reduction and work simplification efforts. Cost reduction is methods-centered, V.E. is function-centered.

Value Engineering is that aspect of the art of value which is concerned with having the design right in the first place.

It has been said by many that V.E. is only what every good engineer has been doing all along – they don't want anyone else 'looking over their shoulders'. This, however, is not borne out in practice.

In setting up a V.E. team the first problem is where in the organisation to place it. While the position is important what is essential is a well-sold top and middle management giving active support. Secondly, there is the problem of size and composition of the group. Good work can be done by single individuals with adequate access to a wide variety of specialists. Where the team method is used, the design engineer, a production man, a purchasing man and a cost analyst or quality man usually can put up a good performance.

The writer explains the 'target cost' concept for computing V.E. savings. The essence of a target cost system is to start out with a decision as to what the finished item should sell for. Then on the basis of experience to distribute this cost through the major components. Prospective costs of design are then monitored against these targets any sharp deviation signalling for Management action. The V.E. target-cost approach can be effective in solving the problems that are capable of good solutions and in the early identification of those that are not.

No paper on getting the most out of Value Engineering would be complete without a description of the sort of people it takes to make the programme grow and grow, and the author lists the following attributes of value engineers: Broad experience; Depth of knowledge in at least one area; Intelligence; Intellectual flexibility; Ability to work with others; and a Highly developed cost-consciousness.
Publishers’ Names and Addresses

Journals

Books
124. O.E.C.D., 2 rue André-Pascal, Paris 16e, France.
163. Value Analysis Inc., 141N Broadway, Schenectady 5, New York, U.S.A.
SIRA (British Scientific Instrument Research Association)
Metron was previously known as Sira—Abstracts and Reviews

METRON is not so much new as fresh. Sira has published abstracts on instrumentation for industry over a period of more than twenty years, but the journal has now been given an up-to-date design and the nature of its contents has been changed. The changes introduced are of two kinds. The organisation of the subject matter has been altered, and the editors intend to concentrate increasingly on review articles instead of abstracts in the future.

Briefly readers will find three kinds of information in the reviews and abstracts sections.

(1) Information relating to development and production of commercial instruments.

(2) Information on the use of instruments in research, industry and in special applications, such as meteorology, geophysics and medicine.

(3) Information on instruments developed as a by-product of research projects—'one-off' type of instrument.

The aim of METRON is to assist scientists, technologists and managers searching for new techniques and developments in the field of measurement and control by providing an awareness and search tool for the technical literature. Reviews provide a condensation and comment on recent literature; abstracts alert to selected current articles of significance.

A subject index in each issue guides to individual techniques and applications. An annual cumulated subject and author index assists retrospective searching.

Please write for subscription details and free inspection copy.