EFFECTIVE TENDERING FOR LARGE SCALE OVERSEAS TURNKEY PROJECTS

(with a SEPARATE VOLUME OF APPENDICES)

BY

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A Thesis submitted for the award of Ph.D.

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A BRIEF SUMMARY

The study has concentrated on selected problems created at a contractor's organisational level when pursuing large scale overseas turnkey project opportunities by accepting the responsibility of a main contractor. The benefits of such projects attract contractors from many countries creating fierce competition. A cross section of opinions expressed independently on various contents of the work provides additional evidence of the need for this research. The main objectives of the study were to identify the causes of uncompetitive bids and to examine solutions to similar problems outside the construction industry. The method of approach has been to review the existing state comprehensively, to apply systems analysis to the contractor's tendering process, to identify sensitive areas and to develop new techniques to improve tendering performance.

The study has identified three major sources of stress in tendering personnel - complexity, uncertainty and time constraint - and has suggested possible ways of improving the environment in which crucial decisions have to be taken. By examining developments in Decision Theory, it has been possible to identify ways of controlling risks and to develop utility curves to deal with multiple objectives. The major conclusions of the study are that a) facts, b) subjective assessments and c) consequences of present decisions need careful evaluation to control risk and thereby reduce the contingency element in tenders. A structured approach to decision making is likely to lead to rational decision making. The human factor in tendering has been considered by examining and applying relevant developments in the field of psychology to suggest ways to improve overall tendering performance.

The proposals are directed towards improving the Sponsor's competitiveness. The main recommendations are to provide targets for each tender by efficient feedback and to introduce a measure of tendering effectiveness. These proposals have been subjected to the criticism of contractors' senior staff.

KEY WORDS FOR INDEXING

1. TURNKEY PROJECT
2. SYSTEM ANALYSIS
3. STRESS
4. RISKS
5. MULTIPLE OBJECTIVES

THE UNIVERSITY OF ASTON IN BIRMINGHAM
(Interdisciplinary Higher Degrees)

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Sponsor Organisation

Each firm has its own organisational structure designed to suit its business and the way it is conducted. The problems discussed in this study are mostly at the organisational level of a Company. Although these problems appear to be common to many organisations in a similar situation, it is more than likely that others may have already found solutions to suit their individual needs. Many proposals in this study are directed towards solving problems of a specific nature and therefore these cannot be generalised.

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PRELIMINARIES

MAIN OBJECTIVES

OF THE STUDY

MAIN OBJECTIVES OF THE STUDY

Within the scope of the subject matter indicated by the title, the following objectives were considered as relevant to the interest of the Sponsor.

A. Identification of the problems leading to uncompetitive bids

To identify key sensitive areas at the Sponsor's organisation level.

B. Examination of solutions to similar problems

To examine solutions relevant to the construction industry arising from the developments in the following fields.

Psychology

Decision Theory

and Systems Analysis

C. Application of the available knowledge

To apply the knowledge available in the above fields to various tendering activities directed towards improving the Sponsor's tendering performance.

D. Develop suitable procedures

To develop suitable procedures to transform subjective assessments

PREFACE

PREFACE

The current trend for overseas turnkey projects has created a need for a role of project lead group (project leader). Although the Sponsor has the expertise and the resources to take the responsibility of such a role, the task of pursuing such projects in the face of extremely fierce competition has been the source of many disappointments.

The problems faced by British contractors in bidding for such projects are numerous. This study reviews briefly, a number of these problems with a view to seek suitable existing solutions. This approach has helped in identifying many gaps in the attempts by Government sources, academics, contractors, institutions, service sector (e.g. insurance) and others to deal with these problems.

Within a framework closely linked with practical tendering and the requirements of everyday work, the study brought together insights from many practitioners, the teaching available in normal text and a considerable variety of inputs suggested by academic research.

The systems approach has been successfully applied in many fields other than bidding. But before it could be applied to tendering, it was necessary to establish that tendering is a process. Having provided sufficient evidence to this notion, the problems identified within the above mentioned gaps were categorised under three main headings - task complexity, uncertainty and time constraint. A pilot study indicated that these are potential major sources of stress-raisers in tendering personnel.

A review of classic texts revealed that bidding for turnkey projects has been inadequately treated. Although the literature search provided guidance to many aspects of tendering, nevertheless, personal interviews were found to be the most useful source of information about the intricacies of tendering decisions in such projects.

A review of literature on uncertainty identified psychological aspects of decision making in which information processing plays a vital role. Integration of various stress factors identified in the field of psychology has helped to understand their overall effect on occupational stress in the tendering environment.

The study has reviewed Decision Theory including multi-attribute utility theory to see what can be offered to reduce complexity, uncertainty and time constraint. The approach to risk analysis takes into account the fact that contractors risks originate from the following three kinds of uncertainty.

- Uncertainty about facts
- Uncertainty about what people think about facts i.e, their subjective assessments.
- Uncertainty about the future consequence of present decisions.

The analysis identifies the range of uncertainty within which contractors have to work and attempts to evaluate the categories of uncertainty mentioned above. Applications of such procedures as decomposing, tradeoffs, etc; have assisted in developing risk profiles, rating charts, utility curves and many other tendering decision aiding tools which can be considered as an encouraging aspect of the Decision Theory review. The following procedures developed in should give the study the status of a 'practical companion' to practitioners.

- selection of suitable projects to bid
- selection of a suitable agent.
- selection of suitable sub-contractors.
- Ascribing probabilities.
- Tender management by objectives
- Project policy statements schedule
- Selection of suitable tendering personnel
- Information centres
- Functional analysis in tender response
- Internal tender audit
- A measure of tendering effectiveness.

The above procedures have helped to transform subjective assessments into objective means (aids) of decision making.

The application of systems approach to the Sponsor's tendering process has assisted in identifying such missing elements as feedback and measure of tendering performance. Additional controls, measures and correctors have been introduced into the proposed tendering process to improve its effectiveness. Value engineering is an example of such a control.

On the whole, this study has attempted to bring tendering a step nearer to treating it as a technology. The end product from the use of this 'technology' depends very much upon the quality of measure of tendering performance and the feedback the Sponsor can achieve from his tender submissions. Like any other technology, there is a danger of it being out of date at the end of a particular construction boom period.

A CROSS SECTION OF OPINIONS ON SOME OF THE CONTENTS

A CROSS SECTION OF OPINIONS EXPRESSED * BY PRACTITIONERS AND ACADEMICS ON SOME OF THE CONTENTS OF THIS STUDY

(*UNCONNECTED WITH THIS WORK)

Objectives

'A specific project has objectives and its own strategies'

S.A. Gregory (1979)
Then Reader, Dept. of Chem. Eng.
Aston University

'Almost all of the issues that decision makers face in actuality involve multiple objectives that conflict in some measure with each other. In such issues, decisions that serve some objectives well will generally satisfy other objectives less well than alternative decisions, which, however, would not be so satisfactory for the first group. The decision maker then must select from among the possible decisions the one that somehow establishes the best mix of outcomes for his multiple conflicting objectives'.

J.G. Vishiani - Chairman

R. Levien - Director
International Institute for
Applied Systems Analysis

(Forward to Bell, Keeny, Raiffa (1977))

Probability & Utility

'Probability is in the domain of information what utility is in the domain of decision consequences: the former quantifies the evidence as you see it, the latter is a numerical expression of your personal values'

Wendt and Vlek (1975)

Systematic Decision Making

'Do tendering procedures serve the best interest of clients and contractors alike and are there any other adverse factors operating against these legitimate interests? While there is no substitute for the exercise of sound business judgement, can risk and uncertainty be reduced by systematic decision making?'

W. Nicol M.B.E. (1970)
Then President of Institute of Builders

'Multi-attribute utility theory as a decision tool, has passed the stage where it needed advocating. What we need to do here is to introduce theory and give a practical example of how it can improve the process of decision making'

M. Salah (1977)

'The decision maker was considered to minimize the costs of the decision process, specifically:

1. the cost of the time of the procedure, and
2. the cost of making errors'

R.M. Hogarth (1975)

'We defined task complexity to be an increasing function of both the number of characteristics per alternative and the degree of overlap between the alternatives'

R.M. Hogarth (1975)

'The results demonstrate that the information processing leading to choice will vary as a function of task complexity'

J.W. Payne (1976)

'In performing complex tasks, individuals utilise different heuristics that will keep the information processing demands of the situation within the bounds of their limited capacity'

Newell and Simon (1972)
cited by J.W. Payne (1976)

'Since the budget is limited and management wants to do "as well as possible" with respect to each mission, the allocation (among missions) involves tradeoffs between competing objectives'

D.L. Keefer (1978)

'The 'revealed preferences' alone simply do not provide enough information necessary to structure the analysis of a given problem, especially when interdependent uncertainties and multiple objectives are involved. Answers to hypothetical questions when consistently put together can provide the information necessary to arrive at a specific utility function.... Evaluation of subjective judgement through hypothetical questions can assist in quantifying unquantifiables.'

Keeney and Raiffa (1976)

'Once again we are drawn to the conclusion that we ought in business to be aware that we are dealing with people's judgements as well as "facts", and to enable one to perform better it would be wise to use decision models, complex though they may be, to aid the choice of better strategies'.

A Tversky and D. Kahneman (1974)

Uncertainty and Risk

'Two general types of uncertainty can be identified: information uncertainty and performance uncertainty....... Methods * exist which are designed to reduce performance uncertainty by improving the consistency of the manager as a decision maker...... but information uncertainty is less discussed.'

P Bell (1978)
Then Asst.Professor at the School of Business Administration, Canada.

* See Scoring Rules - R.M. Hogarth (1975)

'Basic risk dimensions are probability of winning, amount to win, probability of losing and amount to lose.'

J.W. Payne (1973)

'We find that judges have a very difficult time weighting and combining information - be it probabilistic or deterministic in nature. To reduce cognitive strain, they resort to simplified decision strategies, many of which lead them to ignore or misuse relevant information.'

Slovic and Lichtenstein (1971)

'The Credit Insurance Association (CIA) in its report "Major Exports - Managing the Risks" has analysed the financial risks attached to major project business..... there are several factors which contribute to an unwillingness to accept these risks:-

a. The general under-capitalisation of British Industry
b. The effect of inflation
c. The general lack of confidence amongst industry
d. The lack of a focal point to take a leading role

D o T

"Good Management requires risk management. If management are overly conservative, many potentially acceptable projects will be turned down. If the judgements are overly optimistic, corporate profitability will suffer. There are two steps in project risk management:-

a. measuring risk and
b. interpreting risk in terms of a consistent * strategy towards

risk taking.'

(* Utility approach)

H.G. Thorne
Then Manager International Venture
Development - Amoco Chemicals Corp.

"Clearly, international project management (especially of turnkey contracts) is one of today's most acute management problems and the subject has received little attention....... In overseas projects, the potential returns are high - but so are the risks. We need to spend more time developing strategies to cope with that risk.'

D.A. Overton (1977)
Senior Consultant

'There is no point in getting into a panic about the risks of life until you have compared the risks that worry you with those that do not.'

Rothchild, Dimbleby Lecture (1978)

'Some risks are clearly so unacceptable that they must be eliminated. Others, less severe or less likely, should be reduced to the point where the benefits of the risky activity balance the costs of its ill-effects. Striking the balance inevitably involves compromise*.'

* Trade-off

J. Dunster (1978)
Director

'How do we decide which hazards should be treated urgently and which can be accepted. Comparing the numerical risk of hazards gives a logical foundation for their control'.

T.A. Kletz (1978)
A senior ICI Research Associate.

'One of the essential skills of a main contractor is to be able to achieve

'Part of the problem facing firms working overseas is the large amount of contingency pricing that is necessary. British firms are losing out on this'.

H. Dawson (1977)
Building Management
and Marketing Consultant

Selection of Projects To Tender

'.......we must selectively identify project opportunities and pursue them hard'.

D.R. Wheatland (1977)
Then GM, MPD, BBE Ltd.

'One of the problems in the Middle East is that you get plenty of enquiries every week, but a lot of them are never intended to be built. One has to sort those out.'

A.J. Skivington
Managing Director
Rush and Tomkins Ltd
(An Interview by J.D. Allen
Editor-in-Chief - CN)

Project Contribution

'Every contractor in the world has to face a most difficult problem after completing a project estimate and before submitting his bid to the client - what mark-up or profit he should add to the project cost so he can maximize his profit, but also be selected as a successful bidder. His biggest uncertainties in making this decision are:-

1. what his competitors are thinking and how hungry they are in securing this project?
2. what are the conditions of the environment at the time of this project?

3. what are the risks involved with the project?'

P. Kumar
Then Vice President,
Parich International Inc.

Once associated with Ralph M Parsons Co,
Jacob Eng. Co, Flour Corp,
Humphreys and Glasgow and
Brock and Sons.

Occupational Stress

'Social relationships at work, organisational structure and the nature of the work itself have all been found to constitute environmental stressors.'

A. Keenan (1979)

Value Engineering and Time Reduction Analysis

'The client's interest is best served by people committed to his project, not to their profession or trade'.

N Thomson (1978)

'Could value analysis have been so successful if products were not over-designed for their purpose?'

A. Wilson (1976)

'Insufficient regard is paid to the importance of time and its proper use'.

Banwell Report

'Home practice does not always apply abroad'.

S. Porter (1977)

'One of the unfortunate features of UK design is that often the engineer will ponder to technological self-satisfaction rather than the needs of the job'.

D.A. Overton (1977)
Senior Consultant.

Effective Tendering (At a contractor's organisational level)

'Success in competitive bidding depends upon identification of key factors influencing the customer and distinguishing one's own bid from those of competitors by meeting the key factors to a significantly greater extent than they do. In order to identify key factors, one must establish which individuals contribute to the buying decision and their respective degrees of influence.'

P.D.V. Marsh (1970)
Then Contracts Controller, S.T.C. Ltd

Corporate Policy (At the National level)

'The main requirements (Pre-tender) to be met are:-

i) to obtain the earliest information of a potential project and of the proposed contract conditions;

ii) to decide whether British Industry should compete for it;

iii) to form a suitable organisation for the purpose of competing and subsequently for organising and managing the project if the tender is accepted.

iv) to ensure the fullest support for this organisation from industry as a whole (public and private), the City (banking and insurance) and Government'.

LCC - BEHA Report (1976)

Construction Bonds

'One misconception regarding bonds is that they are simply insurance for the contractor and the owner; this is not true.......... It would pay to have a knowledgeable person review construction bonds and insurance on a regular basis'.

D.M. Walker (1978)
Asst. Commissioner.

THE INDUSTRY'S RESPONSE TO THE SUBJECT MATTER AND THE PROPOSALS

In this research, various proposals have been subjected to the criticism of colleagues and specialists in the construction industry and attempts have been made to get answeres to questions such as:

(a) Is this approach something which fits the circumstances?

(b) Is this approach one that you would use?

A. An extract from a memo dated 10th May, 1979 from a Project Manager to the Industrial Supervisor in the Sponsor's organisation referring to the subject matter is given below.

> "I think the decision - making processes he describes must be treated as 'tool' only, the important factors being the weightings or individual evaluations of the inputs and constraints; to this end the multi-attribute technique has a lot to commend it. We do of course use this approach during tendering although not fully utilising the "mathematics" and so we are at least partway along the path he favours.
>
> In Chapter 6, I feel contractual risk evaluations, tradeoffs, ... are some of the most critical areas of competitive tendering - and of course successful business ! The same principles apply to a degree in all uncertainty situations.
>
> Time constraints and shortage of data/information are ever - present to some degree in all tendering situations, and the recoginition of 'grey areas' and then breaking them down into more - quantifiable portions does lead to better decision -

SUMMARISED CONCLUSIONS

SUMMARISED CONCLUSIONS

Although the correct strategy at the national level is essential, nevertheless, the 'grass root' problems if remained unsolved, can adversely affect British attempts to seek overseas contracts.

In the present market conditions, contractors are likely to have more than one objective (e.g. profit maximization). With a chance of some objectives conflicting with each other, explicit corporate policies are needed.

Complexity, uncertainty and time constraint appear to be the major occupational stress raisers in personnel associated with tendering environment. Decision Theory which deals with utility and probability is likely to assist in transforming subjective assessments into objective decisions.

Uncertainty about a) facts b) subjective assessments and c) consequences of present decisions, need evaluation to control risks. Contractors use some form of trade off to deal with undesirable elements and to keep the risk element within acceptable limits.

The application of systems analysis to a contractor's tendering process can improve his learning curve. His tendering performance can be improved by defining objectives for each tender. Such objectives can be provided by efficient feedback.

As far as possible, these conclusions have been checked for feasibility or applicability with those engaged in tendering practice.

A PAGE SUMMARY*

1. THE PROBLEM: (* DIAGRAMATIC)

FIERCE COMPETITION, THE MAIN SOURCE OF MANY DISAPPOINTMENTS FOR THE SPONSOR.

2. THE AIM OF THE STUDY:

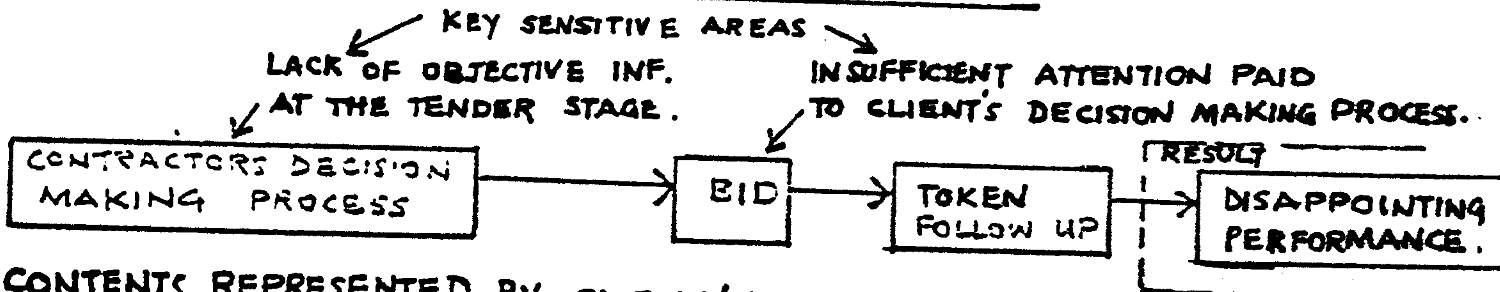
TO IDENTIFY THE MEANS OF IMPROVING THE SPONSOR'S TENDERING PERFORMANCE.

3. THE APPROACH:

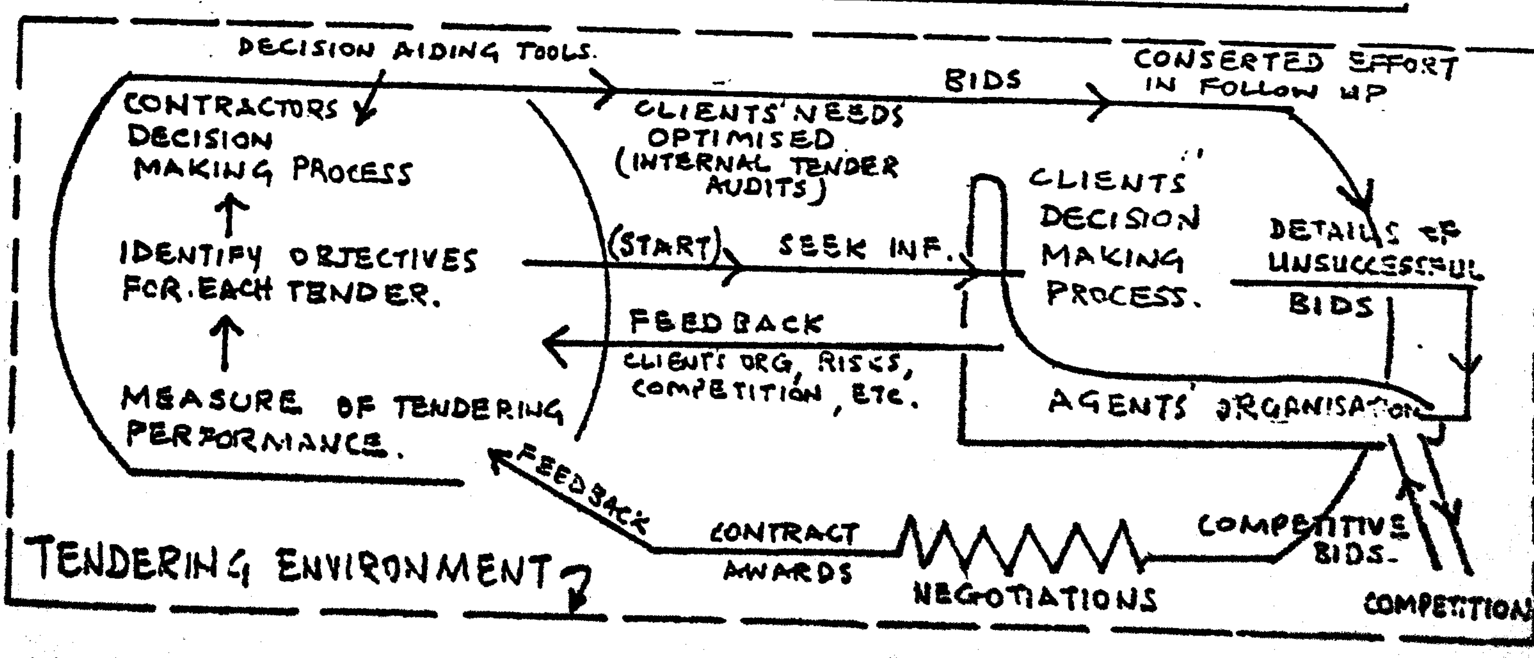
TO EXPLORE WHAT IS KNOWN ABOUT ACTIVITIES IN THE TOTAL TENDERING ENVIRONMENT BY WAY OF 'RAID' APPROACH.

['RAID' APPROACH: (SEE 'MAJOR CLAIMS').
R: Review of existing state, A: Application of systems analysis and existing techniques, I: Identification of sensitive areas and D: Development of new techniques.]

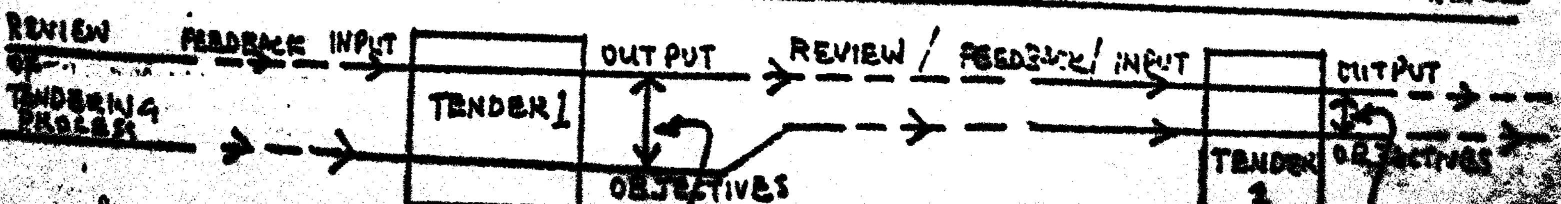
4. MODEL ILLUSTRATING THE PRESENT APPROACH.



5 CONTENTS REPRESENTED BY CLIENT/CONTRACTOR INTERACTION MODEL



6 MAIN RECOMMENDATIONS FOR IMPROVEMENT IN TENDERING PERFORMANCE



MAJOR CLAIMS OF THE STUDY

MAJOR CLAIMS OF THE STUDY

The study has made the following approach.

Reviewed the present tendering environment and the relevant literature. Applied systems analysis to some of the relevant procedures in tendering, Identified sensitive areas and indicated the need for modifying some of the existing decision making processes and Developed new techniques to deal with the special environment (i.e. lack of objective information) of decision making in tendering for overseas projects.

PART 1

REVIEW

The study has comprehensively reviewed:

R.1. the problems faced by British contractors in tendering for large scale overseas projects.

R.2. the current state of literature on organisational stress and has linked stress factors from both, stress and decision analysis literature.

PART 2

APPLICATION

The study has applied:

A.1. systems analysis to the Sponsors' existing tendering system.

A.2. existing techniques to examine their suitability in tendering situations generally short of objective information.

IDENTIFICATION AND INDICATION

The study has identified the following sensitive areas:

I.1. A lack of objective information for decision making at the tender stage.

I.2. Insufficient attention given to clients' decision making process.

I.3. Major factors likely to lead to stress in tendering personnel (This is based on a pilot study).

I.4. The 'political' conflict between divisions as an internal source of uncertainty which can affect the Group's tendering performance.

The study has indicated the following.

I.5. The need for special decision aiding tools for transforming subjective information into objective means of decision making.

I.6. The four most effective heuristics in value engineering for reducing prime costs.

I.7. The five most desirable qualities in tendering personnel.

I.8. The need for measures and feedback in a tendering process.

I.9. The need to carry out unconventional but crucial tasks in overseas tendering.

DEVELOPMENT

D.1. the following techniques to transform subjective information into more objective means of decision making.

D.1.1. An internal tender audit from a client's point of view.

D.1.2. A measure of tendering effectiveness.

D.2. The following techniques using objective information.

D.2.1. Tender tasks performance analysis useful in reporting the progress of a tender.

D.2.2. Tender cost variance analysis useful in producing tender cost variance monitor for effective feedback.

D.3. A procedure for proxy decision making with a potential for providing some flexibility for middle management (and the representatives visiting overseas countries) to take decisions in urgent cases when senior executives are unavailable.

D.4. An alternative coarse screening procedure for establishing instantly, the suitability of a project to bid.

D.5. Compatibility indices for reducing uncertainty when seeking new arrangements for an agent or sub-contractors.

D.6. A procedure for setting up short term objectives in specific tending situations

DEVELOPMENT (Continued)

D.7. A project policy statement schedule for improving communication during tendering.

D.8. Schedules suitable for computer application in

D.8.1. Budgeting and controlling tendering costs.

D.8.2. estimating the costs of a large number of expatriates.

D.9. A comprehensive check list of risk items based on collection of different professions views on the risks in overseas contracting (useful in risk analysis of such projects).

D.10. Project and corporate risk profiles useful in :

D.10.1 tender project management,

D.10.2 tender review meetings,

D.10.3 controlling corporate risks,

D.10.4 controlling risks during the construction phase.

SUMMARY OF RECOMMENDATIONS

SUMMARY OF RECOMMENDATIONS

The recommendations can be categorised as follows:

a) to improve the overall tender performance and

b) to improve competitiveness.

TO IMPROVE THE OVERALL TENDER PERFORMANCE

i) By 'strong bid (qualitative attributes) and low price' policy

Willingness to discount to some extent overhead and perhaps profit depending upon* competitors' cost and pricing flexibility. (See recommendations to improve competitiveness).

* through inhouse research.

ii) By identifying opportunities and potential joint venture partners, sub-contractors, etc. at the earliest

Identification of potential project opportunities through systematic monitoring of international development banks' (World, Inter-American Development, and Asian Development) and other similar sources upcoming projects. Establishing long term relationships with potential JV partners, s/cs, suppliers, etc.

iii) By 'marketing and pricing' strategy

A strategy based on acquiring the knowledge of the project (by acquisitions of or collaborations with appropriate organisations if necessary), product specification and competition.

iv) By implementing marketing plans through a client/contractor relationship (by getting to know the client's decision makers)

Explanation and emphasis on the contractor's expertise and also on special advantages and attributes (durability, contracting experience, spare parts, servicing availability, etc.) i.e. marketing the qualitative attributes of various contents in tenders.

SELF CRITICISM

ACKNOWLEDGEMENT OF THE FAULTS IN THE STUDY (Self criticism)

1. It was recognised at the start of this research study that submitting any evidence of a contractor's tendering performance will be against the commercial practice. Hence the majority of the evidence is in the form of general or specific comments. This report therefore lacks supporting documents.

2. Because of large overseas projects under consideration, it was appreciated that there will not be a sufficient number of tender submissions by one company during the period of the study. Hence a statistical approach was considered unsuitable. The attempt to secure the relevant statistical information from the appropriate government department on the tendering performance of British contractors as a whole was unsuccessful. A simulation exercise was carried out to demonstrate the potentials of a known technique. The suitability of this technique has not been tested with factual data.

3. This study examines specific tendering problems, many proposals therefore cannot be generalised.

4. The complexity of the problem under consideration meant seeking potential solutions from many other fields. It has affected the size of the thesis.

5. Because of the confidentiality of the information used, it has not been possible to identify individuals or organisations. Hence there is no list in this report of any interviews or discussions on the subject matter of the study.

6. Where there is an absence of statistical evidence or case histories for suggesting a structured approach to decision making, the only ground for argument is the 'rationality' of such decisions.

ACKNOWLEDGEMENT OF THE FAULTS IN THE STUDY (Contd.)

7. As the problem under consideration is not a common subject matter for academic texts, the review of normally available texts is rather limited in content.

8. Empirical evidence for occupational stress in tendering personnel is extremely limited. Hence it can only be treated as a pilot study.

9. Tendering is associated with dynamic decision making i.e. internal and external environments are changing all the time. Hence some of the problems or solutions discussed in this study may be out of date within a very short period.

10. For practical reasons, all the tables, charts, figures, etc., have been grouped together at the end of each chapter. At times it makes reading that much difficult.

DEFINITIONS

DEFINITIONS

JOINT VENTURE

The members of the venture pool their resources for the project and the tendered price for the work is decided jointly by them. They sign a single contract with the customer and share profits and losses arising out of the project in pre-agreed proportions.

Member companies would have to accept a joint and several responsibility if this was called for under the contract but otherwise its relationship with the joint venure can be considered to be that of a shareholder.

CONSORTIUM

The members of a consortium would be allocated an identifiable portion of the project accepting responsibility to each other for the proper completion of their respective portions. Each member quotes a price for his work and the consortium bid is the summation of these prices plus an amount for the cost of the consortium. All members sign a single contract with the customer and reply upon their performance on their part of the project for profit or loss.

Member companies would have to accept a joint and several responsibility if this was called for under the contract but otherwise its relationship with the consortium can be considered to be that of a sub-contractor.

DEFINITIONS (Contd.)

HEURISTIC

Webster's New International Dictionary defines the adjective Heuristic as

'serving to discover or reveal'

Newell, Shaw and Simon (1958) define heuristic as

'Principles or devices that contribute on the average, to reduction of search in problem solving activity.' (E.G. in geometry, a familiar heuristic is 'Draw a diagram.')

Heuristic problem-solving procedures are procedures organised around such effort-saving devices. There are high level (general) and low-level (specific) heuristics.

HEURISTIC PROCEDURE

'1. Factorization of problem into a number of "smaller" problems and sub-problems.

2. High degree of interdependence between the specific problem being considered and the particular problem-solving method.

3. Use of recursive procedures to bring to bear on sub-problems the same repertoire of problem-solving techniques used on the original problem.

4. No guarantee of a satisfactory solution or often any solution.'

Newell, Shaw and Simon (1958)

DEFINITIONS (Contd.)

TURNKEY CONTRACT

'A turnkey construction contract is a contract which holds a single entity responsible for the design and construction of a specified facility. The entity may be a single part, or an association of firms necessary to design and construct the project. Award of such contracts may be negotiated or competitively bid and may be reimbursed on many basis, including lump sum, time and materials, cost plus, fixed fee, etc.'

ASCE, Engineering Issue
April 1975, pp 235-241.

ENGINEER CONSTRUCTOR

In the developing countries where there is a limited technical ability and know-how of modern techniques, the countries concerned have relied heavily on consulting engineers to prepare feasibility studies and oversee the work on their behalf.

Engineer/Constructor eliminates the consultancy approach. The client specifies the type of plant and the Engineer Constructor prepares the feasibility study and when the project proceeds, acts as the Engineer Constructor with total responsibility and liability for all phases.

MANAGING CONTRACTOR

He is like an architect or an Engineer, another specialist professional consultant to the client with a working relationship with other professionals and contractors engaged on a project. In general, he is [illegible] but not* liable for his part in a project.

Multidisciplinary Projects

A multidisciplinary project consists of various disciplines such as engineering (civil, electrical, mechanical, etc.) manufacturing (mechanical, electrical, etc.) finance (lending, arranging, etc.) etc. with each specialist working individually in his own specialist field. At the end of the process (i.e. construction of the project) the activities of the various specialists are integrated to complete the project.

In this type of projects, it is not necessary for each specialist to acquire skills of the others. Whoever performs the necessary integrating work, however, must have a firm grasp of all the relevant specialities.

Interdisciplinary Projects

In interdisciplinary projects, specialists of different background such as engineering, manufacturing, finance etc. are closely co-ordinated. They work as an 'integrated' group which means that the group as a whole works together to complete the project.

Interdisciplinary projects demand the intricate merging of insights and methods from several contributing disciplines.

DEFINITIONS (Contd.)

Utility

A numerical expression of personal values.

Probability

The quantification of the evidence as seen.

Multi-Attribute Utility Theory (MAUT)

Multi-attribute utility models are means of decision aiding 'tools' to dea

with conflicting objectives.

Back-to-back terms

A main contractor's terms with his sub-contractors for a project where liabilities and obligations associated with sub-contracts under the main contract are passed on to the sub-contractors.

Objectives

An objective is a future state of affair 'approachable' within a given se

of time.

Goal

Goals are obtainable within planning period.

Criterion

A criterion is the means of measuring, illustrating and choosing the rela

difference among alternatives.

Alternative

It is a solution acceptable within the ranges of cost, time and effectiv

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CHAPTER 1

PART A

GENERAL INTRODUCTION

CHAPTER 1:

PART A: GENERAL INTRODUCTION

Historically, the approach by clients to the construction of multi-disciplined projects has been to employ an independent consultant to evaluate, engineer and recommend a course of action. The consultants approach in general, for executing such a project has been to treat the contents strictly on the basis of engineering disciplines i.e. civil, electrical, mechanical, etc. In the majority of cases, this has resulted in separate contract packages of reasonable sizes. But, due to the recent trend (from the early seventies) for large and interdisciplinary (i.e. manufacturing, contracting, engineering, financing, managing, etc.) projects (resulting from higher rates of industrial growths in the developing countries) the general pattern of contract awards for such projects has diverged significantly from the above conventional approach to turnkey type contracts. This approach enables clients to pass responsibilities and liabilities associated with such projects on to a single contractor.

The Credit Insurance Association, in its report "Major Exports - Managing the Risks", has analysed the financial risks attached to major project business and concluded that, whilst none of the risks attached were new, they now present problems simply by virtue of their sheer size, magnified by the interdisciplinary nature of the projects. There are several factors which contribute to an unwillingness to accept these risks:

- The general undercapitalisation of British Industry
- The effect of inflation
- The lack of a focal point to take a leading role

The LCC - BEHA (London Chamber of Commerce - British Export Houses Association) Joint Committee report (in 1976) on jumbo projects defines jumbo size as

The BOTB - OPG's (British Overseas Trade Board - Overseas Project Group) Report (1975) defines jumbo size as £100 million or more. It treats the problems under the following broad category.

- Project management.
- The role of government.
- Cost escalation.
- Joint and several liabilities.
- Performance guarantee.

Many people concerned with the industry believe that the commercial problems referred to in the above report have come about as a result of combination of factors such as:

- Substantial increase in the size of projects.
- the 'financial independence' of some of the clients, in particular, from the oil-rich countries,
- client's preference to turnkey type contracts,
- the keen competition by contractors from Asia and the Far East.

These have brought some sweeping changes in the seller's market affecting the normally expected client/contractor relationship.

An important fact behind such keen and at times fierce competition is that there is a good deal of pressure behind the bidders to win contracts on grounds of national prestige, and on grounds of strategy in the sense that jumbo projects may establish bases for further penetration of lucrative markets.

This study provides a comprehensive review of the problems faced by British contractors and identifies work carried out in various fields - commercial, contractual, academic, etc. to deal with these problems. It concentrates on the areas mainly at contractor's organisation level which so far have not been dealt with at least in published form. The study has attempted to fill these 'gaps'.

The LCC - BEHA report identifies the four main requirements to be met under project management as follows:

(i) To obtain the earliest information of a potential project and of the proposed contract conditions.

(ii) To decide whether British Industry should compete for it.

(iii) To form a suitable organisation for the purpose of competing and subsequently for organising and managing the project if the tender is accepted.

(iv) To ensure the fullest support for this organisation from industry as a whole (public and private) the city (Banking and Insurance) and Government.

This study discusses the complexities of some of the above tasks and the problems faced within contracting organisations when performing these tasks.

The Working Party of LCC - BEHA report believed that if the commercial market is to play its proper part in the solution of these problems, it will be necessary to clarify the distinction between the inevitable uncertain surrounding contracts of the size and complexity and the risks of various kinds that are capable of more precise definition and quatification.

Large scale projects tend to create a degree of uncertainty which tends to discourage tendering except at a highly protective and thus uncompetitive price The above report refers to this and suggests that there is a disposition on the part of industry to regard the answer to these problems as lying wholly within the sphere of the financial service industries. But Banks do not regard the risks involved as coming within their normal professional activity, and therefo the British Government and the construction industry looks to the insurance industry for solutions, generally in the form of some kind of total composite insurance.

The report distinguishes uncertainty and risks as follows:-

UNCERTAINTY is defined as an unquantified and imprecisely defined anxiety.

RISK is the possibility of the occurence of a definite and quantified event.

The insurance industry does not normally give total comprehensive cover against general uncertainty, but covers against losses due to certain precisely defined events. It is therefore necessary to convert a generalised uncertainty into certain specific defined and quantified risks. It should therefore be possible, given the necessary high degree of sophistication in the analysis of risks, for a main contractor or a consortium to know in advance i.e. during tendering, the precise nature and amount of the commercial risk involved. Should this risk be at an acceptable level, it can then either be insured or otherwise controlled in detail. Theoretically, this procedure ought to reduce risks and increase confidence that the large contingency allowances at present included in tender prices could be drastically reduced. According to the report, the level of contingency in suc tenders is to the extent of 15 percent or even more.

In the majority of cases, the factual information needed to carry out a sophisticated risk analysis is either incomplete or absent. The report regard the devising of techniques, which would be capable of handling these complex and large - scale problem, as a necessity for submitting bids on a competitive footing.

With the help of five risk controlling actions - avoid, transfer, eliminate, retain and prevent (ATERP), the study has developed a risk controlling techniq which has a potential for transforming subjective information into objective means of decision making.

Tendering is a process, in many respects, similar to a manufacturing process, but in comparison with the former, the latter is well documented. The study has critically examined tendering from a process point of view and has applied systems analysis in order to identify any defective elements.

The established practice in manufacturing industry is to test a finished product from the consumer's point of view. This study has shown that this approach has a potential for adoption in the tendering process to review critically, a completed tender from a client's point of view.

A rationale behind any tendering operation can be summarised in the following four statements:

1. All organisations must bring in money to operate.
2. To obtain money they must sell something.
3. Before selling anything, they must propose to sell.
4. In order to prepare a proposal, it is necessary to understand the relevant corporate policies.

Tendering, from the initial stage of forming project policies to the final stage of negotiations, is a series of complex decision tasks.

Many critical decisions are taken under time constraint at times extremely, severe, thus jeopardising the quality of such decisions. The study reviews decision analysis including multi-attribute utility theory to exploit the means by which the effects of time constraint can be mitigated. An extreme case* of decisions under time constraint and its adverse effects is briefly discussed in the following paragraphs. (* A case study discussed in a conferenc

A contractor was given a relatively short period to decide whether to tender for section of the work in a project. The initial rough estimate of the cost of the total project was £20m. and that of the contractor's section of the work was around £4m. The contractor's corporate management considered it as a reasonable venture in the territory at the time.

During the tendering period however, the estimated cost of the total project was constantly on increase and reached a figure around £90m on the bid date. The contractor also had to face the uncertainty due to constantly increasing estimate of the cost of his section of the work. On the day of bid submission his tender showed a figure around £50m and had a consortium of the UK and the overseas contractors sharing his part of the tender. Fig.1.1 shows how these estimates changed during the tender period.

In view of the uncertainty surrounding the likely cost of his section of the work, the corporate management had to reconsider its decision and at one stage, came very close to abandoning the tender work. All these decisions were taken under severe time constraint.

Ultimately the bid was unsuccessful. While the tender work for the above project was in progress and the outcome in suspense, the contractor was not prepared to commit his resources anywhere else. Thus, he had to bear not only the direct cost of tendering but also the cost of lost opportunities.

When dealing with extremely complex tasks, a person can, without being aware of it, reach the limit of his information processing ability. But because of a persevering aptitude this limit often gets ignored. This introduces uncertainty which is known to be a contributory factor in creating an environment which can cause occupational stress. Experts argue that under such a stressful situation, the normal decision time is reduced affecting the quality of decisions taken under such conditions.

A pilot study (aimed at a small tendering team) has confirmed that complexity, uncertainty and time constraint are major causes of occupational stress in tendering. This study examined the complexities of pre-selected tendering tasks, reviewed the current literature on uncertainty and drew attention to undesirable effects of severe time constraint in complex decision situations.

Stress raisers indicated by the above pilot work have been dealt with by the decision analysisists in considering subjective judgement in decisions. The linking in this study of these stress raisers with various stress factors identified in the stress literature, has helped to integrate the observations in both, decision analysis and stress literature. As the literature on occupational stress is rather scarce, this integration provides not only an up to date review of this subject matter but also the basis for further research

The study has also discussed decomposing as a means of reducing complexity and given practical applications of the decomposing procedure. It has shown that the procedure has a potential for use in tendering situations. The computerised rating charts for selecting suitable projects to bid have resulted from the application of the above procedure.

Tendering for large scale overseas projects is an expensive business. Like project management, tender management therefore becomes one of the important aspects of a contractor's total business activities. The study emphasised this point by suggesting the role for a Tender Support Services Manager.

The application of systems analysis to the tendering process has resulted in a number of measures, monitors and controls to improve the effectiveness of tendering resources. (See Fig.1.2)

A more conventional approach for a study at this level is to analyse critically the available literature and the past research work on the subject thereby establishing a need for further work. Unfortunately, because of commercial reasons, very little literature or research data is available in published form on the subject matter of this study. It therefore makes a direct approach by first discussing the problems associated with tendering for large scale overseas project. The appropriate academic literature is reviewed under the chapters concerned. Fig.1.3 shows a cross section of the study. Because of the confidential nature of this work, the majority of the information used in this ... interviews with an understanding that the

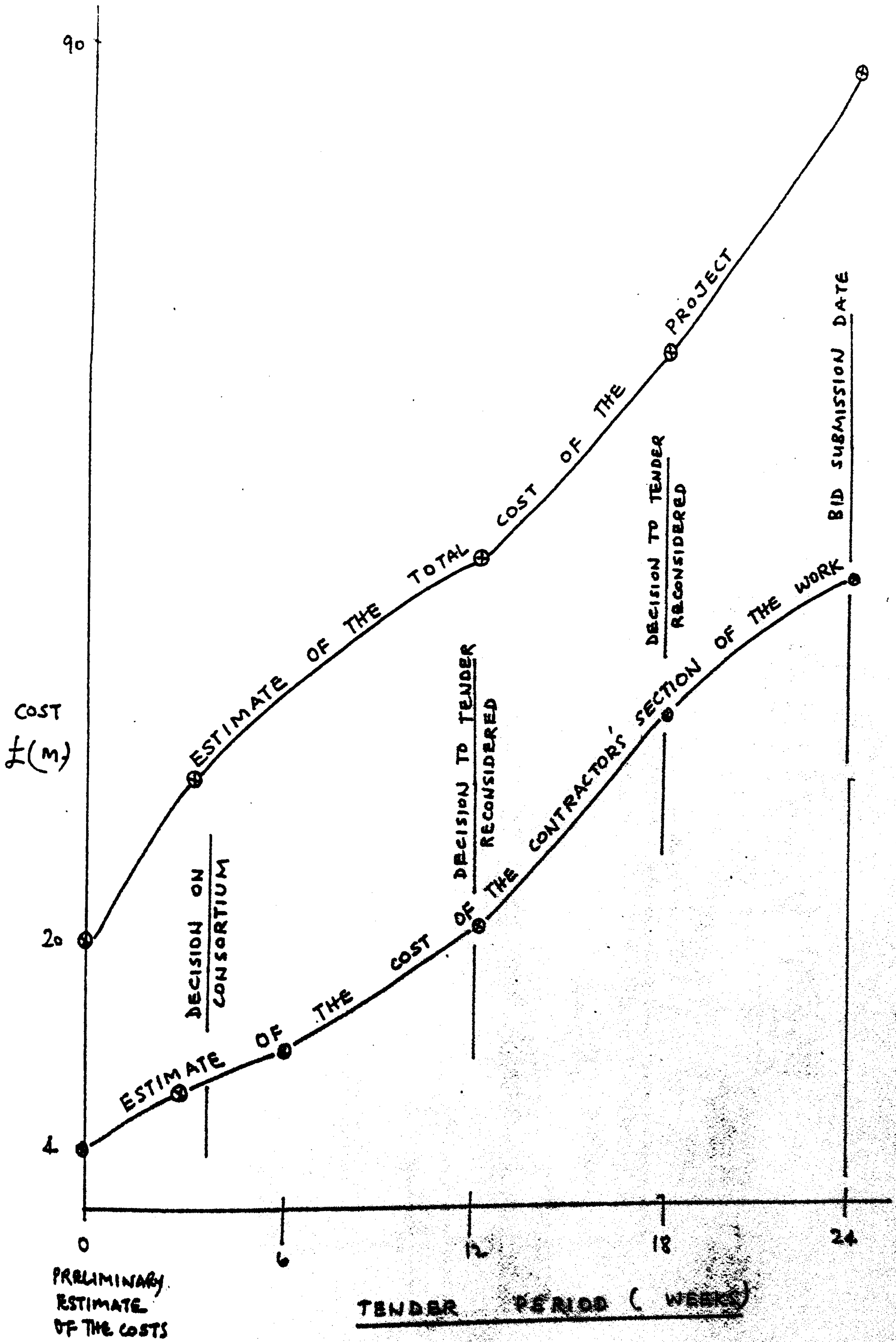
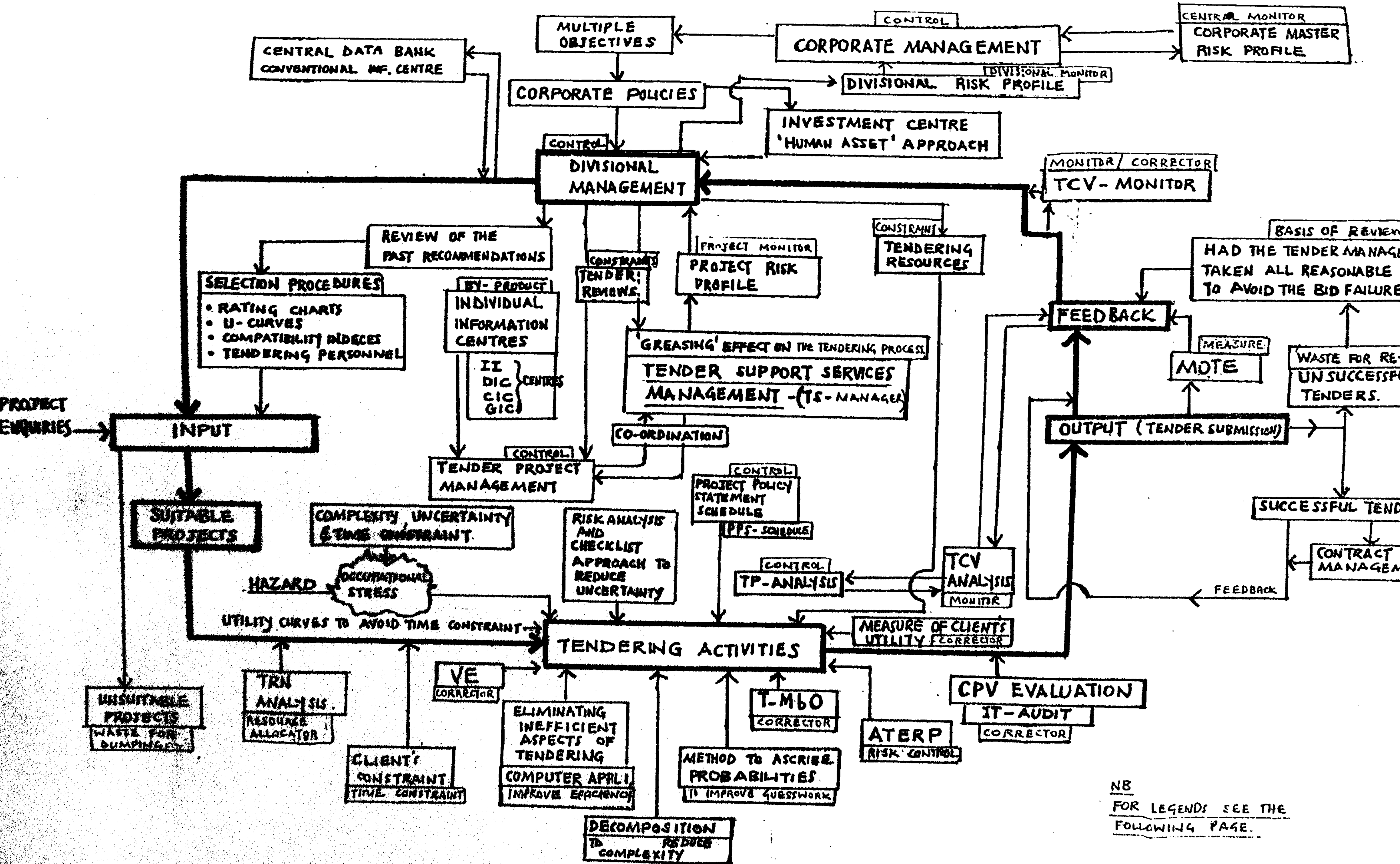


FIG 1.1 : ESTIMATES OF THE COSTS (TOTAL AND

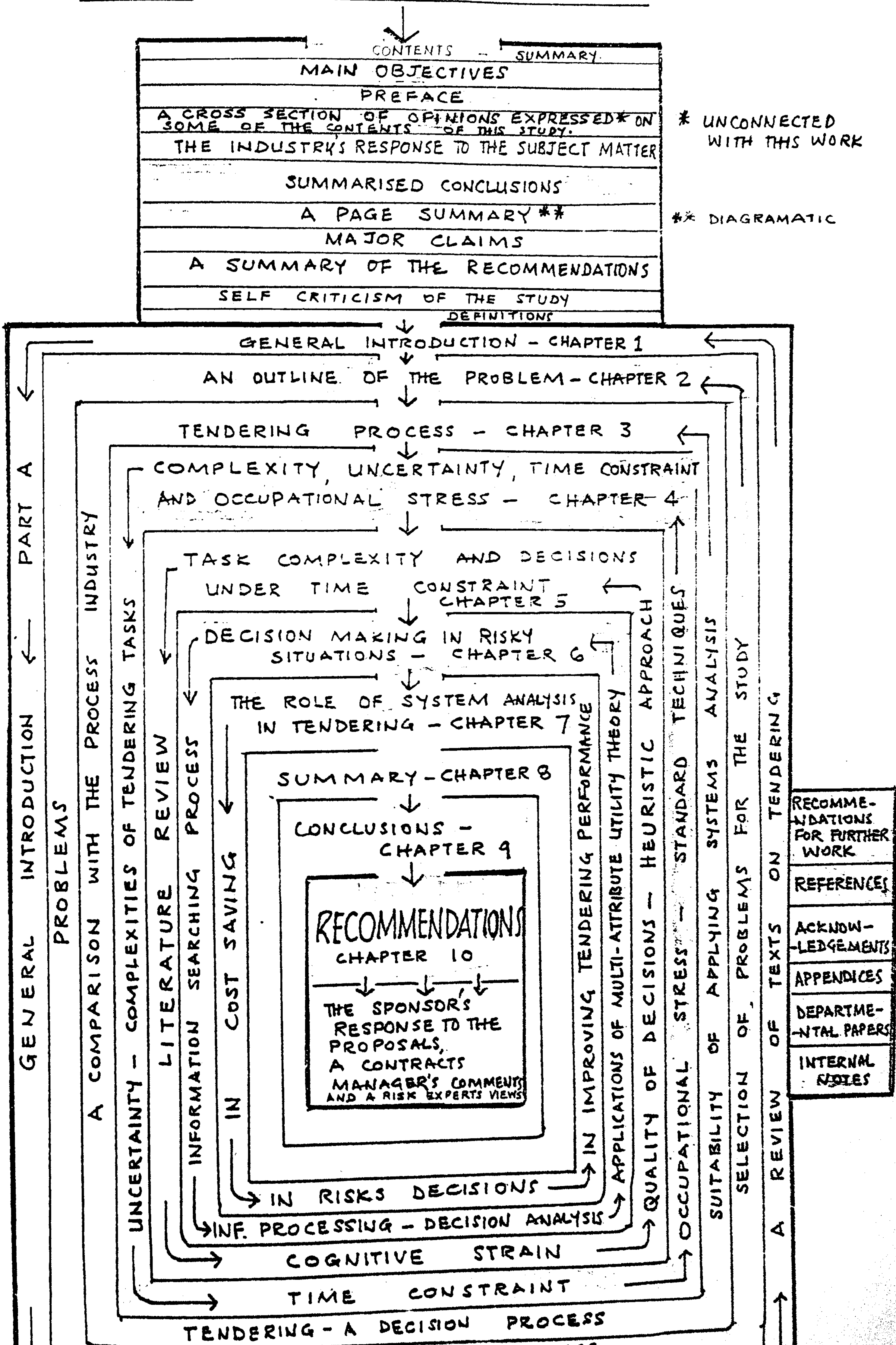


NB
FOR LEGENDS SEE THE FOLLOWING PAGE.

FIG 1.2: MEASURES TO IMPROVE TENDERING EFFECTIVENESS

LEGENDS

HA	-	APPROACH (7.4.2) Human assets approach
II	-	CENTRES (7.4.12) Individual information centres
DIC	-	CENTRES (7.4.12) Divisional information co-ordinating centres
CIC	-	CENTRES (7.4.12) Company information co-ordinating centres
GIC	-	CENTRE (7.4.12) Group's information co-ordinating centre
CR	-	CHARTS (7.4.5) Computerised rating charts for selection of projects to tender
U	-	CURVES (6.10.3) Utility curves for selection of projects to tender - do - when in desperate need to obtain new work.
TS	-	MANAGEMENT (7.4.16) Tender support management
PPS	-	SCHEDULE (7.4.10) Project policy statements schedule
TP	-	ANALYSIS (7.4.3) Tender performance analysis
TCV	-	ANALYSIS (7.4.3) Tender cost variance analysis
VE	-	(7.4.1) Value engineering
T	-	MbO (7.4.9) Tender management by objectives
CPV	-	EVALUATION (7.4.14) Client's point of view evaluation
IT	-	AUDIT (7.4.14) Internal tender audit
MoTE	-	(7.4.15) Measure of tendering effectiveness
TRN	-	ANALYSIS (7.4.13) Tender response needs analysis with 'requirement' and 'attention' values.
'ATERP'	-	RISK CONTROLLING ACTIONS (6.6.2) Avoid, Transfer, Eliminate, Retain and Prevent
TSM	-	(7.4.16) Tender support manager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CHAPTER 1

PART B

A REVIEW OF TEXTS ON TENDERING

CHAPTER 1

PART B

A REVIEW OF NORMALLY AVAILABLE TEXTS ON CRUCIAL ASPECTS OF TENDERING

1.0 Risk and uncertainty

Pilcher (1973) has treated such aspects as risk and uncertainty of a project under economic analysis. His appraisal of projects is based on a classic approach i.e. payback, rate of return, depreciation, present value, project yield and inflation. The majority of contractors pursue projects on a positive cash flow basis hence a different approach to risk is required.

Wood (1971) deals with one aspect of risk (i.e. claims) in contracting. But his arguments are based on the practices in the home market and do not cover the eventualities in overseas countries.

Stone's (1967) project evaluation approach is more suitable to clients than contractors. He refers to the standard investment decision techniques such as cost-in-use, cost effectiveness analysis, discounted cash flow, cost-benefit analysis, etc.

Wallace (1970) treats liabilites, of architects, engineers and surveyors but excludes contractors' liabilities.

2.0 Competitive bidding

Harris and McCaffer's (1977) treatment of competitiveness is based on one aspect i.e. bidding strategy. Although the authors provide a brief review of literature on bidding strategy, their own approach is suitable for the contractors working in the property development

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Nagarajan (1976) suggests standarization in building is one way of reducing costs. Although the author's approach is suitable in building works, overseas projects, especially, in the heavy civil engineering fie tend to be 'one-off' jobs.

Douglas & Munger (1969) deal with bidding procedures in the USA. There is no reference to problems of bidding for the projects in overseas countries.

Clough (1969) under the chapter 'Estimating and Bidding', although deals with various aspects of bidding i.e. lump sum and unit estimates, decision to bid, qualifications, costs of sub-contract bids, allowances, overheads, construction time, insurance, mark-up, bonds etc, these relate to home contracts in the U.S.A.

Willis & Willis (1972) disucss tenders from clients side i.e. opening of tenders and subsequent activities.

Rubey & Milner (1971) list a few actions which they suggest should be helpful in securing preferred status as a bidder. They are as follows:

i. Having special equipment, trained personnel and company experience in a particular kind of work.

ii. Maintaining helpful connections.

iii. Giving extra service 'beyond the call of duty'

iv. Sustaining general helpfulness and co-operation among the contractors organisation from top to bottom.

2.0 Competitive bidding (Continued)

v. Performing speedy constuction.

vi. offering complete service

vii. Bidding many jobs

viii. Having standard professional estimating, then taking decisions regarding special circumstances and in line with the business policy.

ix. Establishment of tighter cost control.

Twort (1972) deals very briefly with some aspects of tendering e.g. contractor's site organisation. His work is however directed towards supervision and management of civil contracts from a consulting engineer's point of view.

Stone (1968) discusses the forms of construction, the methods of production and organisational techneques employed in the industry. Under the section 'Competitive Tenders', the author gives the following reasons for different tender prices from different contractors.

i) becuase of differences in efficiency and therefore in costs.

ii) becuase some firms will be more anxious for the contract than others.

iii) becuase some firms will have achieved a better understanding of the technical nature of the job than others.

iv) becuase some firms aim at lower standards of work than others.

v) becuase some firms have found ways of ensuring a high final settlement price, even on a low tender price.

2.0 Competitive bidding (Continued)

Although the above reasons are fine, the list excludes some of the important reasons for difference in a tender price in international competition.

i) the assistance at the government level.

ii) use of surplus currency in the developing country for buying goods or services in subsequent contracts.

iii) a long term approach in pricing tenders e.g. future opportunities in the host country.

iv) to gain experience and international reputation.

v) to gain foreign currency.

vi) to use surplus labour resources at home and to build home economy.

3.0 Tendering decisions

Laing (1976) highlights the critical nature of tender decisions by pointing out that of all the activities within a construction company it is the procedure for preparing and submitting tender which places greatest responsibility on those concerned. Decisions taken at this stage are of the utmost importance. He suggests that the process of decision making in tendering is intangible but the result of decision making in case of our offer is virtually irretrievable.

The author, by referring only to the decisions in tenders for projects at home, does not draw sufficent attention to the extreme seriousness of some of the tendering decisions in large scale overseas turnkey projects.

4.0 Estimating

Hackney (1965), although providing efficient methods of estimating, mostly covers the chemical engineering field. Understandably, (because of the trend of projects after 1970) it lacks the general approach needed to estimate the cost of a leading contractors work in a joint venture or consortium situation for a turnkey project.

Wood (1970) Wainwright (1967) and Geddes (1971) all deal with estimating such items as concrete work, brick work, joinery, masonary, e which in the majority of overseas turnkey projects, come under the activities of a local contractor.

I.O.B. Code of Estimating Practice (1973) assumes that all the tenders have detailed Bill of Quantities. This is not the case in turnkey projects.

Laing (1976) also excludes many aspects of estimating usually associated with overseas turnkey projects.

5.0 Sub-Contracts

Dand and Farmer (1970) have dealt in some detail with the aspect of sub-contracts in a tender. They point out that

> " 2 per cent saving in purchasing means 50 per cent improvement in profits'.

Referring to the assessment of sub-contract performance, authors recommend a rating approach to assist in selecting sub-contractors.

8.0 Negotiations

Dand & Farmer (1970) deal with techniques of negotiations. They highlight the following main points to watch for in any negotiations.

- what we wish to achieve.
- what we believe the other party requires.
- what we are prepared to concede.

March (1970) deals with the ways of negotiating best possible terms for a contract.

9.0 Conclusions

The above review suggests that the aspects of tendering in classic texts is rather scantily treated. As far as classic texts are concerned, there is very little that has been said about bidding for turnkey projects. Much of the search for information has to be pursued in publications well outside purview of the academic literature. The most fruitful source has been personal interviews with contracting staff.

CHAPTER 2

OUTLINE OF THE PROBLEMS

CHAPTER 2

OUTLINE OF THE PROBLEMS FACED BY BRITISH CONTRACTORS PURSUING LARGE SCALE OVERSEAS TURNKEY PROJECTS

2.1 Introduction

There have been some specific attempts at the national level to examine problems faced by British contractors seeking large scale overseas turnkey projects. As expected, these have resulted in examination of problems only at the national level.

An attempt has been made in this chapter to identify the sources of various problems at both levels, i.e. the national level and the contractors' organisation level. The sources of such problems lie within and outside contractors' organisation level. External sources include the British Governmental policies, fierce competition, clients' actions, etc. Internal sources cover risks, inter-divisional conflict, occupational stress, profit consciousness, bonds, tendering costs, temporary tasks, etc.

This approach should enable some of the future studies to be directed towards interface difficulties.
The chapter also indicates the gaps observed in various attempts to solve these problems.

2.2 The contruction industry, the 'stop/go' policy, and the overseas market

2.2.1 The construction industry at home

Hill (1978) describes the British construction industry as follows:-

"It is the nation's largest single industry, embracing the professions, the construction companies, the many specialist sub-contractors, suppliers and material manufacturers. In total it provides an employment capacity for almost 2.5 million people or some 12 per cent of the country's work force. Its size and complexity can be appreciated by the fact that the combined public and private sectors are responsible for half the nation's total capital expenditure."

2.2.2 The 'stop/go' policy

In 1952, the industry had to meet the social needs of a post war boom which created high demands on the industry. Since then, the industry has experienced high and low peaks through governmental stop/go policy which have been superimposed upon the effects of the business cycles. Hillebrandt (1974) argues that the successive British government's policy to use the UK construction industry as an economic regulator has caused significant problems for British contractors.

2.2.3 Fluctuations in demand

Hill (1978) points out that a severe recession at home is likely to reduce the resources of the industry and influence its capacity to meet future demands. Prabhu (1976) summarises the reasons for fluctuations in demand for construction work and their likely effects. (See Appendix A2.1).

2.2.4 Overseas construction

Overseas construction brings a substantial sum annually to aid the balance of payment. In 1970-71, the figure was £311 million. This figure rose to £1,500 million in 1976-77.

The previous British Government (1974-79) suggested that much of the success of its economic policy relied largely on the lead given by exports. The Government was concerned over the decline in the UK share of the world trade (See Table 2.2.4.1.) and was of the opinion that one way of increasing the share of world trade (manufactured goods) is through large scale overseas turnkey contracts. With the previous (1974-79) and the present (1979) Government's policy of cuts in public spending there is a significant drop in home demand. (See Table 2.2.4.2) Large British contractors are therefore left with little choice but to continue seeking work overseas for their growth and in some cases for survival.

2.3 Traditional exports and recent opportunities.

Traditionally British contractors assisted in the promotion of exports to the colonies by building the basic infrastructures of roads, railways, ports, power stations etc. Even after the colonies achieved their independence, British contractors had access without serious competition to these territories during the period of nation-building. Hence, British contractors with their overseas experience were well placed towards any expansion in the international market.

2.3 Traditional exports and recent opportunities (Continued)

With the emergence of international lending agencies, e.g. World Bank (International Bank of Reconstruction and Development, IBRD), contractors from all member countries secured equal opportunities for the Bank - sponsored projects, thus introducing competition, at times severe, in the territories where British contractors historically had an advantage or a connection.

In other areas, mainly as a result of surplus revenue from the rise in oil prices in the early part of seventies,the size of some of the overseas projects (See Table 2.3.1)markedly exceeded the normal limits of a large project. A new terminology - jumbo projects - came into existence to distinguish these projects from other normal sized projects.

The enormous size of such projects attracted contractors from all parts of the World creating fierce competion.

Chart 2.3.1 highlights major changes in the type of exports prior to large-scale turnkey projects and the exports associated with such projects.

2.4 Unique problems

These projects, because of their extremely high value, sophisticated technology, complex contractual arrangements and massive contingent liabilities and risks, create extreme (possibly unique) problems for contractors.

2.4 Unique problems (Continued)

Furthermore, such projects require co-operation of a number of groups which are themselves interdisciplinary. There are both technical 'interface' and contractual problems and they consume contractors scarce and valuable resources. Some of these problems and their likely consequences are listed in Table 2.4.1.

2.5 Independant sources of project finance

Many Arab nations e.g. Saudi Arabia, Kuwait, have established their own independant financial sources for the benefit of poorer nations. The problems with such financing is that there are often 'strings' attached to a loan or an aid and there is a bias towards contractors from Islamic countries.

Other opportunities created by co-operation at government levels show bias towards the manufacturers and contractors from Lender countries. for example, the French government provided the finance ($200m) for the state fertilizer plant in Aquaba, Jordan. As a result, French Manufacturers and contractors secured most of the contracts associated with the project.

2.6 Ambitious plans for economic growth

The majority of Middle Eastern countries, influenced by the hyper-inflationary wave (See Table 2.6.1) in early seventies, embarked on ambitious plans for economic growth. Davis (1975) distinguishes growth and economic growth as follows:

Growth: Complete restructuring of an economy

Economic Growths: A growth which proceeds along a fairly clearly defined path.

2.6 Ambitious plans for economic growth (Continued)

Saudi Arabia allocated over $140 billion for the 1976-80 five year plan. This type of acceleration has its own problems. Contractors are sometimes asked to carry out more than they can reasonably expect to achieve. (For example, the official average rate of expenditure per week at Costain-Taywood JV for Dubai dry dock contract was approximately £2 million.) As a result, many of these countries found it difficult to spend all the funds within the allocated period. Under these circumstances, some contractors were made scapegoats of the authorities over-ambitious planning where the actual expenditure could not be matched with the planned expenditure.

Furthermore, such a rate of expenditure for a project increases the ratio:

$$\frac{\text{Annual project expenditure}}{\text{Contractor's total assets}}$$

to such an extent as to create an extremely high level of risk which in the majority of cases, is found unacceptable.

2.7 Fierce competition

Often contracts are awarded on the lowest bid basis which encourages 'cut-throat' bids. Main reasons for such rock bottom prices are to earn foreign currency, gain experience and reputation, develop expertise, seize opportunities to develop internal economy, etc. Although, the level of state support plays a prominent part in the final tender price, contractors have no way of knowing their competitors national strategies.

2.7 Fierce competition (Continued)

Table 2.7.1 shows the general decline of growth rates of real exports by industrialised countries, a reason for fierce competition for large seale turnkey type projects.

Table 2.7.2 highlights some of the factors likely to affect a bid.

2.8 Inflation and fixed price contracts

Because of inordinate rates of inflation both, at home and abroad, a fixed priced contract has become one of the major problems in overseas tendering.

It creates uncertainty in estimating project costs and cash flow calculations. Although, the dramatic increase in oil prices is the more obvious source of inflation, there are other factors (see chart 2.8.1.) which can contribute significently to this undesirable situation. Chart 2.8.1. illustrates some of the major influences at work, which collectively explains why many foreign contractors are being forced to submit apparantly inflationary tender prices for fixed price contracts. There are however recent cases where clients have signed contracts with a cost price adjustment clause.

A Western contractor involved in bidding for the above Saudi Power Project suggested that his price was based on a great number of unknown factors and most importantly, inflation in the host country (no official figure was available but reliable estimates suggested between 30-35 per cent per annum). When these tenders were compared with rock-bottom prices from contractors from such countries as Korea and Taiwan, they appeared inflationary.

When contractors experience non-payments, delays in payments, etc, it reflects when bidding for other jobs in the territory and thus becomes a source (often unknown) of inflation.

In a tender co-ordinating meeting for a large scale overseas project, some of the questions raised by the contractor's estimator are listed below.

2.8 Inflation and fixed price contracts (Continued)

> How much will a telephone cost? How long will it take to get one? And therefore, how much should be allowed for communicating by way of messenger or other means? How much will electricity and water connection cost? How much will tanked water cost, particularly at times of shortage? What size standby generator is needed? What is the cost of breakdown e.g. during a critical concrete pour? How much is allowed for sewage and waste disposal? How much sould be allow for transporting operatives to and from site?

Uncertainty is created because of imperfect, incomplete or in some cases absense of information which leads to contingency pricing. Chart 2.8.1. illustrates this point.

The duration of a contract can have significant influence on many factors in tendering. Chart 2.8.2 lists some of these factors.

2.9 High standards

Because of the home market requirements, British contractors are used to high standards in design and safety. In turnkey type projects in developing countries, these standards can prove more than required. The following examples illustrate this point.

Example 1

Acceptable standards of installing overhead cables in undeveloped and semi-developed countries are different to the CEGB standards in this country.

Example 2

A British architect appointed by a British contractor to design (preliminary) a project in a developing country, specified items of Western standards for a permanent village (a part of the project).

The above examples illustrate how they can adversely affect contractors prices.

2.10 Risks

2.10.1 Client's requirements

Generally, the client, who opts for a turnkey type contract, has three basic requirements and through these he hopes to pass on project responsibilities and liabilities to the contractor. The requirements are that the contract is executed:

2.10.1 Client's requirements (Continued)

(a) on time

(b) to his specification and

(c) to a minimum and within his estimated cost

2.10.2 Critical stage

The tendering stage (including negotiations) of a turnkey project is therefore critical for both, the client and the contractor.

For the client, to ensure that the responsibilities and the liabilities are properly passed on to the contractor.

For the contractor, to try and seek reduction in the likely risks, by single or combination of the following actions.

(a) By direct negotiations with the client.

(b) By a joint venture/consortium

(c) By letting sub-contracts.

(d) By insuring

(e) By providing a contingency, etc.

2.10.3 Clients tasks

In order to safeguard his interest the client has many tasks to perform during tendering and negotiating stages. Table 2.10.3.1 lists some of these.

2.10.4 Contractors tasks

2.10.4.1 Joint and several liabilities

A contractors task of reducing risk on the other hand, becomes immensely complex as a consequence of the clients actions. Fig. 2.10.4.1.1 shows contractors flow of funds and some of the itmes at risk as a result of a political action.

Generally, contractors form joint ventures or consortia but, as highlighted by the Overseas Project Group's Report (1975) (See Appendix A2.2), the problem lies in finding a satisfactory solution to joint and several liabilities. This requirement is often more than an individual member of a joint venture or a consortium can accept. The following example illustrates this point.

In a recent case, an European capital plant manufacturer was a JV partner with a British contractor.
The prospective partners were identified after the press invitation to submit pre-qualification documents. It was possible for these two partners to have spent a considerable proportion of pre-tender period in trying to find an acceptable basis for sharing the risks of joint and several liabilities. On the other hand, the Japanese contractor had all the advantages of being a part of a large corporation consisting of interdisciplinary groups.

2.10.4.2 Unquantifiable risks and contingency

In large turnkey projects, various contingencies that are generally considered necessary to cover unquantifiable risks e.g. unforeseen ground conditions, can amount to a substantial sum. If a contractor tries to cover against all such risks, he stands a chance of losing the contract. He has the task of diversifying these risks and to decide the total amount of contingency. In addition to other requiremen such a decision requies a good knowledge of sub-contractors' (or suppliers') pricing procedures.

2.10.4.3 Complaints Reserve and Development Reserve

Many plant manufacturers make undisclosed provisions for items such as "Complaints Reserve" and "Development Reserve" in their estimates which are generally separate from any contingency they may decide to include in their offers. Thus, a civil contractor in a JV partnership with a plant manufacturer, may get a wrong impression of a low contingency disclosed by his JV partner.

It has been argued that British firms are losing out on many overseas contracts because of their ad-hoc methods of contingency pricing (Dawson 1977).

2.10.4.4 Engineer Constructor's Role and Inadequate Return).

Engineer Constructor's role

There are some contractors who can offer a comprehensive management service including design, engineering, procurement services, site supervision, financial control, commissioning and operator training.

2.10.4.4 Engineer Constructor's role (Continued)

They offer these project management services under the role of Engineer Constructor.

The philosophy of an Engineer Constructor leading a joint venture is not readily acceptable and usually misunderstood by the manufacturing industry. Even with a high plant content, it is argued that a competent project management is a critical part of the whole concept of turnkey projects. An Engineer Constructor with a proven record is therefore better equipped for the job.
In practice however, the above misunderstanding causes immense delays in setting up joint ventures.

Inadequate return

Engineer Constructors generally sublet to specialists, portions of their total work which are outside their normal activities. The role therefore exposes them to the risks which are disproportionate to the value of the work for which they are directly responsible and their returns on such projects. This is illustrated by the following example.

The value of an Engineer Constructor's work in a typical 2000 MW thermal fuel power station is usually around one-third of the total value of the project. Table 2.10.4.4.1 shows the breakdown under the main headings.

The Engineer Constructor, in adopting the role of Principal, will therefore be required to expose himself to risks which are not only associated with the scope of his work but also with the rest of the work.

2.10.4.4 Engineer Constructor's role (Continued)

However, one can argue that in practice such risks are passed down the line by various 'back to back' agreements. Nevertheless, one cannot ignore the fact that the Engineer Constructor, in his role as the Main Contractor, is the source of last resort. But on the competitive note, he is expected to limit his return within his 'physical' share of the contract.

2.11 Conditions of Contract

The majority of overseas projects are based on the Federation Internationale des Ingenieurs - Conseils (FIDIC) Conditions of Contract. These conditions have been described by an Expert as "notorious for the obscurity and difficulty of their prolix and often near-archaic language and also for containing many pseudo-legal expressions which have no clear or relevant meaning".

Furthermore, the standard conditions are more often than not amended to remove those clauses most advantageous to the contractor and to insert new clauses which suit the interests and convenience of the client. This 'adulteration' of conditions poses many problems to contractors.

2.12 Consultants' and contractors' cost estimating procedures

The procedure used by consultants to estimate project costs is based on their assessment of historical unit prices and is commonly known as 'factored' estimating. (See Appendix A2.3).
For turnkey projects, Bills of Quantities are seldom included in the tender documents.

2.12 Consultants' and contractors' cost estimating procedures (Continued)

In absence of any such quantities, contractors have to prepare their cost estimates by developing unit prices through taking into consideration each and every activity they have to undertake to execute a project. These unit prices are used against their own activity schedule by simulating the construction process. This operational method requires major operations to be indentified, construction methods to be selected and an operational network to be produced isolating each and every activity in the network for costing purposes. Contractors' indirect costs are estimated separately and all intangible factors are analysed and taken into consideration in arriving at the total cost estimate.

Hence, there are fundanmental differences in two methods of estimating (1) consutlant's factored estimate (2) contractor's operation-based estimate. It is therefore extremely unlikely that these two methods of estimating will give a like result. It is ironic however that contractors, more often than not, get blamed for submitting higher bids where in practice they estimate the cost on factual information.

2.13 Sub-contract prices

Prime contractors in JV or consortium situations use specialists as sub-contractors (and or suppliers). The responsibilities and the liabilities associated with the scope of such sub-contracts are usually passed down the line through 'back-to-back' contractual arrangements.

2.13 Sub-contract prices (Continued)

When a large number of sub-contracts are involved the task of ensuring that all the bids fully comply with the need of the main contract is immensely complex. It often occupies considerable resources of an intended main contractor. His cash flow depends upon the Terms of Payment he has agreed with his sub-contractors. Some of the problems main contractors face are as follows:

- Delays in submission of sub-contract bids
- Omissions, arithmetical errors
- Deviations from the conditions of main contract especially terms of payment e.g. down payment, payment due dates, etc.
- Deviations from the specification issued
- A lack of feedback for the conceptual design to proceed
- Change in the financial status or the top management during sub-contract tendering
- Late in submitting cash flows.

2.14 Inter-divisional conflict

It is not uncommon for contracting groups to operate on a profit centres basis. Under this situation, when a division is given the responsibility to lead tenders submitted on behalf of the Group, ROI as a measure of divisional performance is often a main cause of political conflict between the divisions.

Some of the other reasons are:

- a lack of firm directives from the corporate level
- a lack of incentive to tender on behalf of the Group

2.14 Inter-divisional conflict (Contd..)

- clash of personalities
- too much power given to the leading division
- a difference of opinion on sharing the risks
- a lack of experience of working together for a common interest
- divisional policies inflexible to meet the common need.

This overall lack of inter-divisional harmony sometimes results in undisclosed contingencies, ad-hoc pricing, non-cooperation, etc. affecting the Group's tender performance.

2.15 Unsuitable projects

Figures obtained by this study for the number of project enquiries handled and the number of tenders submitted by a contractor showed that an excessively large proportion of prospective business enquiries did not reach the tendering status.
In developing countries, usually there are plenty of schemes with potential for construction projects. But, many of these if scrutinized from the point of view of sequential development of a new or a relatively new country, have no prospects of immediate viabilities. Commitment of resources without such a detailed scrutiny invariably results in loss on two fronts - a direct cost of pursuing such projects and an indirect cost of lost opportunities. In other cases, projects may be unsuitable from several points of view, i.e. inhouse experience, required rate of expenditure, etc. Sometimes a 'pet' project gets through the contractor's initial screening procedure.
An argument against such a detailed scrutiny is that it consumes time and resources. In addition there is a lack of efficient methods of identifying suitable projects to bid.

2.16 Tendering costs

Bidding for large-scale projects has cost well over £100,000 (each project). If a contractor has a leading role to play in a joint venture situation, his share of the cost can be extremely high in proportion to other partners. Although there are some ways in which part of the tendering cost could be recovered, nevertheless, it is a major factor influencing contractors' fixed overheads.

Turnkey projects require the engineering design to be carried out in sufficient detail to ensure a competitive bid. The cost of such pre-bid design is, more often than not, a major portion of the total tendering cost. It can only be justified if the prime cost of the project could be markedly reduced. Unlike project cost, which is subjected to a number of critical reviews during construction, tendering costs lack similar attention i.e. budgets for individual tenders followed by periodic reviews to control such costs. The tendency is to regard the cost of tendering as something that is unavoidable and to accept high tendering costs as a necessary part of seeking overseas projects. The activities associated with budgeting for and controlling such costs are generally not given sufficient importance.

2.17 Value engineering

No degree of accuracy in estimating can provide the desired results if basic engineering design, resource allocation and planning are uneconomical in their results.

2.17 Value engineering (Continued)

Some times contractors use outside expertise to improve their chances of success. The following example illustrates this point.

The consortium of Davy Powergas, ICI and Klockner (W. Germany) were negotiating with a Russian client for a year but at the end, had to rely on the ingenuity of Morgan Grenfell (City Merchant Bankers) to conclude the deal. The contract for construction of two methanol plants (worth £147 million) was won by a narrow margin (under 5 percent) because, the bankers pioneered a scheme by which the Davy Consortium was able to switch to US dollars and thereby reduce the price it was quoting by as much as 6 percent.

The above example illustrates the importance of keeping the cost to the customer down to an absolute minimum without which, the above bankers would have had no scope to manoeuvre. But because of time constraint, contractors in general are not in a position to apply such techniques as value engineering (VE) (identifying unnecessary costs during the design phase i.e. reducing the prime cost of a project without reducing its value to the client) to improve their bids.

Peltier (1978) highlights the importance of VE in project cost saving (see Table 2.17.1). He has referred to VE in relation to productivity in the construction industry. In suggesting the means of improving productivity in construction (See Table 2.17.2), he indicates that clients should tell what they want to be built and not how it should be built.

2.18 Client's needs

Overton (1977) highlights an uncompetitive element - a 'self-satisfaction' approach - in British engineering designs. He points out that some engineers will pander to technological self-satisfaction rather than the needs of the job. Fig 2.18.1 illustrates this point. The functional need of a Middle Eastern client was for an assembly plant 'housing' but a British contractor's response was that for a factory building of a Western standard.

Individual members of trade missions visiting clients countries have their own interests and priorities. When some of these members bid in a joint venture, the tendency is to try and sell one's own product irespective of the client's need. Trying to sell stand-by generators through a power generation scheme in a rural area in an undeveloped country is just one example. Breakdowns and occassional blackouts are tolerable and perfectly acceptable inconvenience in some parts of the world. The clients from such countries would rather settle for this than higher initial investment in stand-by-generators.

An excellent example of responding to the clients need was when a British contractor submitted a bid for a wood burning power station in a developing country with surplus of manpower. The contractor had a choice of boilers i.e. either to provide sophisticated automatic or manual feed boilers. The contractor submitted his bid based on manual feed and had a favourable response from the client. This should be contested with the tendency for clients to call for the most up-to-date equipment.

2.18 Client's needs (Continued)

It has been suggested that one of the reasons for being on top of the 'bid ladder' (the list of priced tenders after opening) is when a contractor makes provisions in his tender for what he thinks client should have rather than what the clients actual requirements or needsare. Sometimes there is a lack of structured response to clients requirements.

2.19 Client/contractor interaction

Thomas (1977) suggests that most training in salesmanship in the UK still assumes that sales arise from a two person, salesman/buyer interaction, whereas the reality is that teams from buying and selling organisations interact to produce sales with all the political problems this raises. Governments of the two nations are often involved and Thomas therefore points out that training in 'salesmanship' needs to to focus on how to manage the complex international/political problems.

He also claims that there is, in general, limited understanding by British sales executives of sophisticated investment appraisal techniques used by some customers either through inhouse expertise or by hiring the necessary expertise.

According to Overton, too many British organisations concentrate on offering exclusively technological solutions to customer problems. Thomas points out the current research which shows the importance of the after sales service. In turnkey contracts, it could mean supply of spare parts, training, up dating plants, operating a plant on behalf of the client, etc. But to price such items under a

2.19 <u>Client/contractor interaction</u> (Continued)

competitive and or a fixed price contract situation is an extremly difficult task especially when the period of such 'after sales service' extends upto 5 years or even more.

<u>Thomas</u> implies that British contractors, in general, "lack effective management of the politics of clients' organisations". This brand of management requires a careful study of the methods used by clients for their search for 'suppliers' and an understanding of how, in general, the buyer sector in a particular country behaves and whether there is a deviation from this general pattern for a particular project.

He argues that there is a lack of commercial training of British professional engineers before taking management posts.

<u>Dingle</u> (1977) in disregarding the above training aspect provides a different view on the problem of a lack, in general, by British contractors in understanding their clients. He argues that "it is mostly due to the British contractors' typical approach for research into the potential of new market areas which is too closely identified with analysis of supply-demand balances and not concerned enough with evaluating commercial (including political) practice in such areas".

This approach could also assist a contractor to improve his chance by reviewing his bid from the client's point of view. But often in practice, the time available during the final stages of the bid submission leaves little scope for the contractor to deviate from the routine self-interest bid review.

2.20 Profit consciousness

T. Wyatt, Group Chief executive of Costain, says that "UK contractors are more profit conscious".

A common practice for contractors is to establish the prime cost of a project and the contingencies and add a contribution to make up the tender price. A substantial effort usually goes into estimating the project cost and with the help of such techniques as risk analysis, a contingency figure is arrived at. But according to a British contractor, the issue of the amount of contribution very seldom gets the full treatment' i.e. analysis from a likely competition point of view.

This type of analysis will require such information as:

- number of competitors
- their likely strategies
- likely cut price bidder (s)
- likely political manoeuvres
- competitors past performance in the territory
- existing contracts in the host country
- clients predispositions about the competitors

In practice however, it is difficult to obtain reliable information on these matters in time for the crucial decision i.e. the level of contribution. The tendency is therefore to add an amount based on the corporate policy irrespective of the likely competition.

2.21 Inadequate cover for cost escalation

In some parts of the world e.g. Middle East, international bids are invited on a fixed price basis. The ECGD only covers 70 to 75 percent of the price and the annual inflation in a 10 percent band above 7 percent.

The French Government, by comparison, covers any inflation and not just in a band.

2.22. Bonds

Bonds are less of a problem to countries like the USA which has a more sophisticated performance bonds market based on a surety system and South Korea where the Governments need for foreign exchange means it will underwrite the risk incurred by its contractors overseas. But for UK contractors on-demand performance bond considerations can make a large contract simply impossible. Chart 2.22.1 shows two types of bonds, conditional and unconditional (on-demand type). (See Appendix A2.4 for the operation of different types of bonds).

2.23 Benson Committee

In 1975 the government, having realised the long term implications of decline in export orders, appointed a committee under the chairmanship of Sir Henry Benson, the Governor of the Bank of England, to investigate this problem. Sixteen UK bodies associated with consortia type contracts made their contributions to the Report.

The main proposal of the Benson Committee is summarised as follows:

2.23 Benson Committee (Continued)

> A surety pool should be formed which would provide a main contractor and all the sub-contractors with the bonds necessary for the contract. It would be backed by insurance companies, underwriters, ECGD and banks in an intricate network. This will be a government-backed company "Capital Projects Ltd." or "Great Britain Ltd.", with an initial capital of £20 million to handle all British bids for contracts worth over £50 million.

Julian Radcliffe, of Credit Insurance Association and one of the leading members of the Working Party associated with the Report, subsequently claimed (See Appendix A.2.5) that none of the contributors to the Report was in a position to see the problem as a whole.

Radcliffe pointed out that such a scheme would need a high degree of co-operation from all the parties concerned and in practice they would take their own time. Contractors tendering for large and jumbo projects will not be able to get decisions in sufficient time for their bids.

2.24 British response to the challenge from overseas interdisciplinary corporations

The figures in Table 2.2 4.1 suggest that the British manufacturing industry suffered mainly as a result of Japanese competition.

2.24 British response to the challenge from overseas interdisciplinary corporations (Continued)

Japan, basically through her giant interdisciplinary corporations (See Table 2.24.2), was able to secure a large number of turnkey contracts abroad (See Table 2.3.1.). For example, in 1978, Mitsubishi Group won a £211 million Desalination Plant Project in Saudi Arabia. The Group is led by Mitsubishi Heavy Industries and the others involved are Mitsubishi Electrical, Mitsubishi Machinery and Mitsubishi Corporation.

To counteract this serious threat from such interdisciplinary corporations as Mitsubishi, the British government encouraged the leaders of the home industry to put up its front. In 1976, a committee - Jumbo Project Committee - (later became known as LCC - BEHA jumbo project committee) with representatives from GEC, BICC, GKN, Hill Samuel, Kleinwort Benson, Hawker Siddeley and Standard Chartered Bank was formed. The National Enterprise Board was also given a specific role in the British attempts to seek jumbo projects. Two British bids - a power station in Dubai (£90m) and Venezuelan Railway Project (£1 Bn) - submitted in 1977 with NEB involvement were unsuccessful. The Jumbo Committee subsequently cited these two failures to demonstrate the unsuitability of the NEB for a jumbo contract role. Instead, the Committee was in favour of an amalgamation of the kind which then existed between the British Rail Board, London Transport, Department of Trade and supplier firms - called "Briex".

2.25 Internal bureaucracy and occupational stress

A tender project manager suggested that, at times, tendering resources required to comply with corporate constraints (as regards to tenders) reach such a proportion as to hamper the progress of the bid in hand. These constraints are often referred to as 'red tape' and 'internal bureaucracy' and can be a source of frustration. Nevertheless, they are considered as necessary for the effective control within the organisation.

Basically, a tender project manager has two major objectives to achieve. They are a) to satisfy the requirements of the client and the corporate management and b) to submit a competitive bid. These objectives often conflict with each other.
The gap between the interests of a client and the corporate management is sometimes so wide that an attempt to close it under a time constraint can create uncertainty and can lead to occupational stress thereby affecting the quality of decisions i.e. decisions taken without considering and evaluating all the possible alternatives and not only the known alternatives.

2.26 Japanese approach to decision making

Pascale (1978) suggests that a Japanese manager may be as involved with others in management as his British counterpart but has constructs which allow him to ease his way through the red tape and business jungle.

2.26 Japanese approach to decision making (Continued)

Norfolk (1977) highlights these constructs as follows:

" the traditional Japanese way of life which minimises the harmful effects of competition by maintaining a strict social hierarchy in which everyone knows their place and in which competition is recognised as a group activity rather than a lonely personal struggle ".

Kidd (*) suggests that the Japanese leadership is notional. Peer groups discuss problems and the documented discussions are passed up and down the organisation thereby being accepted in the consciousness of the organisation. He agrees that this process of 'ringi' can be disfunctional in many ways i.e. it is slow, can prevent entrepreneural flair being exercised, nevertheless, he suggests that it provides an excellent opportunity to discuss a problem by general argument. Arai (1971) believes that ringi makes good use of the middle and lower staff's ability and energy especially if the excessive formalism is removed.

2.27 Temporary task and leadership

Preparing a tender is a 'temporary' task because it is of a short duration. Tendering teams are formed for specific tenders and then disbanded to form new teams. The experts argue that there are intrinsic problems associated with such temporary tasks.

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* Ph.D. thesis not yet published.

2.27 Temporary task and leadership (Contd.)

Murphy (1977) states that project teams, staffed with people with specific expertise, are disbanded after their assignments are completed. He suggests that this type of temporary organisation requires a manager who understands the subtle difference between leadership and authority, who has the ability to plan and organise to a definite time table and yet flexible enough to "wing it" when necessary and who can build a team through involvement and by helping members become fully committed to a common objective.

2.28 Tendering process and systems analysis

Although some aspects of tendering, e.g. bidding strategy, risks in joint and several liabilities, etc; have been dealt with by the experts in their respective fields, tendering as a whole has not yet been reviewed as a process.

Furthermore, the tendering process as a whole has not been subjected to systems analysis. Process industries on the other hand, come under a constant scrutiny through systems analysis to improve its efficiency. Many information systems are subjected to similar forms of analysis.

2.29 The present state of response

Table 2.29.1 shows the present state of response to various problem discussed so far. The response can be categorised as follows:

a) Government Sources

Examples: Benson Committee, LCC - BEHA Jumbo Committee, OPG, Road Research Lab.

b) Academic Sources

b.1 Books

Examples: Marshall and Cooper, Hackney, Raiffa and Keeney, Hillebrandt

2.29 The present state of response (Continued)

c) Papers

c.1 Technical

Examples :

Fine, Pim, Hertz, CIA.

c.2 General

Examples :

Nelson, Cliff, Leach and Smart.

d) Conferences, seminars, short courses, etc

Examples :

FIDIC conferences, EGCI [Establishing a J.V. overseas], Silver, Perry (UMIST), Hobson, Marsh

e) Contractor's own sources

Examples :

Internal reports

f) General discussions

Examples :

Wyatt, Thomas

g) Problems not yet examined

Examples :

Selection of suitable projects to bid, delays in risky decisions, occupational stress in tendering personnel, complexities of tendering tasks, uncertainty associated with tendering tasks, etc.

2.30 Selection of problems for this study

This study concentrates on the problems at contractors level (not government level) which have not yet been examined and which can have adverse influence on tendering performance. The four main categories of the approach to deal with the problems are as follows:

a) The tendering process and the application of systems analysis to a contractor's tendering process to indentify its defective elements.

b) Tendering task complexity, decisions under time constraint and occupational stress.

c) Uncertainty and risks in large scale overseas projects.

d) Solutions to pre-selected problems.

2.31 Conclusions

Because of the size of the British home construction industry, it is likely that it will continue to be used as an economic regulator. The overseas market is therefore vital for the industry's growth.

Although the correct strategy at the national level is crucial for the success in the overseas market, nevertheless, the internal problems i.e. at the grassroot level (in the 'engine room' of the industry), if remained unsolved, can adversely affect British attempts to seek overseas orders.

CHAPTER 2

CHARTS, TABLES, ETC.

	USA	France	W. Germany	Italy	UK	Japan
1960	22.8	9.1	18.2	4.8	15.3	6.5
1970	21.3	9.1	19.8	7.1	10.4	8.9
1975	19.2	10.2	20.1	7.3	8.9	11.4
1976	18.8	9.8	20.8	7.2	8.5	12.0
1977	17.3	9.9	20.9	7.7	9.2	12.6
1978	17.0	9.9	20.7	7.9	9.4	12.5

Table 2.2.4.1: Share of World's export of manufactured goods (Excluding export to the USA). Figures in per cent.

Source: International Economic Indicators
US Department of Commerce
December 1979 (P. 34).

TABLE 2.2.4.2

UK Public Sector Construction Output

(£m at 1975 prices)

1973	3136	(+ 1)
1974	2714	(-13)
1975	2511	(- 7)
1976	2489	(- 1)
1977	2376	(- 5)
1978	2283	(- 4)
1979	2180	(- 5)
		Forecast
1980	2125	(- 2)
1981	2125	(NC)

Figures in brackets indicate percentage annual change

Source: Construction forecasts (1979-80-81)
Joint Forecasting Committee of Building and
Civil Engineering

- Nedo (December 1979)

TABLE 2.3.1

SOME RECENT JUMBO CONTRACT AWARDS

Classification	Project	Country	Award Year	Cost	Contractor Nationality
Process & Chemical					
	Sugar Plant	Sudan		US.$475	
	Aluminium Smelter Complex	Dubai	1977	Over £500m	British
	Petro Chemical	Qatar	77	US.$200m	French
	Petro Chemical	Iraq		US.$1.1 bn.	USA/WG.
	Reduction Plant Jubail	S.Arabia		US.$200m	USA/SA
	Cement	Iran	77-78	US.$ 91m	Swiss
	Chemical Plant	Iran	77-78	US.$104m	N.Chemateur
	Natural Gas Project	Abu Dhabi	78	£850m	ADNOC
	Gas Project	Bahrain	78	$ 80m	Japanese
	Water Treatment	S.Arabia	77	£ 70m	British
	Methanol Plants	Russia	77	£147m	British
	Hydrogen Plant	Jordan	77	US.$120m	Rumania
	Fertilizer Plant	Jordan	77	US.$200m	French
	Desalination	Dubai	77	US.$100m	British
	Copper	Iran	77-78	US.$143m	Krupp etc.
	Gas Pipeline	Iran	77-78	US.$255m	Saipem Itchan
	Desalination Plant	Iran	77-78	US.$265m	Japanese
	Lub.Oil Production Plant	Iran	77	£120m	Royal Dutch
	Desalination	Saudi Arabia	78	£211m	Japanese
	Desalination	Saudi Arabia	78	£300m	Japanese
Power Generation					
	Hartha Power Station (4 x 200 MW)	Iraq	77	US.$372m	Japanese
	Electrification complex	S.Arabia	77	£500m	Indian, Pakistani, Taiwan, S.Korea
	Nuclear	Iran	77-78	US.$3 bn.	Creusot-Loire etc.
	Power Plants	Iran	77-78	Over £100m.	Japanese
	Power Station	Iran	77-78	US.$247m	WG
	Power Station & Transmission.	HongKong	79	Over £200m.	British
Heavy Civils					
	Port Damman	S.Arabia	78	£660m	JV (not British
	Industrial Harbour	S.Arabia		US.$1000m	S.Korean
	Seaport	Oman	77	US.$ 85m	W.German
	Mina Jebel Ali	Dubai	77	US.$ 800m	International Consortium incl. British
	Dubai Dry Dock	Dubai	76	£162m	British
	Harbour	Abu Dhabi	77	US.$100m	S.Korean
	Jeddah Port Development (II,III Stages)	S.Arabia	78	£ 70m	Greek
Transport					
	Two Airports	UAE	77	US.$150m	Japanese
	Infrastructural & Energy Development Protocol	Iran	77	US.$6 bn.	French & Iranian
	Kuwait Airbase (Naval)	Kuwait	77	£ 30m	Japanese
	Highway	Iran	77	US.$800m	American/French

TABLE 2.3.1 (Contd.)

Classification	Project	Country	Award Year	Cost	Contractor's Nationality
Agricultural	Irrigation & Reclamation of land	Iraq	77	US.$137m	Pakistan
Townships & Factories	Factories	Iran	77-78	US.$117m	Japanese
	Medical city	Iraq	77	US.$ 90m	American
	Housing Contract	Iran	77	£100m	Finnish
	Housing Project	S.Arabia	78	$ 4 bn.	S.Korean
Pipeline	Gas Pipeline Project	Algeria	78	£154m	Italian
MassTransit	Mass Transit scheme Kaula Lumpar	Malaysia		over £100m	
	Mass Transit scheme Seol	S. Korea		over £200m	
	Hong Kong M.T.	Hong Kong		over £100m	Japanese
	Mass Transit scheme	Singapore		over £100m	
	M.T. Auckland	New Zealand		over £100m	
	Venezuela Underground system	Venezuela		£224m	
	Railway Network	Venezuela		over £1 bn.	
Telecommunication	Telecommunication Project	S.Arabia	78	$600m	S.Korean

CHART 2.3.1

UK EXPORTS

EXPORTS

		EXPORTS PRIOR TO LARGE SCALE TURNKEY PROJECTS	EXPORTS ASSOCIATED WITH TURNKEY PROJECTS INCLUDING SERVICES
1.	Item	Manufactured goods & machinery e.g. cars, lathes, consumer goods etc.	Capital goods e.g. large size generators, turbines, water treatment plant, switch gear, consulting & contracting services.
2.	Nature	Repetitive	One off.
3.	Size	Relatively small and medium	Large (over £50m).
4.	Contract Conditions	Relatively simple	Highly complex, harsh.
5.	Delivery	Reasonable delivery time	Demanding.
6.	City support for finance, insurance.	Excellent	Support rare and difficult because of size (but situation improving).
7.	Risks	Relatively small or non-existent	Extremely high.
8.	Selling	Relatively easy	Extremely competitive.
9.	Political influence	Relatively high	Relatively low or non-existent.
10.	Capability	Within the capabilities of most of the medium size firms.	Very few firms capable of undertaking the contractual obligations.
11.	Basic approach	Could be handled by individual firms.	Require JV or Consortia approach.
12.	Discipline	Mostly single discipline.	Multidisciplinary or Interdisciplinary

TABLE 2.4.1

SOME OF THE PROBLEMS OF TENDERING FOR LARGE SCALE OVERSEAS CONSTRUCTION PROJECTS AND THE LIKELY CONSEQUENCES.

PROBLEMS	LIKELY CONSEQUENCES
EXTERNAL	
1. CLIENT'S CONSTRAINTS	
Fixed Price	Risk, High Bid Price
Joint and Several Liabilities	Risk
Unconditional Bonds (On-Demand Type)	Unacceptable Risk
Performance/Maintenance Bonds	Risk
Retention Bond	Risk
Joint Venture partner or sub-contractor Bankruptcy	Unacceptable Risk
Payment Excessive in Local Currency	Risk
Exchange Control	Risk
Rate of Expenditure on Contract	Cash Flow Problems, Risk
Import Controls - Labour/Material	Delays/Lack of Progress, Risk
Custom Regulations	Delays/Lack of Progress
Inadequate Tendering Period	Risk Higher Bid Price (Contingency Pricing)
Inadequate Contract Time	Delays/Risk
GENERAL	
If the Risks are Unacceptable, Contractors Show Reluctance to Bid for Turnkey Contracts.	Adverse Effect on Export Hence a set back to the Govt. Economic Policy.
Tendency is to seek Sub-contracting work and as a result less work for the UK Industry as a whole.	
2, POLITICAL	
Harrassment (Staff, Contract)	Risk
Expropriation	Risk
Embargo (Import/Export)	Delays/Risk
Riot/Disturbance	Damage/Risk
Open/Undisclosed Political Action	Risk
Revoked Contract	Loss/Risk

Table 2.4.1 (Continued)

	PROBLEMS	LIKELY CONSEQUENCES
3.	NON-PAYMENT/DELAYS IN PAYMENT	Risk/Cash Flow Problems
4.	NON-RECOVERY UNDER FORCE MAJEURE	Risk
5.	EXCESSIVE REMEDIAL WORK	Delays/Cash Flow Problems/Risk.
6.	NON-PERFORMANCE BY SUB-CONTRACTORS	Delays/Risk.
7.	UNCERTAIN TAX LIABILITIES IN THE HOST COUNTRY	Cash Flow Problem/Risk
8.	INFLATION IN THE HOST COUNTRY	Contingency Pricing
	- Lack of Reliable Information	Higher Bid
	- Inordinate Rate of Inflation	- DO -/Risk.
9.	DEFICIENCIES IN THE UK GOVERNMENT Policies	Higher Bid Price Loss of Orders
	- Lack of Adequate Support (Commercial Financial Political/ Local)	Higher Bid Price Loss of Orders.
10.	DELAYS IN JV AGREEMENT (PRE-BID) MAJOR POINTS OF DISAGREEMENT	General Delays, frustration, Ineffective Bid.
	- Risks	
	- Management of JV	
	- Interface Responsibilities	
11.	'UNFAIR' COMPETITION	
	- Undisclosed Assistance at Govt. Level - Non-Compliance with the Client's Spec. - 'Unauthorised' local Representation	Loss of new orders.
12.	BUYER'S MARKET	
	- Clients with surplus cash	Fierce Competition
	- Too many Competitors	
13.	LIABILITY FROM BANK OR ECGD RECOURSE	Risk
	- Overdraft facilities affected	Effect on Contractor's business activities, reluctance to bid.

Table 2.4.1 (Continued)

	PROBLEMS	LIKELY CONSEQUENCES
14.	INADEQUATE INFRASTRUCTURE/PORT FACILITIES REMOTE SITE LOCATION/DIFFICULT ACCESS	Uncertainty, Risk, Contingency Pricing, Higher Bid.
15.	UNFORSEEABLE GROUND CONDITIONS	Uncertainty, Risk, Contingency, Pricing, Higher Bid.
16.	HARSH CLIMATIC CONDITIONS - Difficulty in getting expatriates.	Higher Salaries - Higher Bid.
17.	NON-AVAILABILITY OF LOCAL LABCUR & MATERIALS	Uncertainty, Contingency Pricing, - Higher Bid, Delays.
18.	LACK OF INFORMATION ABOUT LOCAL SERVICES E.G. Water, Electricity, Telephone, Transport, Food, Accommodation, Security, Minor Services, Medical, etc.	Uncertainty, Contingency Pricing, Higher Bid.
19.	CONSULTANT'S (OR CLIENTS) AD HOC ESTIMATE OF THE PROJECT COST	Adverse Effect on the bid price.
20.	LACK OF RELIABLE & FACTUAL PROJECT INFORMATION - General - Contractual - Commercial - Technical - Local/Site	Adverse effect on the bid price. Contingency pricing - Higher bid price
21	LANGUAGE OTHER THAN ENGLISH - Translation of bid documents - Translation of important aspects of the offer.	Information Uncertainty
22.	BUREAUCRATIC APPROACH IN GIVING PROJECT INFORMATION	Delays, Frustration, Contingency Pricing, Higher bid price.
23.	INADEQUATE METHODS OF TENDER EVALUATION	Risk of losing a competitive bid.

Table 2.4.1 (Continued)

PROBLEMS		LIKELY CONSEQUENCES
24.	LENGTHY NEGOTIATIONS	Adverse effect on bid price.
25.	BULKY TENDER DOCUMENTS	Risk of scanning procedure for studying the tender documents.
26.	UNKNOWN ABILITY OF THE LOCAL PARTNER	Uncertainty.
27.	RAPID GROWTH - Large or 'Jumbo' size projects - Excessive rate of expenditure - Projects with shorter construction periods. - Delivery Problems - Labour Problems	Risks delays in JV agreement, lack of performance, risk of liquidated damages/penalties, excessive remedial work, delays.
INTERNAL		
28.	LACK OF APPROPRIATE CORPORATE POLICIES - Selection of a project to bid/ Selection Criteria. - Limit on acceptable volume of work - Acceptable Risks - Inter-Divisional Relations with respect to a turnkey project - Individual profit centres/ corporate contribution. - Responsibilities	Adverse effect on the bid price

TABLE 2.6.1.

CONSUMER PRICES (ANNUAL CHANGES %)

Country	1973	1974	1975	1976
Iran	9.9	14.2	13.0	11.3
Iraq	4.9	8.3	9.5	10.4
Kuwait	8.0	13.8	8.13	2.25
Libya	7.6	7.9	9.1	-
Saudi Arabia	16.5	21.4	34.6	35.0
Bahrein	14.4	24.7	16.3	14.9
Egypt	5.1	10.1	9.7	10.4
Jordan	10.6	20.2	12.1	15.1
Lebanon	6.1	11.2		
Syria	20.5	15.6	15.9	15.2
Yemen PDR	19.7	20.3	11.3	3.9

Source: IMF

TABLE 2.7.1

GROWTH RATES OF REAL EXPORTS

Source:
'Management Today' June 1978 p.7.

Countries	Annual Change %			
	1976	1977	1978	1979
USA	6.5	1.8	10.7	4.2
BELGIUM	5.5	5.7	6.1	4.5
FRANCE	10.5	6.5	7.1	5.2
GERMANY	11.0	4.2	5.1	2.8
ITALY	12.6	9.6	7.6	5.4
JAPAN	16.6	13.7	9.4	7.9
NETHERLANDS	10.6	-1.1	5.0	4.2
UNITED KINGDOM	7.5	6.4	4.4	3.6

TABLE 2.7.2

SOME OF THE FACTORS LIKELY TO AFFECT A BID

1.0 Conditions of Contract

1.1 Cost escalation clause (whether included or not)

1.2 The definition of excepted risks.

1.3 Settlement of disputes.

1.4 The engineers powers and responsibilities.

1.5 The terms of payment.

1.6 Guarantees - (Conditional or unconditional)

1.7 The general spirit regulating the relations between the three main parties - the Employer, the Engineer and the Contractor.

1.8 The extent of deviation from an internationally accepted Conditions of Contract e.g. FIDIC.

2.0 The quality and detail of the technical information in the tender documents.

3.0 The contractor's experience of the Consulting Engineer.

4.0 The contractor's tendering process.

5.0 The import of plant and equipment.

5.1 Custom delays/duties.

5.2 Port congestion.

5.3 Infrastructure.

6.0 The consultant's cost estimate of the project

7.0 Living conditions in the country and on the site.

a) climate

b) salary levels

c) tax reliefs

d) availability of experienced expatriates.

TABLE 2.7.2 (Continued)

8.0 Labour Situation.

a) Availability

b) Productivity

c) Cost of import

d) Delays in importing

e) Restrictions on importing

f) Living conditions

9.0 The duration of the contract.

(See Chart 2.8.2 for the factors likely to be influenced by the duration of a contract).

10.0 Continuity of similar work in the same or in a nearby country.

11.0 The extent of local involyement.

- Agent
- Sub-Contractor, supplier
- Partnership for a specific project
- Long term partnership.

12.0 Political and economic stability of the country.

13.0 Regulations regarding the transfer of currency.

a) foreign currency payment

b) the exchange control regulations

14.0 Tax liabilities

15.0 The legal system in the host country.

16.0 The rate of exchange to re-transfer foreign currency into local currency if the contract is not paid sufficiently in the local currency and vice versa.

17.0 The competition.

18.0 Inflation rates at home and abroad.

19.0 The standard of workmanship required.

20.0 Sub-contract prices.

CHART 2.8.1

REASONING FOR WIDE RANGE OF BIDS FROM FOREIGN CONTRACTORS

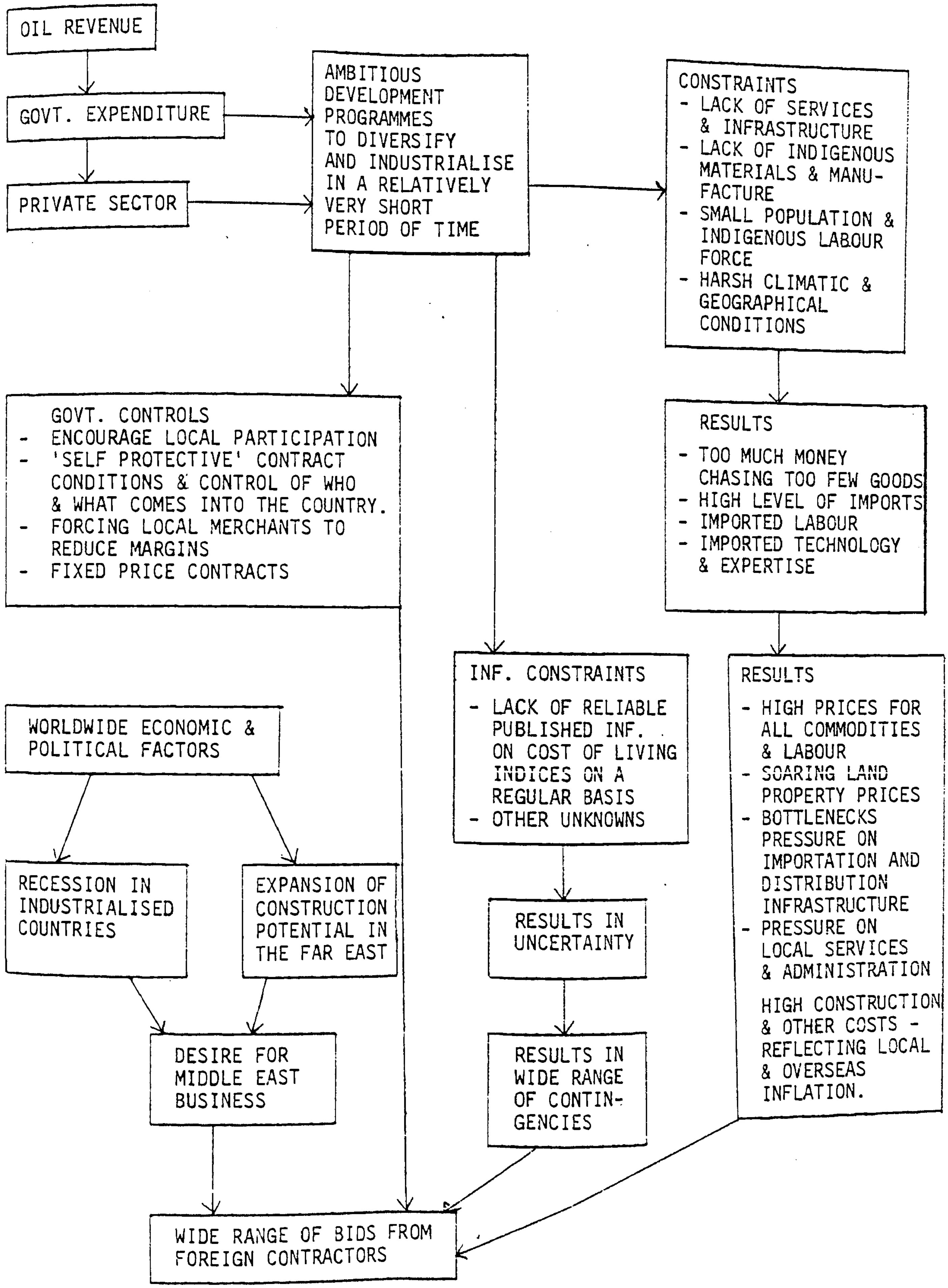


CHART No. 2.8.2

THE FACTORS LIKELY TO BE INFLUENCED BY THE DURATION OF A CONTRACT

FACTORS INFLUENCED BY THE DURATION OF A CONTRACT.

CHANGES IN

1 - LOCAL LAWS
  - Taxes
  - Custom regulations
  - Social reforms
  - Transfer of currency

2 - ECONOMIC CONDITIONS
  - Interest rate
  - Availability of cash
  - Inflation rate

3 - FINANCIAL STATUS OF THE CLIENT
  - Ability to pay on time

4 - OIL PRICES

5 - CENTRAL GOVERNMENT/RULER ETC.

6 - THE MINISTER CONCERNED WITH THE PROJECT

7 - GOVERNMENT POLICIES

8 - RELATIONS BETWEEN THE CONTRACTORS COUNTRY AND THE HOST COUNTRY.

9 - INSURANCE COVER/PREMIUM

10 - CONTRACTOR'S FINANCIAL STATUS

11 - FINANCIAL STATUS OF JV PARTNERS, S/Cs, ETC.

12 - CONTRACTOR'S LONG TERM POLICY

13 - ENGINEER'S POWERS

14 - GENERAL SPIRIT OF THE CONTRACT

15 - LIVING CONDITIONS

AVAILABILITY OF

1 EXPERIENCED EXPATRIATES

2 LABOUR

3 Material

4 Contractor's Finance

RISKS

- Political
- Currency
- Natural
- Overrun of Cost

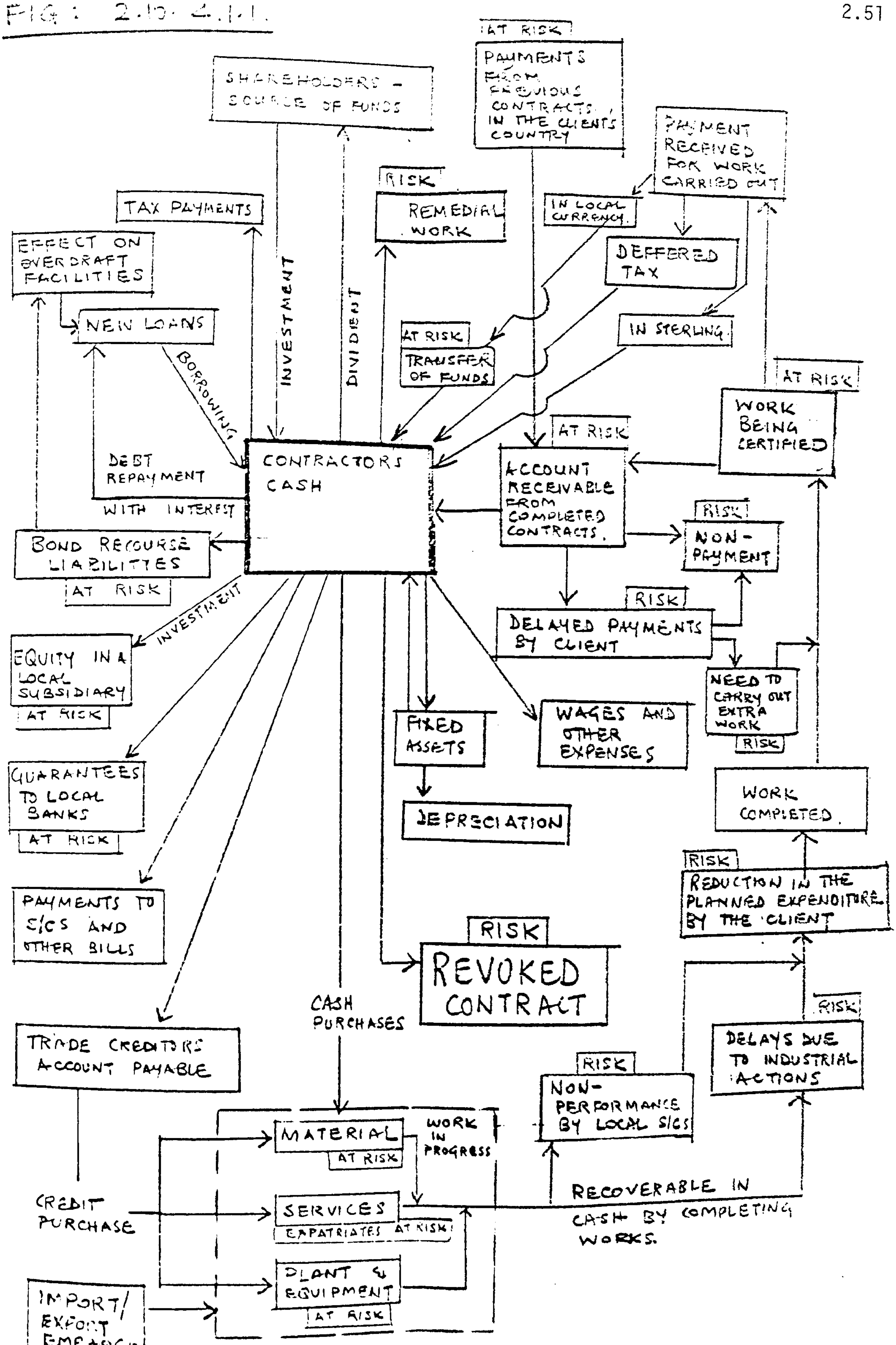
TABLE 2.10.3.1

JUMBO PROJECTS CLIENTS TASKS AT THE TENDERING STAGE AND THEIR ACTIONS TO ACCOMPLISH THEM

	CLIENT'S TASKS	ACTIONS
1.	To ensure that the prospective contractor has the appropriate experience and the required resources.	He examines critically, pre-qualifying documents from a number of international contractors.
2.	To ensure that the prospective contractor will perform to his requirements.	He specifies various forms of financial securities e.g. tender bond, performance bond, retention bond, maintenance bond, etc.
3.	To avoid project responsibilities and liabilities and to pass them preferably through a single contract.	He specifies turnkey contract and issues only a performance specification rather than detailed specification.
4.	To provide experienced management for his project.	He makes the project management a part of the contract with the commitment from the contractor of an agreed number of senior staff for administrating the project.
5.	To ensure a full control of the bidding situation.	He gives himself a freedom for him to open negotiations with a fresh contractor in case he is not satisfied with the bids he received as happened in a Saudi power project.
6.	To avoid limited liabilities for partners in a joint venture situation.	He specifies joint and several liabilities.
7.	To ensure training for his operatives.	He makes the training of operatives a part of the contract.
8.	To ensure a long term supply of the project spare parts.	He asks the tenderers to make a list and price the spares that may be required for a period of five years or even upto ten years after the maintenance period is completed.
9.	To ensure smooth running of the project.	He specifies a maintenance period and asks for a guarantee.
10.	To ensure a minimum but a specific cost for his project.	He creates an intensely competitive situation, specifies a fixed price contract and usually engages the lowest bidder.
11.	To ensure that his project will cost a minimum.	He enters into lengthy negotiations with a contractor or even with a couple of contractors with one or two contractors on a standby.

Contd./....

	CLIENT'S TASKS	ACTIONS
12.	To avoid any payments over and above the tender price.	He discourages arbitration by stipulating some form of control over the arbitration procedure e.g. the venue for arbitration in his own country.
13.	To hedge the risk of fluctuations in the exchange rate.	He stipulates a type of currency or a mix which is most advantageous to him.
14.	To avoid bids with contractual jargon difficult to interpret easily misunderstood in favour of a contractor.	He stipulates that all the important aspects of the offer are translated in the local language.
15.	To ensure that no collusion takes place between the bidders.	He, more often than not being in a position to do so, threatens to blacklist them until such time as they can prove their innocence, as happened in the case of a Western contractor whose bid was rejected for alleged price-fixing but was later reinstated when he could prove his innocence.
16.	To ensure a long term interest of the local contractors.	He stipulates joint ventures with indigenous companies.



CONTRACTOR'S FLOW OF FUNDS AND ITEMS AT RISKS AS A RESULT OF A POLITICAL ACTION.

Table 2.10.4.4.1 : A breakdown of the value of a typical 2000 MW thermal power station in the UK.

		Percent
Civil works + Engineering design + Project Management		29
Boiler Plant		29
Generating sets		22
Ancillary Plant		
	Mechanical	9
	Electrical including Switching station	10
	Land and other costs	1
		100

Table 2.17.1

PRODUCTIVITY IN THE CONSTRUCTION INDUSTRY
MANAGEMENT PROCESSES.

By E.J. Peltier,
J of ASCE Vol. 104 January 1978.

Some of the concepts, claims, charges and countercharges cited by Peltier in August 1976 ASCE conference papers.

1. There is waste in design and redesign due to continuation of design work on bases no longer appropriate. Changes that are conceptual ruin productivity and drive up design costs, when they come after start of detailed design.

2. One of the most important factors affecting productivity is information, or lack of it.

3. Increased productivity attributable to the computer has been offset by designing better, rather than faster. The potential of the computer for improving productivity has barely been touched.

4. 50,000 man-hours of construction management at the front end of a project can save 500,000 man-hours during construction. Management systems can more than double journeyman productivity in terms of productive hours at work per day.

5. Project management can do little to improve productivity of some jobs due to basic attitude of the work force. Managers and workers must agree on where productivity can be improved - and how the benefits are to be shared.

6. A "communicating atmosphere" with the public can protect a project from unnecessary costly delays. Perhaps the greatest challenge facing the construction industry today is to change public attitudes, gain broad-based support for projects.

7. The Environmental Protection Agency (EPA) will require Value Engineering on all projects costing $10,000,000 or over, hoping to achieve 10% - 15% net cost savings.

Table 2.17.1 (Continued)

8. Productivity is more than GNP; it relates to producing the environmental conditions desired by people. Intangible benefits must be applied to the concept of productivity. Environmental controls have been essential to productivity, yielding benefits valued by the citizen.

9. Public participation is often a farce. Bureaucrats seem to be searching for absolutes. We need regulators who are familiar with the industry they are regulating. Since we must regulate, we must improve the regulatory process. It's time to evaluate regulation, to determine if it always contributes to our prosperity and quality of life. We need economic impact statements as well as environmental.

10. Billions have been spent to make construction equipment-intensive, instead of labor-intensive.

11. Equipment is getting to be safer and quieter, but not more productive.

12. Today's young engineers are having the initiative and creativity regulated out of them.

Table 2.17.2

SUGGESTIONS TO IMPROVE PRODUCTIVITY IN CONSTRUCTION

By MIT's Prof. W.A. Litle in ASCE Conf. Aug. 1976.

Cited by E.J. Peltier

' Productivity in the construction industry management processes'.

J of ASCE, Vol. 104. Jan 1978 (P.52.)

Suggestions:

1. Avoid changes in the design base.

2. Improve contracting procedures for risk sharing.

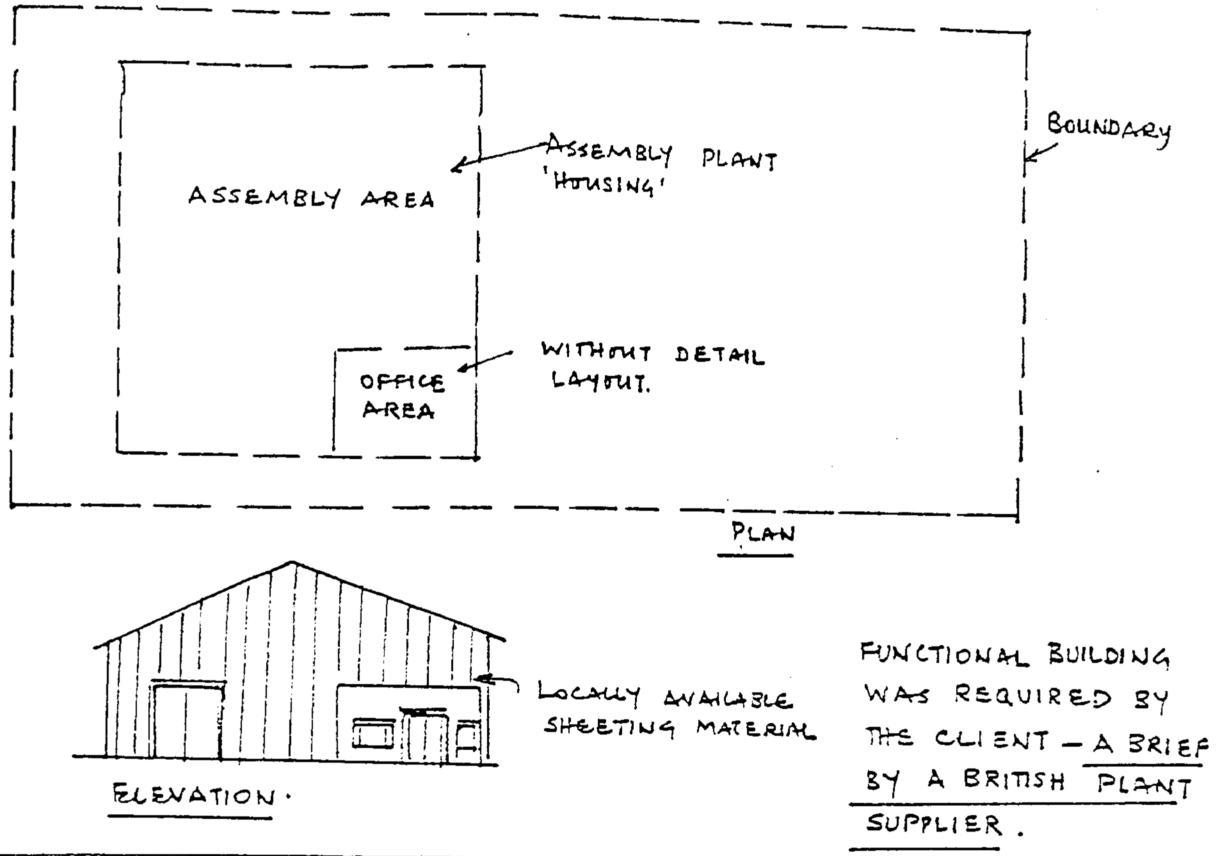
3. Tell me what you want to build; don't tell me how to build it.

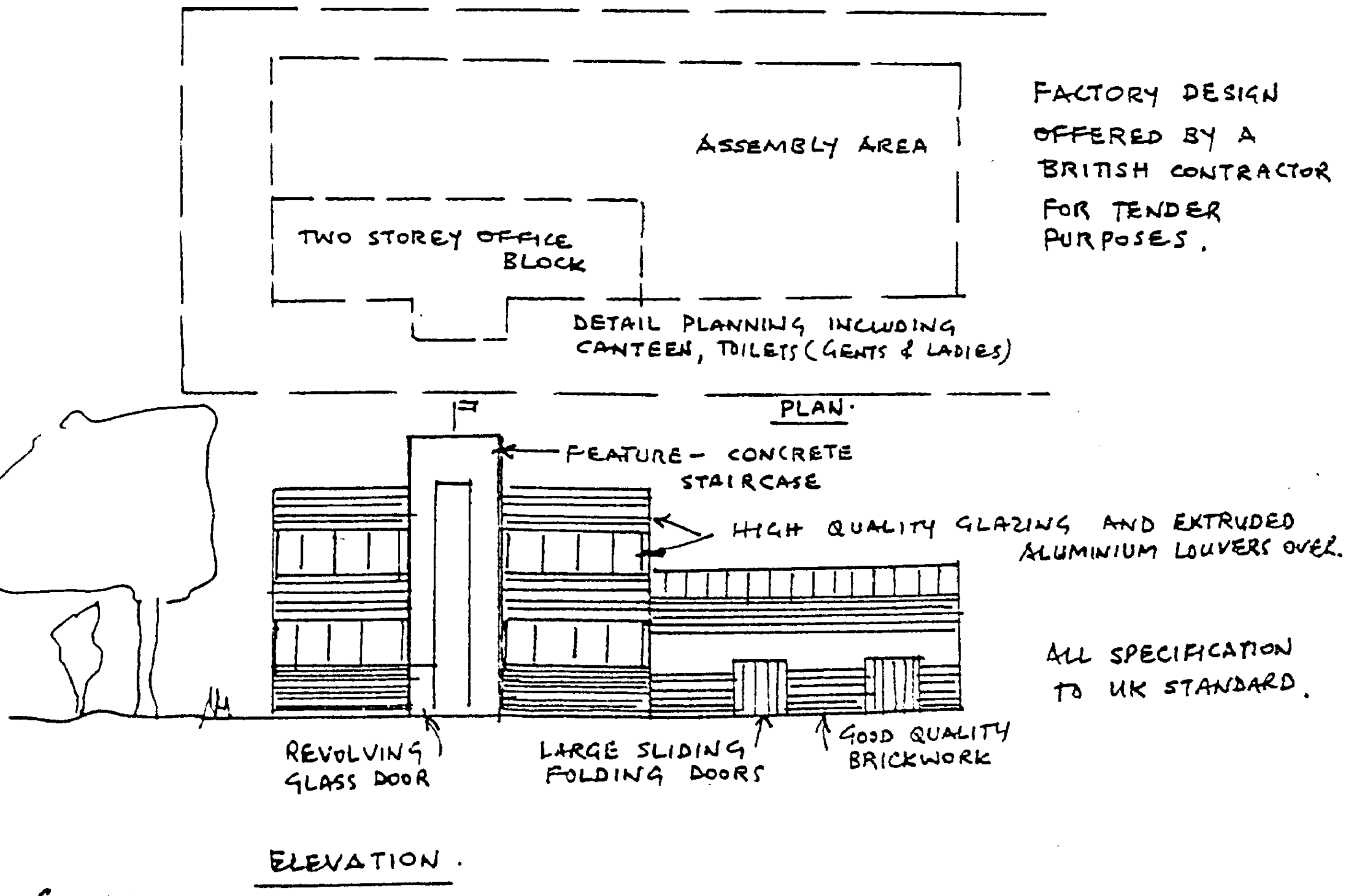
4. Create closer owner/architect-engineer/contractor relationships.

5. Cut back on expanding requirements for documentation.

FIG 2.18.1 : A CLIENT'S NEED AND A BRITISH CONTRACTOR'S RESPONSE

CLIENTS NEEDS





CONTRACTOR'S RESPONSE.

CHART 2.22.1.: BONDS

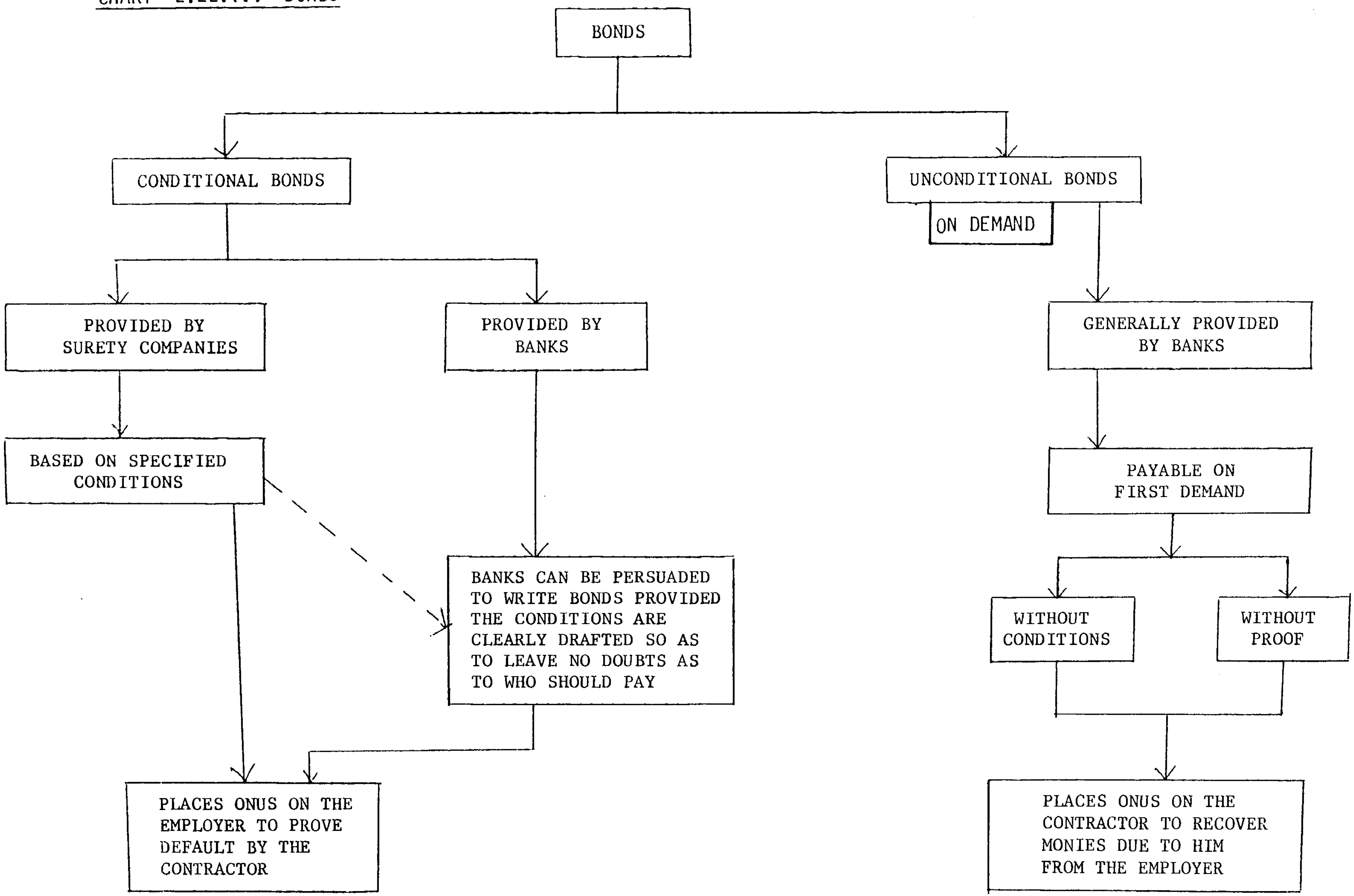


TABLE 2.24.1

Changes in percentage of world export of manufactured goods by country from 1960 to 1975

Year	UK	France	Germany	Italy	Japan	USA
1960	15.3%	9.1%	18.2%	4.8%	6.5%	22.8%
1970	10.1%	8.3%	19.0%	6.9%	11.2%	18.4%
1973	8.8%	8.5%	20.0%	6.1%	13.1%	16.4%
1975	8.9%	9.0%	18.5%	6.7%	14.4%	19.0%

Source: U.S. Dept. of Commerce.

TABLE 2.24.2

Number of Companies among the World's top 12 by Country, in all 13 industries in 1959 and 1976.

COUNTRY	1959	1976	INCREASE % + or -
USA	111	68	- 61 drop
UK	14	15	+ 7% Incr.
CONTINENTAL EUROPE	25	40	+ 60% Incr.
JAPAN	1	20	+2000% Incr.
OTHER (Principally Canada)	5	13	+ 260% Incr.

Source: HBR Multinational Organisation pages 96, Nov. Dec. 1978.

TABLE 2.29.1

SOME OF THE PROBLEMS FACED BY BRITISH CONTRACTORS TENDERING FOR LARGE PROJECTS AND THE PRESENT STATE OF RESPONSE

PROBLEM	PROBLEM IDENTIFIED OR EXAMINED BY (Published Sources)
1. Problems resulting from successive British Governments policy to use the construction industry as an economic regulator.	Hillebrandt (1974, 1977 & 1978) Stone (1968) Turin (1969) Hill (1978)
2. Requirement of single contract (Turnkey contracts)	OPG Report (1975)
3. Competition from overseas interdisciplinary corporations	LCC-BEHA Committee Report (1976) Neo (1974 c) Torrance (1975)
4. To formulate appropriate bidding strategy	Fine (1974), IOB No. 75, Fine (1971) Grinyer (1971) Harris & McCaffer (1977) Pim (1974, 1975) Pim (Undated), Gates (1967) Casey & Shaffer (1964), Park (1966) Friedman (1956) Wittaker (1971) Prabhu & Wootton (1978) Hamman (1971)
5. Selection of suitable projects to tender	Identified by Wheatland (1977) Not yet examined.
6. Selection of suitable agents and sub-contractors	Not yet examined.
7. Arranging international finance	Holland (1979), Neo (1975) Nelson (*), BoTB (1976) Evans (1978), Spaeh (1978) UN (1967) Crosswaite (1972) *Undated
8. High tendering cost and its effects on overheads - In general a lack of tendering cost control.	Not yet examined.
9. Tendering for a project is a 'temporary' task	Not yet examined.
10. Require special leadership	Thamhain & Wilemon (1977)
11. Delays in feedback from sub-contractors	Not yet examined
12. Fierce competition	Identified by OPG (1975)
13. Risks	
13.1 Financial (currency, exchange risk, inadequate financial policies and control, forward exchange, etc.)	Furlong (1966), Siegel (1972) Stoll (1968), Stobaugh (1972) Shilling (1970), de Vries (1968) Lietaer (1970), Ross (1972)

TABLE 2.29.1 Contd..

PROBLEM	PROBLEM IDENTIFIED OR EXAMINED BY (Published Sources)
13.1 Financial (Contd.)	Trimble (1974) Clements (1979) Zenoff (1969) Wheelwright (1975) Brooke (1967, 1972)Hillebrandt (1977) Chetwin (1977) Remmers (1968) Robbins & Stobaugh (1973)
13.2 Investment	BICC (1975), Hertz (1964) Coucoulas (1970), Singh (1977) Aharoni (1966), Pierce (1970) Kindleberger (1969), Lunn (1973) Nazem (1968)
13.3 Political	Richardson, Neo (1974 a) Neo (1974 b) Radcliffe and Berry (1975) Rummel & Heeman (1978)
13.4 Commercial (General)	Hobson (1973)
13.4.1 Bonds	ECGD, Hermann (1979), CIA Corry (1978)
13.4.2 Non-Performance	Walde (UN) 1979 Colchester (1979)
13.4.3 Conditions of Contract and Claims	FIDIC (1978), Simmonds (1978) Stephenson & Davis (1977) Rushbrooke (1978) Thompson (1974) Thompson (1973)
13.4.4 Cost escalation & insurance	CIA (1976)
13.4.5 Joint & Several Liabilities	Hobson (1976)
13.5 Company risk	Nagy (1979)
13.6 Natural(Unforeseen Ground conditions, etc.)	Cottiss (1979)
13.7 Management attitude	Thorne (1978)
13.8 Insuring major works	Sasoon (1978) Germond (1978)
13.9 Conditional risks	Saipe (1978)
13.10 Inadequate risk-return ratio, bankruptcy	Lee (1977) IOB (1970) I Chem. E (1972), Spellman (1978)

TABLE 2.29.1 Contd..

PROBLEM	PROBLEM IDENTIFIED OR EXAMINED BY (Published Sources)
13.11 Less consideration to human resource in the management of corporate risks	Neumann & Seger (1978)
13.12 Delays in risky decisions	Not yet examined
13.13 Overspending on sub-contract management	Prabhu (1976)
13.14 Overspending on contract cost, drop in productivity	Boyd (1966), Moolin (1978) Peltier (1978)
13.15 Managing risk	CIA (1976) Fraser (1978)
13.16 Hazards	Halliwell, Oakes & Slater (1979)
13.17 Changes in specification	Thompson & Barnes (1977) Peltier (1976)
13.18 Difficulty in assessing export risks	Curry (1974)
13.19 Force Majeure	Davis (1974), Simms (1974)
14. Delays in forming consortia and joint ventures	OPG (1975), LCC - BEHA Jumbo Committee (1976) Benson Committee (1976) EGCI Conf (1978), EGCI (Check List) Kahan and Rapoport (1977) Maschler (1963) Taylor (1978) Cassidy & Neave (1977) Jaynes (1978) Friedmann & Kalmanoff (1961) Hlavacek and Thompson (1978) Tomlinson (1970), Franco (1971)
15. Fixed price contracts in inflationary periods - cash flows	Perry (1975)
16. To provide a positive cash flow	Prabhu (1976) Fondahl & Bacarreza (19 Harris & McCaffer (1977) Neo (1974d)
17. Estimating problems	Hackney (1965), Porter (1977) Jarvis (I.Chem.E Symposium Series No. 45) McKirdy (1971) Ashley (1977), Ratledge (1975) Road Research Lab Report (1978) Stacey (1979), Flanagan (unpublished) Thompson (1970)

TABLE 2.29.1 Contd..

PROBLEM	PROBLEM IDENTIFIED OR EXAMINED BY (Published Sources)
18.1 Occupational Stress	Keenan (1979) Kahn et al (1964) French and Caplan (1973) Marshall and Cooper (1979)
18.2 Occupational stress during tendering and its effects on competitiveness	Not yet examined.
18.3 Human factor	Borcherding (1972)
19. Profit consciousness	Wyatt (1978), Anslow (1978)
20. Internal bureacracy	Borcherding (1977)
21. Crucial decisions under severe time constraint	Not yet examined
22. The approach to tender management unsuitable for an extremely competitive market - A lack of understanding of the client/contractor interaction	Identified by Thomas (1977) Not yet examined.
23. The competition on the basis of construction management, engineer/constructor roles and turnkey type contracts	Prabhu (1976) Verden (1976) Harris (1977, 1976) Cliff (1966) Burgess (1969)
24. The tendering process is associated with uncertainties and complexities	Not yet examined
25. The necessary skill of contract negotiations including barter deals and switch trading not fully appreciated.	Marsh (*) The Economist (1967) Neo (1975) * Undated
26. Uncertainty about methods adopted by clients to search for a contractor, forms of contract, sharing of work, etc.	Commander (1979) Newall (1977) Nankivell (1966)
27. Cost of pre-tendering engineering design	Leech and Smart (1975)
28. Proposal presentation is given insufficient importance.	Silver (1977)

TABLE 2.29.1 Contd..

PROBLEM	PROBLEM IDENTIFIED OR EXAMINED BY (Published Sources)
29. 'Excessively' high standards	Anslow (1978)
30. Motivation to work is given less importance in certain tendering situations.	Handy (1976)
31. Individual strain	Norfolk (1977) Marshall & Cooper (1979) Keenan (1979)
32. Less understanding of pricing method	Research by University of Nottingham reported by Thorncroft in the Financial Times (*) * Date unknown.
33. A lack of market planning in a rapidly changing world	Sizer (1977) Nitingale & Butt (1978)
34. Difficulties in forecasting workload	Basu & Schroeder (1977)
35. Insufficient attention to the influence of engineering design and specification on prime costs	ASCE (1978), Robson (1978) IQS (1972)
36. Excessive cost of back-up services	Boomer (1978)
37. Banks own methods of evaluating contractors	Nelson (1978)
38. High rate of bankruptcies in the home construction market	Spellman (1978)
39. High cost of expatriates	Egan (1977)
40. Japanese long term approach in bidding for large scale projects, e.g. Japanese oil needs and her investment approach in bidding for such projects.	Tharp (1977)
41. Foreign competition and Government incentives.	OPG findings (1974-75) Electrical Review Vol. 200 No. 7 Feb. 18 (1977) Page 39.
42. The tendering process as a whole not subjected to scrutiny from system analysis	Not yet examined

TABLE 2.29.1 Contd..

PROBLEM	PROBLEM IDENTIFIED OR EXAMINED BY (Published Sources)
43. Insufficient attention given to clients' point of view when pricing tenders.	Identified by Silver (1977) Not yet examined.
44.1 Banks own method of acceptance of a project for financing	A confidential letter.
44.2 Contractors profit to Banks	Trimble and Kerr (1974)
45. Insufficient time for detail analysis of failed tenders	Milford (1977)
46. Insufficient time for identification and analysis of likely competitors	Minshull (1978)
47. A lack of appreciation of the need of special tendering services for comprehensive tenders.	Cliff (1970)
48. Disparity between central and local objectives	Easton (1974)
49. A need for excessive design in some tenders	Leech, Jenkins and Turner (1979)
50. Tax problems	Fox (1974)
51. Uncertainty about factors affecting cash flow and net profit margins in construction projects	Kerr (1973), Trimble (1972 a and b) Neo (1974 d) Fondahl and Bacarreza (1972)
52. Inadequate knowledge of how IBRD and World Bank Projects are handled	Chadenet and King (1972) IBRD (1972)
53. Management	Grant and Shaw (1970) Cockburn (1969) Robinson (1973)
54. Complexity in construction	Bennett (1978)

CHAPTER 3

TENDERING PROCESS

CHAPTER 3

TENDERING PROCESS

3.1 Introduction

A process is a series of actions and one of its basic characteristics is that it can be represented by flow charts. Tendering is a series of actions and therefore it should be possible to describe it in terms of flow charts. The earlier discussion in this chapter is centered around this concept in order to search for evidence to support the notion that tendering is a process and therefore should be comparable with other processes.

The chapter also highlights that the tendering process as a whole comprises of decisions which are, in the majority of cases, subjected to such constraints as time, resources, etc.

One of the reasons for the attempt to identify tendering with the process industry is that the latter uses a proven method - systems analysis - to deal with various constraints. In Chapter* 7 of this study, systems analysis has been applied to some tendering tasks in an attempt to reduce undesirable effects of various constraints and to improve the effectiveness of the tendering performance.

* Appendices to Chapter 7

3.2 Tendering - a process

Tendering programmes are generally represented by bar charts or in case of complex projects (as shown in Chart 4.2.4.2) by network diagrams. Unless such programmes describe a series of activities, this type of representation is not feasible. This suggests that tendering satisfies the definition of a process - a series of actions.

3.2 Tendering - a process Cont/...

The tendering process can also be tested for a basic characteristic of a process. Chart 3.2.1, demonstrates briefly how tendering activities for a project can be represented by flow charts. The above evidence therefore supports the notion that tendering is a process.

3.3 Argument against the notion.

A senior manager in a contracting organisation suggested that not all tendering activities for a project follow a schedule as one expect them to do. For various reasons, there are interuptions and delays in practically every tendering programme and hence, it (i.e. tendering) can be discontinuous. He therefore argued that it differentiates from the basic charactenistics of a process.

Although it is true that delays occur in obtaining information and/or taking certain key decisions which can disrupt a tendering programme for longer periods of time in comparison with disruptions in the process industry, nevertheless, the durations of such disruptions should be viewed in perspective. For instance, a tendering period of 12 weeks or more for a large scale overseas project is not uncommon and disruption periods, if any, are likely to be proportional to the overall tendering period and still within the bounds of the basic characteristic of a process - a series of actions. Hence, disruptions in tendering activities as an argument against the above notion can be disregarded.

3.4 Comparison between tendering and other processes

Fig. 3.4.1 shows a comparison between tendering and a manufacturing process. In a manufacturing process, basic materials delivered to a factory are checked for correct specification, shortages, defects, etc. Tender documents are similarly studied for incorrect or insufficient information. Planning and design too have comparable activities in the manufacturing process.

Actual manufacturing follows these initial activities. Assembling testing, monitoring, making good any defective parts, etc.; are the subsequent activities in the manufacturing process. In the tendering process, detail tendering activities such as collaboration agreement, estimating, s/c enquiries, tender design, etc., take place once the tender documents are studied. They are followed by the 'assembling' activities (i.e. putting the tender together) such as finalising cost estimates, the level of contribution, cash flows, etc.

The tender is then reviewed from the corporate policies' point of view. A parrallel activity in the manufacturing process is that of testing against the specification. Any items in a bid which do not comply with corporate policies are revised. A similar activity in the manufacturing process is 'making good or replacing defective parts' after testing the product.

The bid is finally ready for submission to the client on a similar basis as a product is ready for delivery. In the process industry, public relations activities in the consumer section are designed to feed the information back to management in order to improve the quality of a product. The feedback of a client's pre-dispositions and his reaction to the bid can have similar effect on tendering decisions.

3.4 Comparison between tendering and other processes Cont/...

Figs. 3.4.2 and 3 compare tendering with a 'single conveyor belt assembly' and a 'tree assembly line for one off product' respectively.

It appears that the above arguments provide sufficient basis to accept the notion that tendering is a process and therefore it is comparable to a process in the process industry.

3.5 Decision situations

Tendering is a series of actions to arrive at various decisions. For instance, estimating the cost of a project enables contractors to take decisions on the risks involved in the project, on the level of contingency, the level of contribution and ultimately, the final tender price.

Fig. 3.5.1(a) shows in general, how a decision situation regarding selection of a project to tender is handled in practice. This is comparable to a refining process in the process industry as shown in Fig. 3.5.1(b).

3.6 Interruptions and time constraint

Fig 3.6.1 shows a general process of scanning prospective business enquiries. It is not unusual for enquiries for large projects to take longer periods than what one would consider normal, in order to decide whether to submit a bid or not. Often delays are caused by postponed decisions because of lack of information.

3.6 Interruptions and time constraint Cont/...

As shown in Case(ii), Fig 3.5.1 (a), if a decision about a prospective business enquiry requires more information but because of a time constraint such a decision is taken without further investigation, then it is not only likely to create extreme uncertainty but also affect performance.

In practice, valuable time is lost in obtaining vital information. As illustrated by Case Study 3.6.1, it affects the tendering performance.

There are serious repercussions of hasty decisions especially in overseas projects hence the tendency is to postpone decisions where possible (as shown in Case (i), Fig 3.5.1 (a)) until the necessary information is obtained. This interrupts the tendering process. Although disliked by tendering personnel, such actions are considered essential in order to ensure that decisions are not taken under undesirable circumstances.

3.7 Review of a tendering process and some possible refinements.

Fig. 3.7.1 shows the tendering process in a contractor's organisation. A division within the contractor's group has the responsibility to prepare those tenders which are submitted on behalf of the group. All the major decisions are referred to the corporate management.

If a tender is unsuccesful, an aftermath of the tender takes place in form of a general report. Occassionally, a thorough investigation is carried out and as a result, recommendations are made in order to improve certain aspects of the group's tendering procedure. But very rarely such recommendations get implemented. According to a tender Project Manager in the organisation, the tendering process as a whole lacks a recommendation implementation procedure which he considered should ideally review the recommendations made in the past before a go ahead is given for a new tender.

He also pointed out that a detail monitoring of tendering activities and measuring of the tendering performance are missing from the process. The absence of monitoring mechanism has resulted in a lack of control on certain tendering activities, and non-existence of a measure of the contractor's tendering performance , according to the Manager, means 'shot in the dark' approach each time a tender is submitted.

This uncertainty is due to the absence of necessary procedures to refer to relevant tendering decisions in the past. Without such retrieval of historic information i.e. feed back on critical decisions, it has the effect of extending the 'learning curve' as far as the contractor's tendering performance in open competition is concerned.

3.7 Review of a tendering process and some possible refinements (contd.)

In view of the above, the general approach to refine a process in the process industry was reviewed. Fig.3.7.2 shows a typical process with measures, controls and correctors. An attempt has been made in this chapter to implement this approach in order to provide some refinements to the tendering process observed in the above contractor's organisation. The suggested refinements are shown in Fig.3.7.3.

Instead of an aftermath and occasional recommendations, a measure of the overall tender effectiveness after each tender is submitted can provide an objective assessment of the tender performance. Chapter 7, SectionA7.4.15 dicusses this type of assessment in detail.

Prior to commencing any activities on a new tender, the corporate management should ideally review the past recommendations in order to implement the appropriate ones for the tender under consideration. This action on the part of the corporate management can have the 'corrector' effect on the tendering process.

Various tendering activities can have controls and measures as necessary. For instance, the tendering cost of a project can be controlled by first budgeting the cost and then monitoring it. Chapter 7, SectionA7.4.3 illustrates a procedure for such a control. An approach similar to 'Management by Objective' (MbO), as discussed in Chapter 7, SectionA7.4.9 can provide a means of measuring tender performance against certain targets.

Figs. 3.7.4. and 5 illustrate the basic tendering process and some refinements to this process, respectively. Some of the activities such as appointing a suitable agent, selecting tendering personnel,

3.7 Review of a tendering process and some possible refinements (Contd.)

selecting suitable projects to bid, budgeting and controlling tendering cost, a review of a bid from the client's point of view,etc., shown in the tendering process in Fig.3.7.5, are discussed in detail under appropriate sections in Chapter 7.

Some members of the tendering staff in the above contractor's organisation are of the opinion that although the tendering process can be improved by some of the refinements suggested in Fig.3.7 .5, the constraints such as resource, time, etc, which are generally imposed on the majority of tendering activities, are likely to deter the management from seriously considering any modifications to the existing tendering process.

As discussed in Section 3.6 above, the time factor is one of the most commonly applied constraint in many decision situations during tendering. This problem and its serious repercussions in overseas contracting are recognised by tendering personnel as a whole but the majority of them appear to have developed a sense of helplesness resulting from the fact that it is an externally applied(i.e. usually by clients) constraint on which they consider they have no control whatsoever.

Other industries e.g. process, manufacturing, have found systems analysis as a useful method to deal with the problems created by internally and externally applied constraints. It is with this in mind, the systems analysis approach has been reviewed in Chapter 7 and an attempt has been made to apply it to pre-selected tendering tasks in order to examine its usefulness in tendering situations.

3.8 Conclusions

Tendering is a process consisting of numerous sub - processes all leading to decision situations. In other words, the tendering process as a whole comprises of various decision processes. Although the process is comparable to any other process, it appears to lack certain controls, measures, correctors, etc. commonly applied to other processes to improve their effectiveness.

Like other processes, the tendering process is also subjected to various constraints. Hasty decisions are not only likely to lead to ineffective use of tendering resources but may also have serious repercussions on the contractor's business as a whole. In this context interruptions in the tendering process caused by delays in taking crucial decisions, although disliked by tendering personnel concerned, appear to be necessary in order to reduce the chances of irrational decisions.

Tendering process in operation should be periodically reviewed in order to determine defective or missing elements and appropriate refinements should be incorporated in this process to avoid unnecessary wastage of tendering resources.

To reduce the period of the 'learning curve' of a contractor, a review of the past recommendations and the recommendations implementation procedure i.e. some form of 'corrector' to the contractor's tendering process, are among the important refinements to the process. A measure of tender effectiveness appears to have a potential for improving tendering decisions and thereby the tender performance.

3.8 Conclusions (Continued)

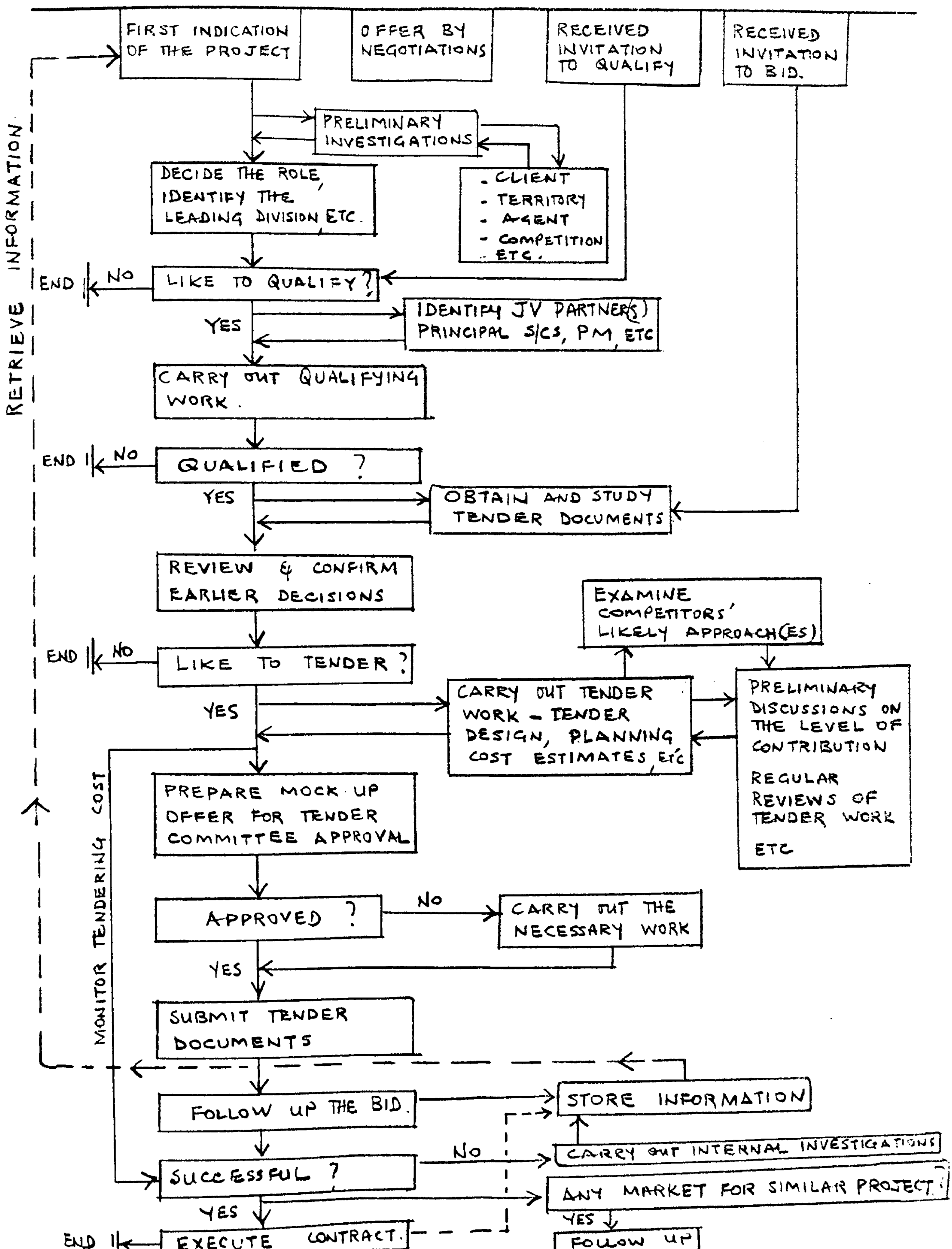
There appears to be a scope for the application of systems analysis to some of the sub-processes in the tendering process in order to cope with internally and externally imposed constraints and to improve the effectiveness of the tendering process.

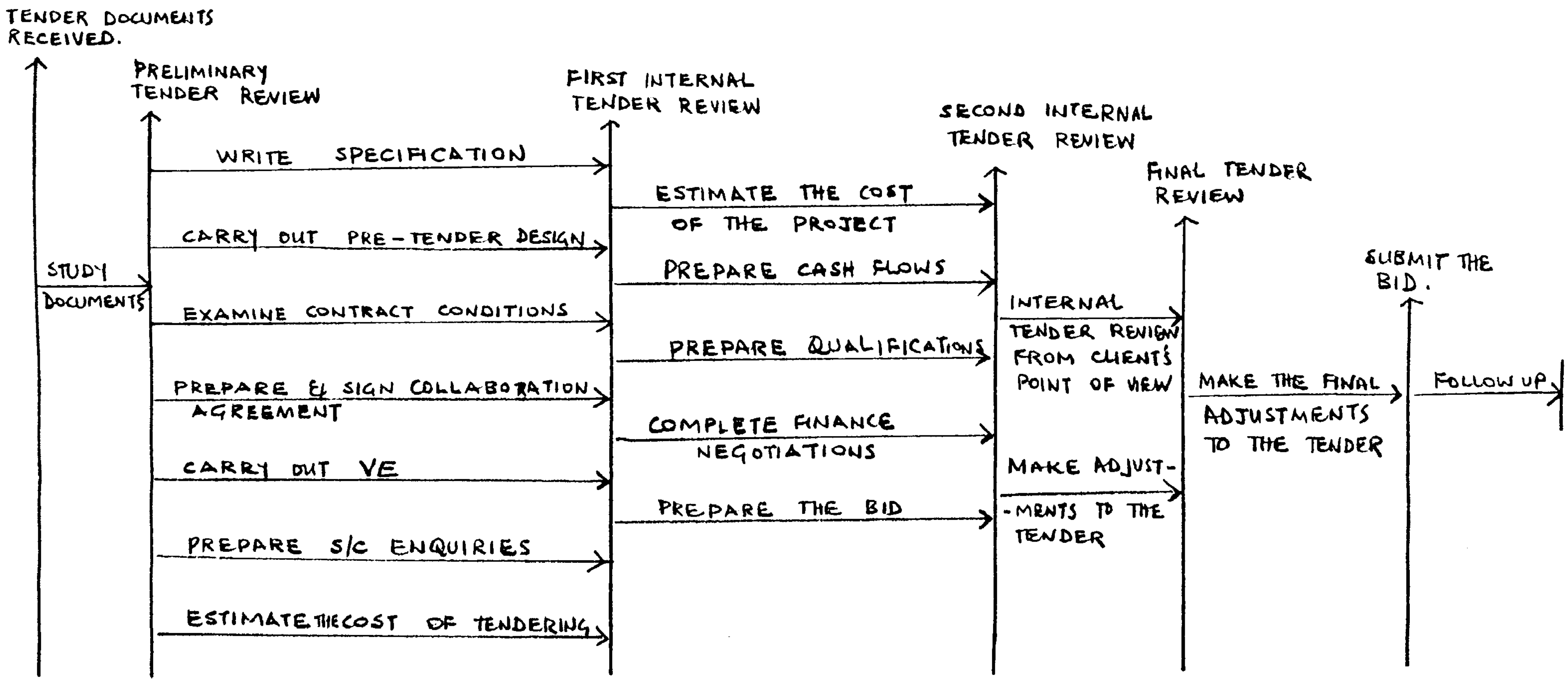
CHAPTER 3

CHARTS, TABLES, ETC.

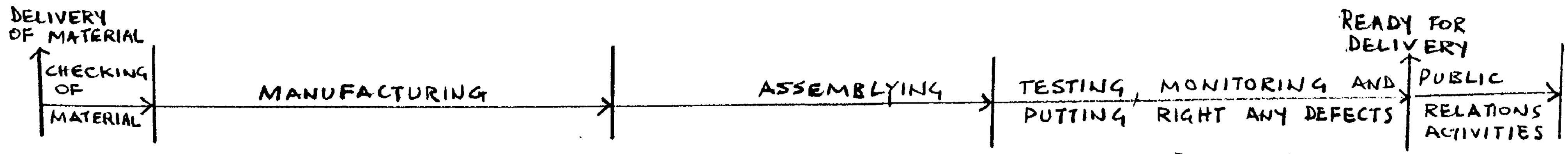
CHART : 3.2.1

A BRIEF FLOW CHART OF TENDERING ACTIVITIES FOR A DIVISION WITH A LEADING ROLE IN TENDERING ON BEHALF OF THE GROUP





TENDERING PROCESS (A SAMPLE OF ACTIVITIES)



MANUFACTURE AND ASSEMBLY PROCESS

FIG 3.4.1: A COMPARISON BETWEEN TENDERING AND MANUFACTURING PROCESSES

FIG. 3.4.2

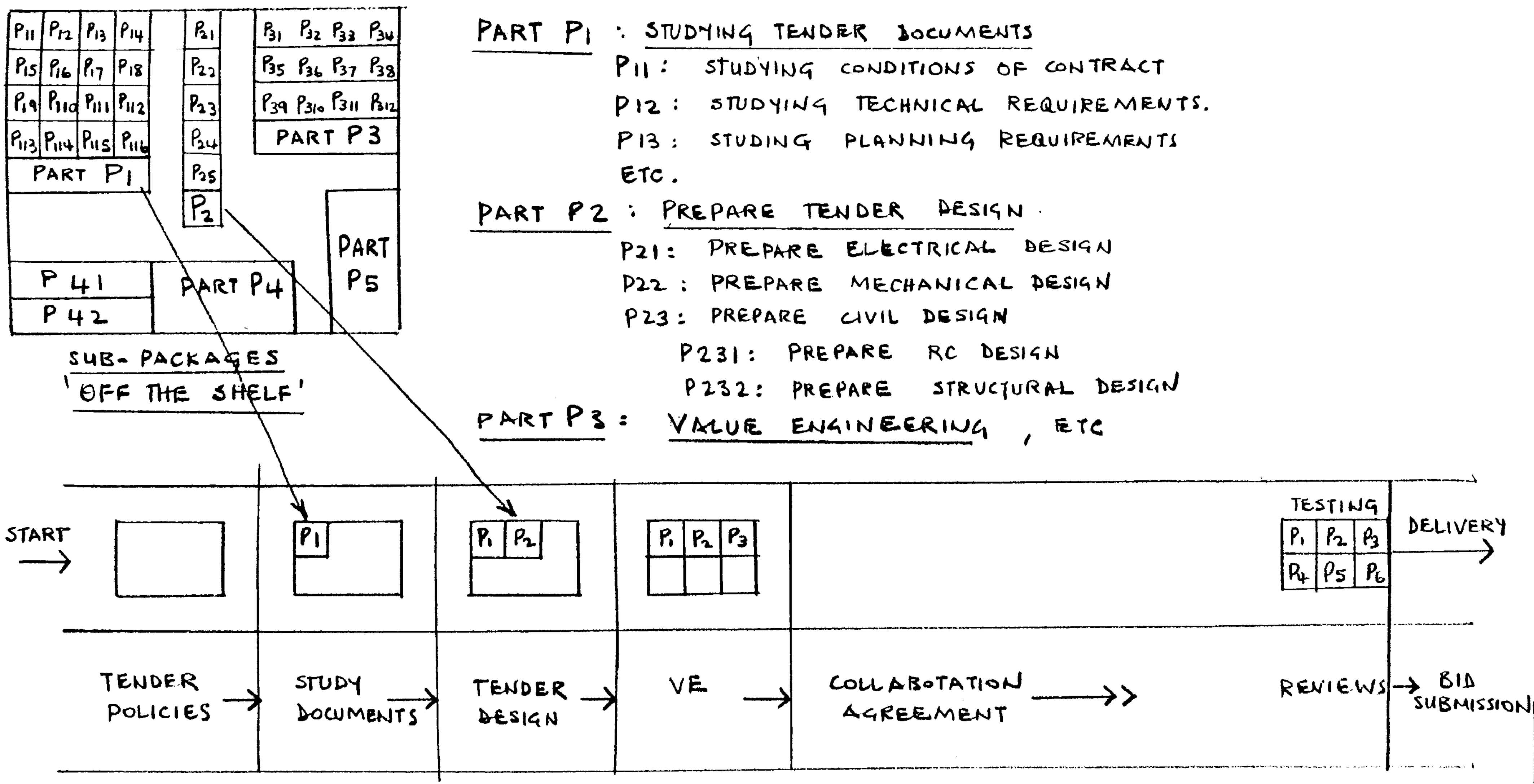


FIG 3.4.2 : TENDERING AS A SINGLE CONVEYOR BELT ASSEMBLY.

NOTE : SUB-PACKAGES IN FORM OF COMPANY PROCEDURES CAN SPEED UP CERTAIN ASPECTS OF TENDERING.

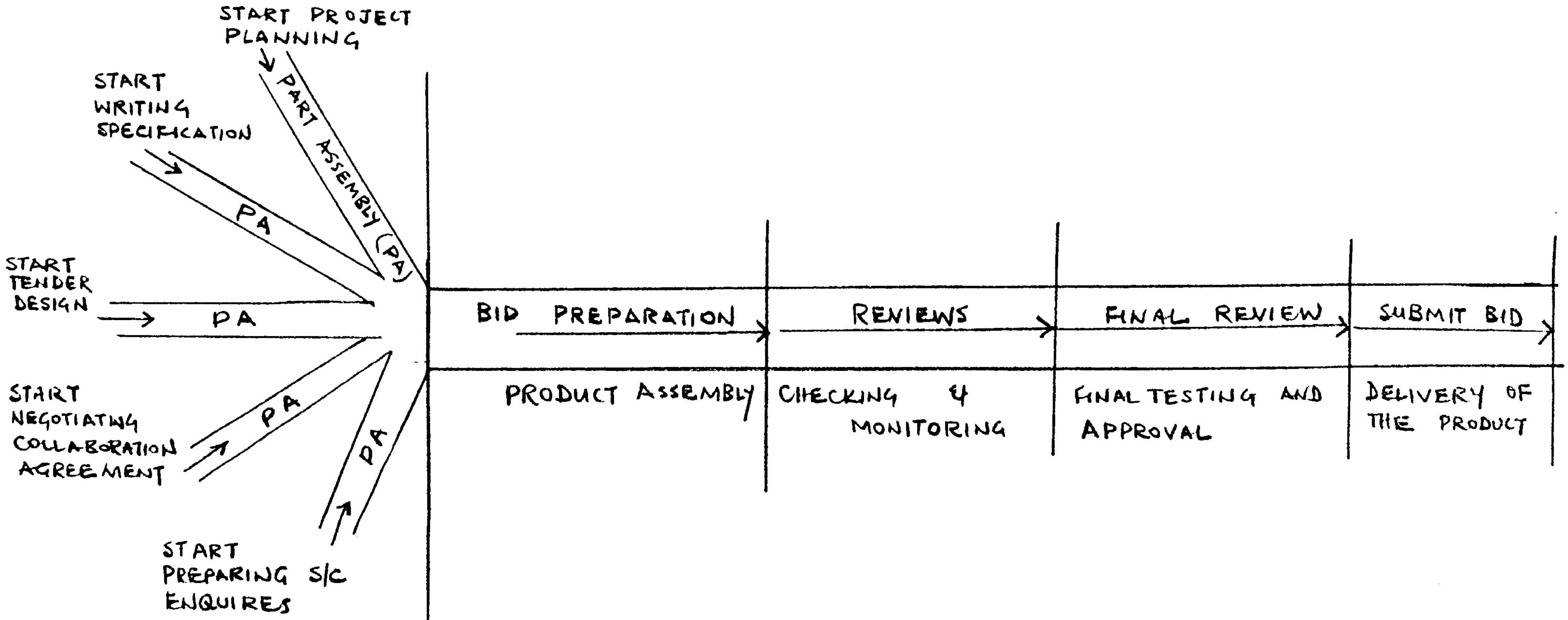


FIG. 3.4.3 : TENDERING AS A TREE ASSEMBLY LINE FOR ONE OFF PRODUCT.

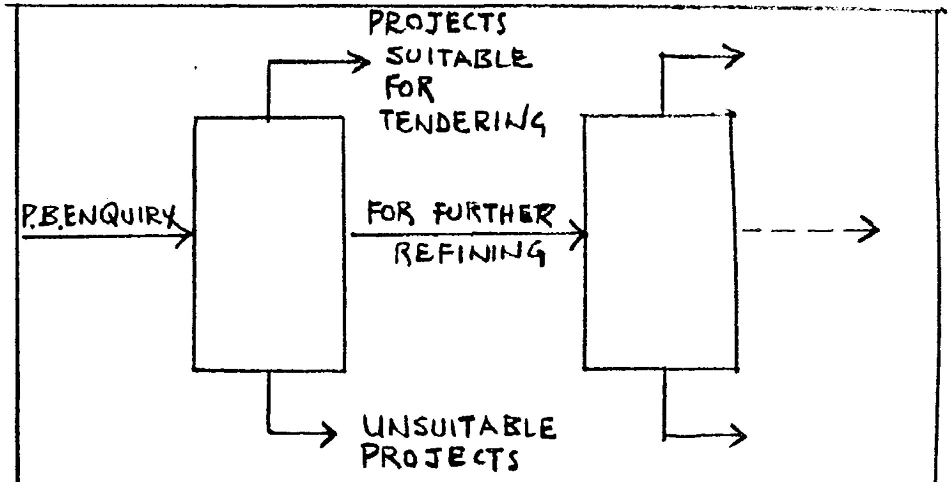


FIG. 3.5.1(b): DECISION PROCESS IN FIG. 3.5.1(a) SEEN BY THE PROCESS INDUSTRY AS A REFINING PROCESS.

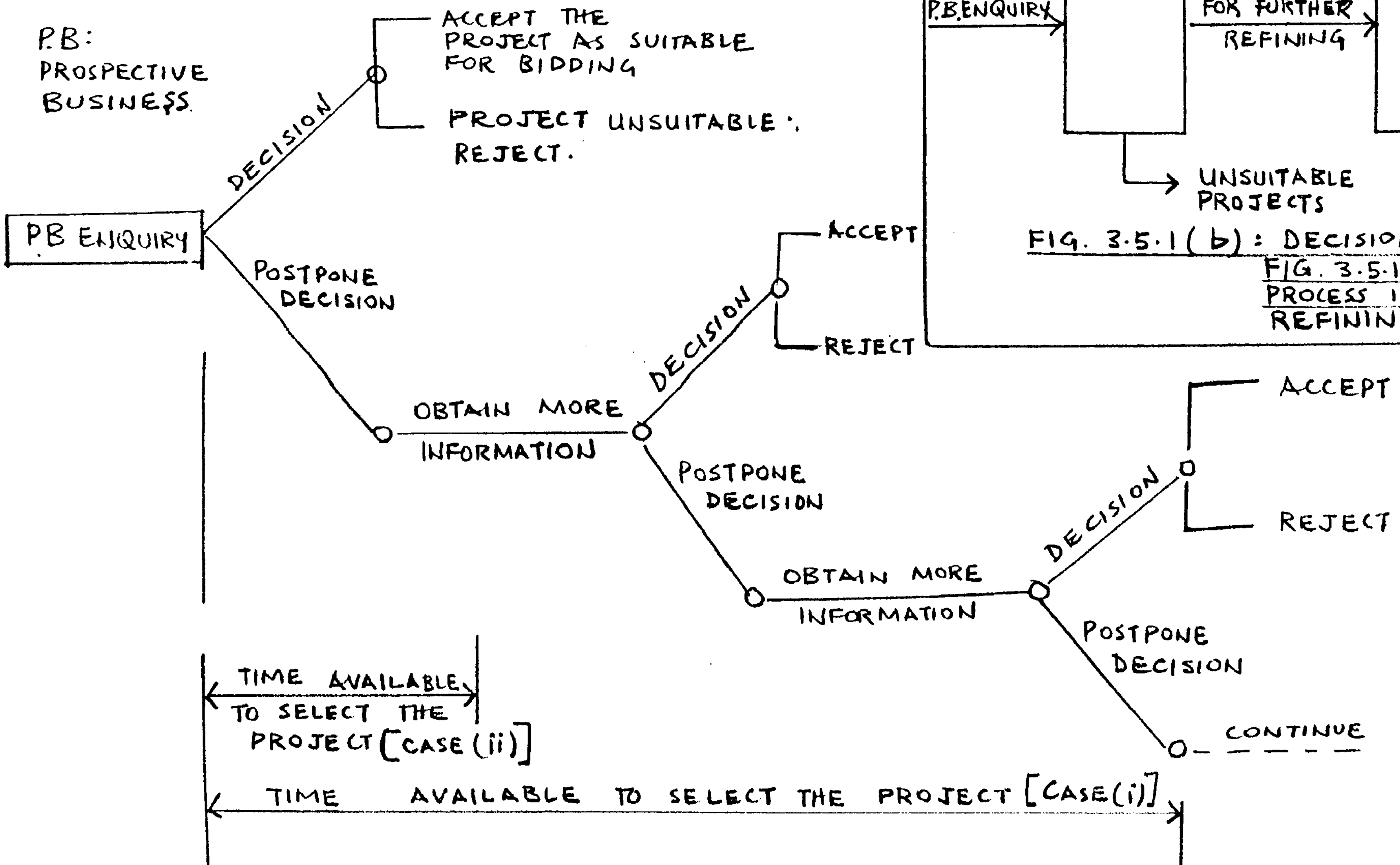
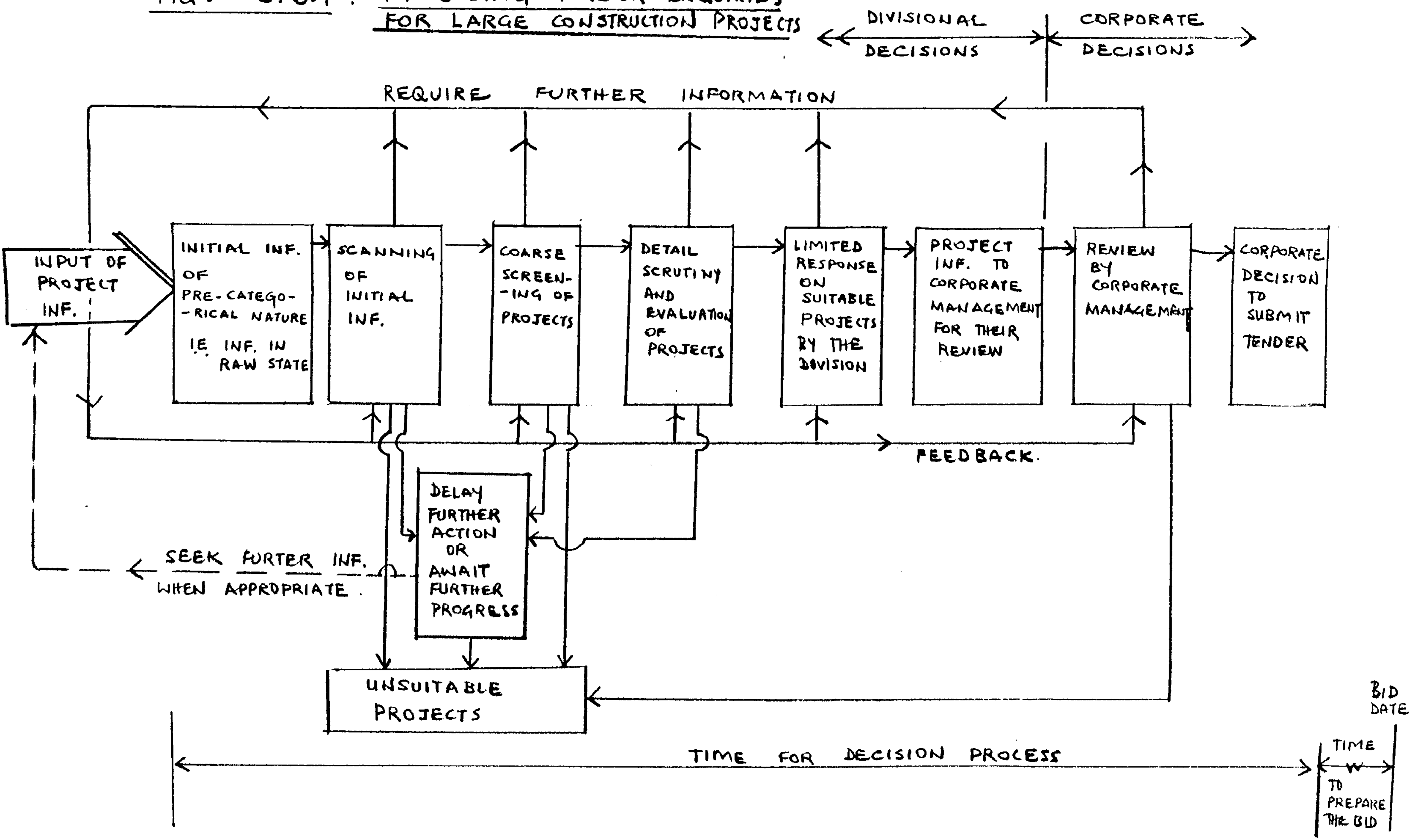


FIG 3.5.1: (a): DECISION PROCESS FOR SELECTING A PROJECT TO TENDER.

FIG: 3.6.1: PROCESSING TENDER ENQUIRIES FOR LARGE CONSTRUCTION PROJECTS



Case Study 3.6.1:

DECISION TIME IN PRACTICE

Background:

Analysis of certain decisions and their timings for an enquiry for Engineering Services for a dam project in a Middle Eastern country.

Brief Details

1. Enquiry documents were sent by a prospective Agent under his covering letter stating his opinion and interpretation of the Client's requirements.

2. One of the requirements was that the foreign Engineering Services Contractor must use locally available technical services.

3. Tendering period 6 weeks.

Severe time constraint

By the time the contractor obtained the necessary information from the site visit, he had approximately two weeks to prepare and submit the bid. The bid was unsuccessful. Various decisions took approximately four weeks as shown in Chart 3.6.1.

CHART 3-6-1: DECISION TIME

S: SUBJECTIVE INF.
O: OBJECTIVE INF.

DECISION SITUATION	TYPE OF INF. AND DECISION TIME	DECISION MAKER	COMMENTS
IS THE INF. FROM THE PROSPECTIVE AGENT SUFFICIENTLY RELIABLE TO COMMIT THE RESOURCES? → YES	PARTLY O, PARTLY S (ONE WEEK)	BUSINESS DEVELOPMENT MANAGER (BDM.)	O: CLIENT'S ENQUIRY DOCUMENT. S: AGENT'S INTERPRETATION OF THE CLIENT'S REQUIREMENTS.
HAS THE COMPANY THE NECESSARY TECHNICAL RESOURCES? → YES	O (ONE WEEK)	BDM AND THE CHIEF CIVIL ENGINEER (CCE)	
IS IT THE TYPE OF PROJECT THE COMPANY IS INTERESTED IN? → YES	O (ONE WEEK)	BDM.	
IS THE TERRITORY ACCEPTABLE? → YES	O (TWO WEEKS).	THE DIVISIONAL BOARD.	THE CORPORATE POLICY.
ARE THE COMMERCIAL LIABILITIES ACCEPTABLE? → YES	O (ONE WEEK)	COMMERCIAL MANAGER	INF. FROM THE DOCUMENTS
IS THE LEVEL OF RESOURCE COMMITMENT ACCEPTABLE? → YES	O (ONE WEEK)	CCE	WORK LOAD CONSIDERED.
ARE THE NECESSARY TECHNICAL SERVICES AVAILABLE IN THE HOST COUNTRY? → YES	S (TWO WEEKS)	BDM/CCE	AGENT'S OPINION CONSIDERED.
IS THE TIME AVAILABLE SUFFICIENT TO PREPARE A COMPETITIVE TENDER? → TIME RESISTENCE → YES	S (3½ WEEKS)	BDM/CCE CHIEF QS	AGENT'S INTERPRETATION OF THE FLEXIBILITY IN THE CLIENT'S REQUIREMENTS CONSIDERED.
MORE INF. NECESSARY? → YES.	O (ONE WEEK)	BDM/ CHIEF GEOLOGIST	FROM THE DOCUMENTS IN HAND.

DECISION:

IT WAS DECIDED TO SEND THE CHIEF GEOLOGIST TO THE SITE TO GET MORE INFORMATION.

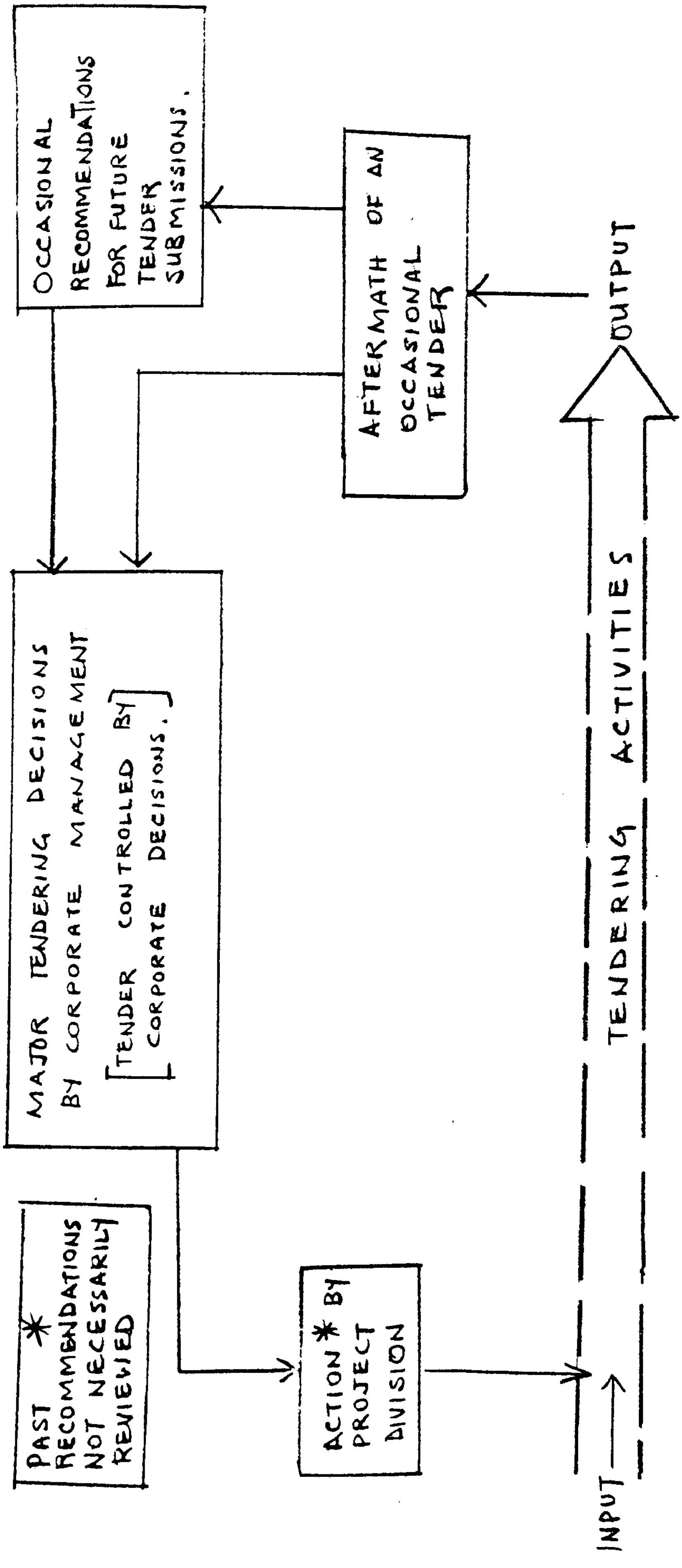


FIG 3.7.1: THE TENDERING PROCESS IN A CONTRACTORS ORGANISATION

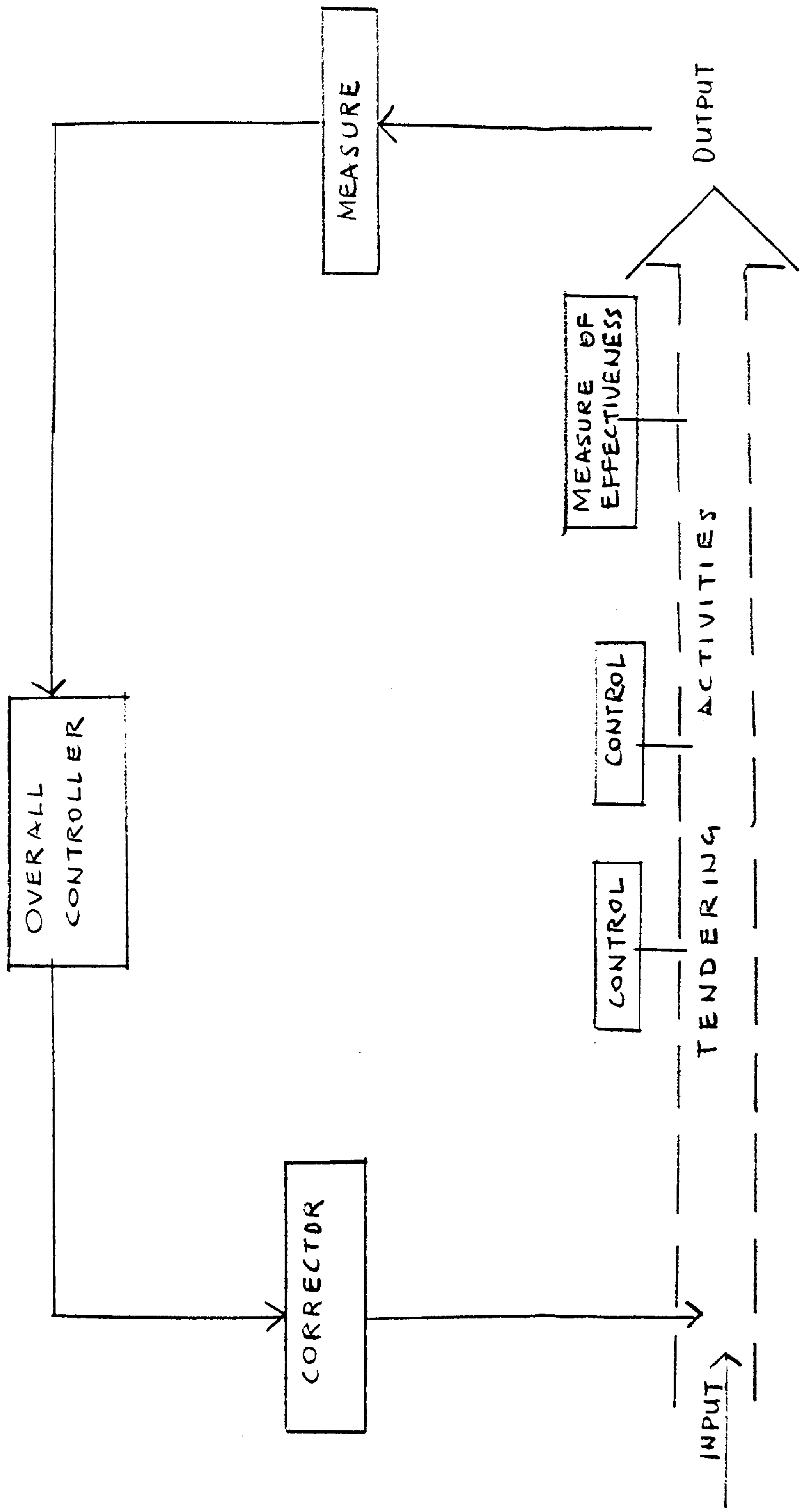


FIG. 3.7.2: A TYPICAL PROCESS WITH MEASURES, CONTROLS & CORRECTORS.

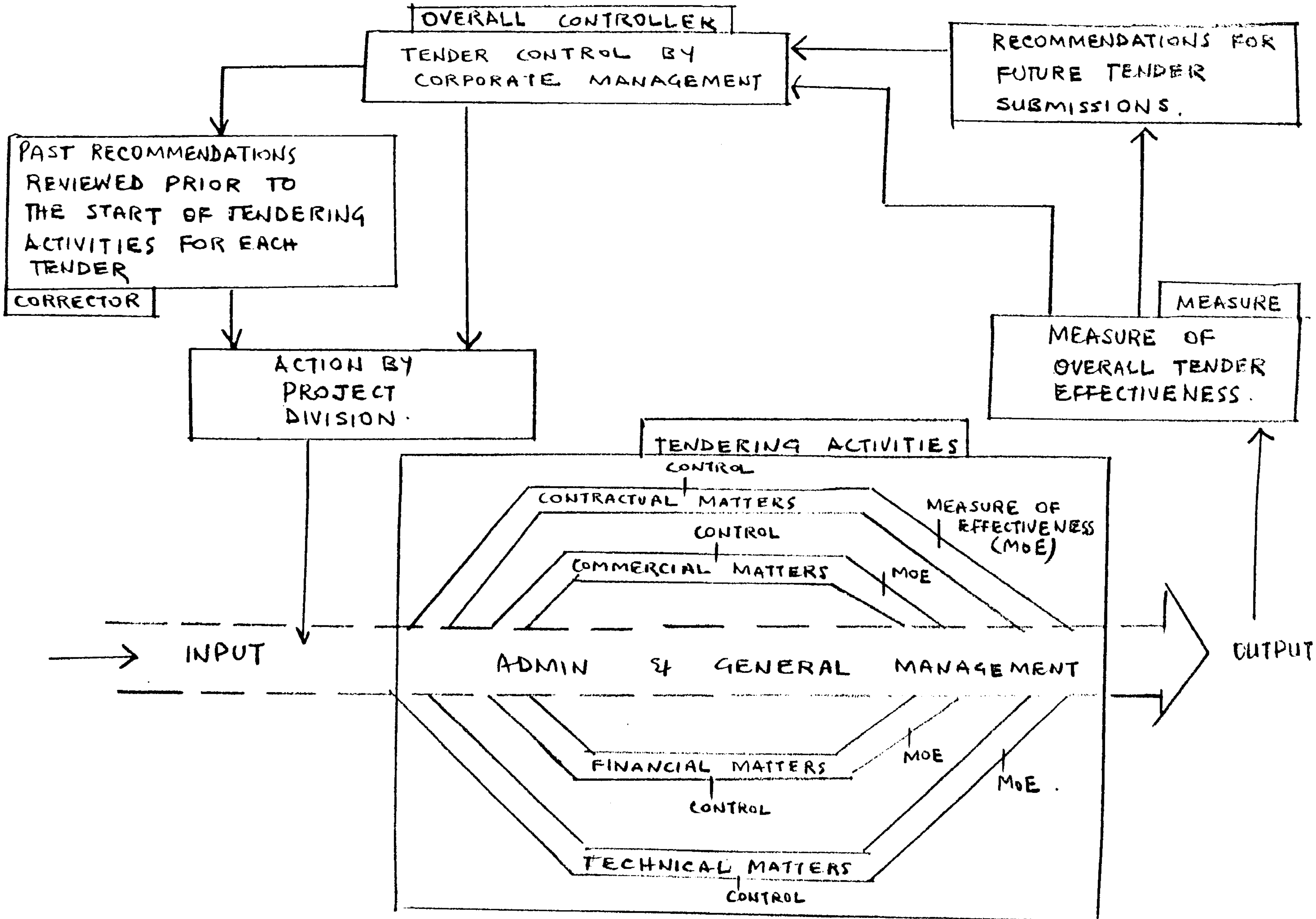


FIG 3.7.3: SUGGESTED REFINEMENTS TO THE EXISTING TENDERING PROCESS INORDER TO IMPROVE THE TENDER EFFECTIVENESS.

FIG 3.7.4:
BASIC TENDERING PROCESS

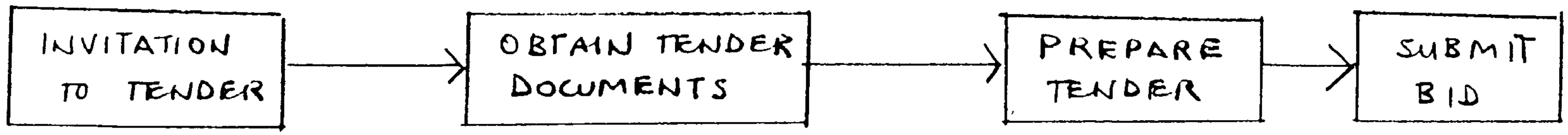


FIG 3.7.5:
SOME REFINEMENTS TO THE BASIC TENDERING PROCESS.

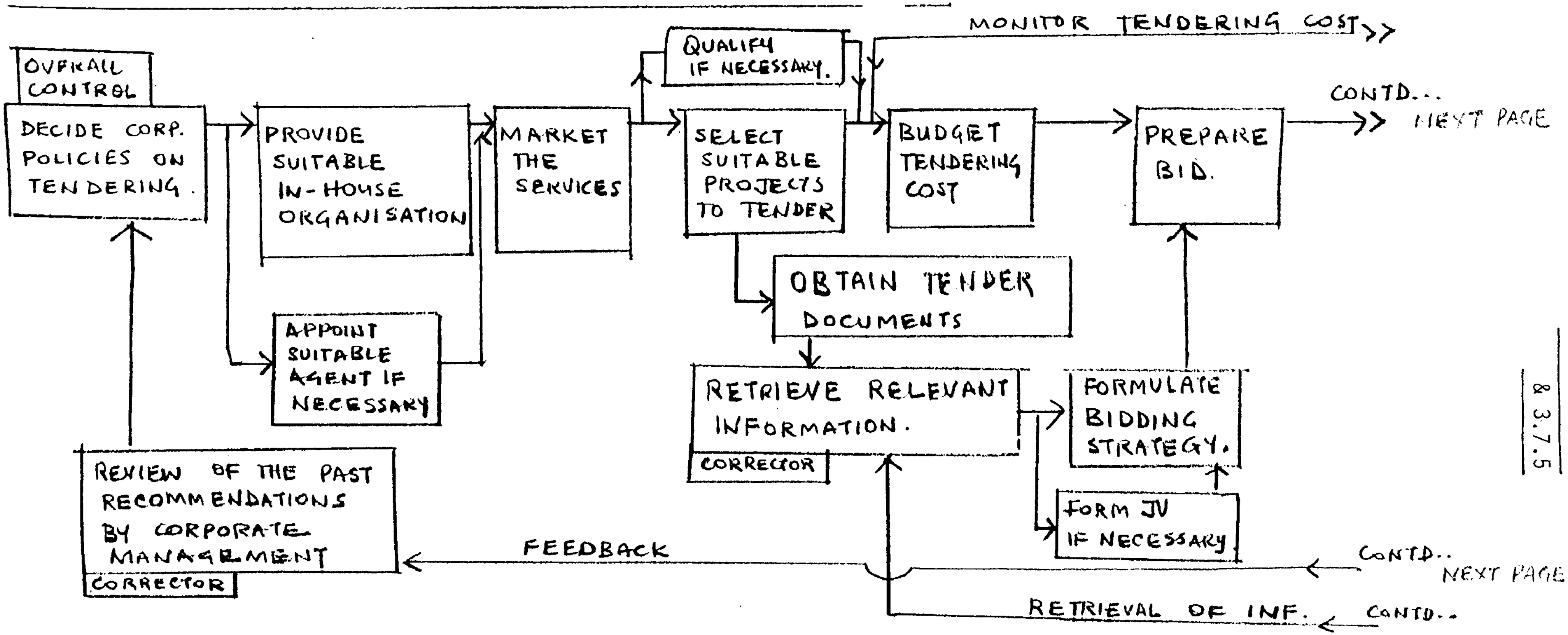
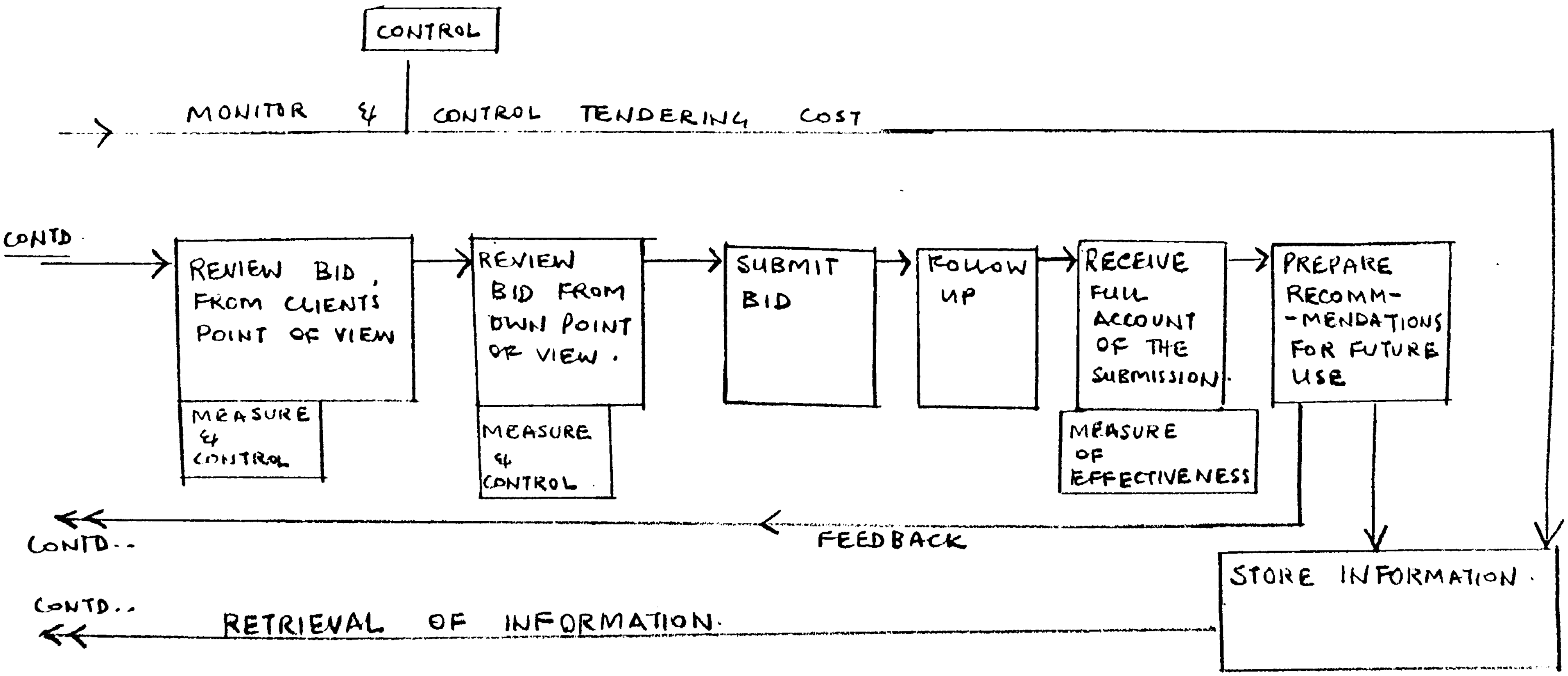


FIG 3.7.5 (CONTD..).

SOME REFINEMENTS TO THE BASIC TENDERING PROCESS.



CHAPTER 4

COMPLEXITY, UNCERTAINTY, TIME CONSTRAINT AND OCCUPATIONAL STRESS

CHAPTER 4: COMPLEXITY, UNCERTAINTY, TIME CONSTRAINT AND OCCUPATIONAL STRESS

SYNOPSIS

Contractors have to take many critical decisions during the initial stage of tendering when uncertainty is at its peak. They are often faced with complex tendering tasks to be performed under severe time constraint. The pilot study suggests that the above three factors - complexity, uncertainty and time constraint - are the main sources of occupational stress in tendering personnel. It can affect the quality of their decisions under such adverse conditions. By highlighting both, the complexities in pre-selected tendering tasks and internal and external uncertainties that exist in contracting organisations, the attention has been drawn to practical difficulties of using some of the known management techniques in these situations. It has been indicated that there is a need for decision aiding tools which can transform subjective assessments in to objective means of decision making.

4.1 Introduction

It has been argued in the previous chapter that tendering is a process. From the initial stage of identifying a suitable project to bid to the final stage of bid submission and the follow up, the process consists of a series of tasks, the majority of which are of a complex nature. The complexity of these tasks increases as the size of a project exceeds the normal limits of large projects.

More often than not, contractors are given insufficient time to process tender documents (which at times need translating or searching for more information) and submit their bids. Apart from technical and commercial requirements, a project may be poorly defined from a contractor's point of view thus, creating a great deal of uncertainty. Generally, contractors tendering staff show a persevering aptitude when dealing with complex tasks but this desired quality, when subjected to uncertainty and time constraint, can introduce an element of stress (cognitive stress), thereby affecting the quality of their decisions taken under such adverse conditions.

This chapter scrutinizes such conditions and examines the suitability of some of the known management techniques to deal with these situations.

4.2 Complexities of tendering tasks

4.2.1 Selecting suitable projects to bid

Chart 4.2.1.1, showing the number of project enquiries handled and the number of tenders submitted by a contractor, suggests that a large proportion of prospective business enquiries never reached the tendering stage. Furthermore, for a small number of enquiries that did reach this milestone, the contractor's tendering performance was far from being satisfactory

4.2.1 Selecting suitable projects to bid (Continued)

The analysis of these projects showed that the contractor had practically no experience in 33 percent of the projects pursued, 8 percent covered a wide range for which the contractor's expertise could not be identified with. Although 51 per cent of the total prospective business that was pursued could be vaguely associated with the contractor's general line of business, only a small percentage could be closely identified with the contractor's expertise and his image in the construction field. A high proportion of what little number of bids he submitted proved uncompetitive mainly because of the level of contingency in his bids to counteract the uncertain aspects of such projects.

Fig. 4.2.1.1 highlights the need for early decision to commit the resources to develop a proposal.

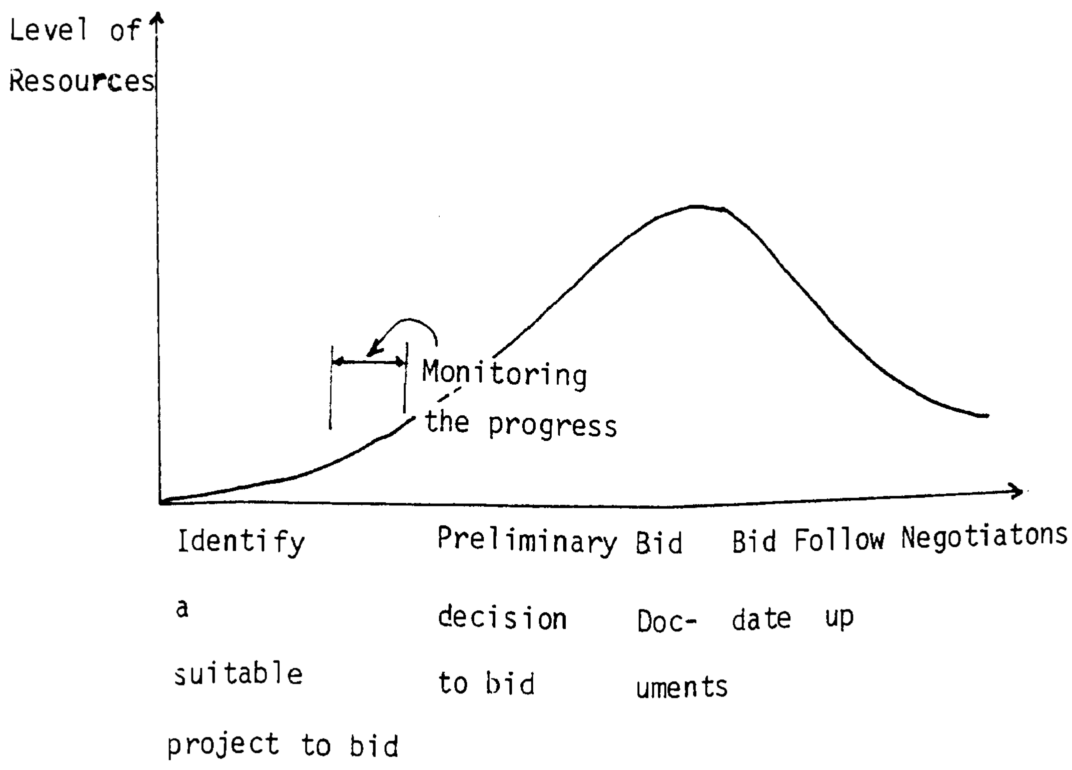


Fig.4.2.1.1

Silver (1977) suggests a check list (See Appendix A.4.1) to arrive at a preliminary decision to commit resources which starts with 'Is it a " Real" project ?'

Ziomas (Unpublished) has identified economic factors influencing the 'reality' of a project in a developing country.

Referring to the monitoring the progress of a project in Fig 4.2.1.1. Bessant (1978) has identified five stages of project monitoring in Werdegang (a Swiss chemical company) and has established a parallel procedure in the chemical industry.

Once a project is identified as a 'real', it is necessary to study the project from a contractor's own corporate policies point of view. An approach of pursuing prospective business enquiries without a detail scrutiny was described by a senior manager as 'shooting at anything that moves'. A detail scrutiny is necessary to decide whether the contractor is sufficiently interested in submitting a bid and willing to allocate the necessary resources to its preparation, otherwise, the resources could be employed more advantageously elsewhere.

Appendix A.4.2 lists some of the aspects of power generation projects in developing countries which could be considered for a detail scrutiny.

The task of identifying and selecting suitable projects to bid based on sound economic factors and from contractor's corporate policies point of view, is therefore complex.

4.2.2 Selecting a suitable agent

As soon as a project is publicised, it is a common practice for local agents to write (See Exibit 4.2.2.1.) to international contractors introducing their services and offering to buy the tender documents on their (contractor's) behalf. In some countries e.g. Dubai, Jordan, it is a statutory requirement for an overseas contractor wishing to obtain work in these countries, to appoint officially, a local agent for a specific project. The fees for this service is usually stipulated by the local laws. Such agents often try to form associations with more than one contractor in order to improve their chances. At times they use one contractor against another to further the chances of one whom they consider has a better chance of winning the contract.

Prabhu (1976) cites Stilling's comments referring to making a choice of an agent as one of the critical decisions in tendering. It is a long term relationship i.e. for the life of a contract, if the bid is successful, and may be unwise to break once an association is formed. If a contractor has no existing arrangements for the local representation for a project the task of selecting a suitable agent can be extremely complex.

4.2.3 Client/contractor interaction

It is important for a contractor to distinguish between economically demanding projects and prestige projects. Many of the decisions taken by the client will depend upon this categorisation. King Faisal Hospital in Riyadh in Saudi Arabia, whose final cost climbed 25 tomes to $250m, is a typical example of a prestige project. It took eight years to complete.

4.2.3. Client/contractor interaction (Continued)

Motivating factors will be different according to the interests and prejudices of the decision maker. Pre-dispositions can incluence the final decision.

It is therefore necessary to identify the client's motivating factors and then weigh them according to functions (i.e. engineering, management, etc.) and the degree of influence they may bear upon the final decision. (Table 4.2.3.1 lists some of the likely motivating factors in a client's decision to select a particular contractor)

4.2.4 Sub-contract enquiries

In construction contracts, main contractors have to rely heavily on sub-contractors to carry out specialist work. In his relationship with sub-contractors, the main contractor assumes the role of a client. But where most of the clients leave consultants to deal with such matters as preparing and issuing contract documents, negotiating and recommending contract awards, etc, main contractors have to perform these tasks themselves. Their tendering resources are often stretched to a limit in preparing and issuing sub-contract enquiries. There are a number of tasks to be carried out (see Table 4.2.4.1) and depending upon the size of a project, some of them can be extremely complex.

4.2.5 Estimating tendering cost

Basically, tendering costs for large scale overseas projects can be divided into the following two main categories:-

a) Manhour cost

and b) Expenses.

4.2.5 (Continued)

When more than one division of a contractor's group is involved in tendering, it is necessary for the leading division to prepare a master tendering programme with tendering cost estimate inputs from other divisions. The majority of contractors use a line and staff structure to keep the tendering cost down to a minimum. For large scale turnkey projects, because of the inter dependent nature of the engineering design (i.e.civil engineering design cannot proceed until loadings from electrical, mechanical, etc., equipment are known and the electrical/mechanical design is completed), the overall bid preparations are often planned in a network form as illustrated in Chart 4.2.5.1.

4.2.6 Evaluation of risks and contingency pricing

Risk analysis for a construction project is the identification and the evaluation of a contractor's exposure to accidental losses in the project. The evaluation is usually made in the following two sections:

a) frequency

and b) severity

Frequency is the number of times the same loss making item will occur over a chosen period e.g. likelihood of paying liquidated damages over a series of key dates.
Severity is the loss usually expressed in monetary units that each loss making item in a project will represent for the contractor e.g. total liquidated damages, loss due to remedial work, etc.

As far as evaluation is concerned, losses fall into the following four broad categories:

4.2.6 Evaluation of risks and contingency pricing Continued.

(a) Losses with low frequency and severity.

(b) Losses with high frequency but low severity.

(c) Losses with low frequency but high severity.

(d) Losses with high frequency and high severity.

Obviously, the last category will not be acceptable to any reasonable contractor. In identifying risks, contractors have to think through consequences of events with potential risks such as listed in Table 4.2.6.1.

The complexities of the task of evaluating risks in a project are illustrated in Fig. 4.2.6.1. Case study in Appendix A.4.3 illustrates some of the uncertainties and risks faced by the client and the contractor in a mining project.

4.2.7 Competitive pricing

A tender price is generally made up of the following figures.

a) Prime cost

b) Contingencies

and c) Contribution

Prime cost

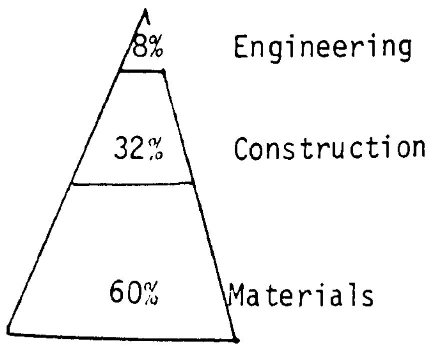


Fig. 4.2.7.1

Typical contents of a process plant project is 8% engineering, 32% construction and 60% materials. The project cost on this basis is shown in a pyramid form in Fig. 4.2.7.1

4.2.7 Continued

Normal reaction in such projects is to assume that material and construction costs should be controlled during the tendering period in order to improve the chances of success.

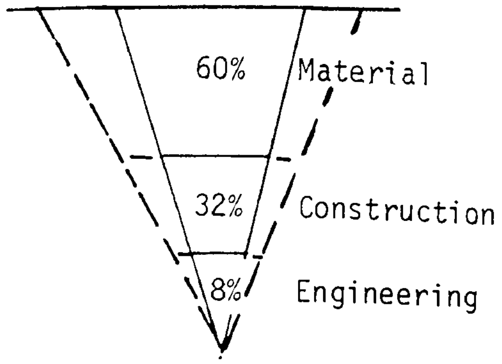


Fig. 4.2.7.2.

If the project cost pyramid is turned round, as shown in Fig. 4.2.7.2, one can see that the critical area of cost control is the engineering i.e. any uncontrolled design can increase the cost of a project enormously.

The complexities of producing a competitive tender with government co-operation is illustrated by Case Studies. 4.2.7.1 and 2. Case Study 4.2.7.3 discusses the complexities of a competitive tender for a power project.

4.2.8 Estimating expatriate costs

International contractors consider many sources of remuneration to expatriates to attract right applicants. CBI's estimate of the cost of a senior expatriate in a Middle Eastern country suggests that for the first year the cost could reach as much as £50,000. The summary of an American contractor's cost estimate of 14 expatriates is given in Table 4.2.8.1. Prabhu (1976) highlights the complexities of estimating local tax liabilities on expartriate salaries.

4.2.9 Tender reviews

In order to ensure that divisions comply with corporate policies, the majorityof contracting groups have internal tender reviews at the

4.2.9. Continued

through a bureaucratic process.

The tasks involved in satisfying such a tender committee are complex. Table 4.2.9.1 lists some of the items which undergo the scrutiny of such a committee.

4.2.10 The level of contribution

The contribution from a project covers a percentage of fixed overheads and a profit. Typical fixed overheads for an international contracting organisation are shown in Chart 4.2.10.1. These overheads are separate from project overheads shown in Chart 4.2.10.2. The latter is fully recoverable as a project cost while the former is only partially recoverable under contribution. In practice, the level of contribution is not decided until the project cost has been fully established. Hence, the decision regarding contribution is often taken a few days prior to the bid submission. The factors likely to influence this decision are listed in Table 4.2.10.1A. and their likely interaction in Table 4.2.10.1B. in form of a notional matrix.
The task of taking a rational decision under such circumstances can be extremely complex.

4.2.11 Accountability of tender submissions

For a post-bid review to be meaningful, it has to consider a wide range of organisational problems. The areas in which potential problems may occur when submitting a tender on behalf of a Group of companies, are listed in Table 4.2.11.1.

4.3 Uncertainty

4.3.1 Definition

Knight (1921), Luce & Raiffa (1957) and Raiffa (1968) define uncertainty as those situations where probability of the outcome of events is unknown and cannot even be predicted in probabilistic terms.

Lawrence and Lorsch (1967) take a wider view of uncertainty. They suggest that uncertainty is a situation where there is an absence of specific, relevant and timely information and there is usually a long time gap in definitive feedback.

In the contracting world, uncertainty is a situation with a long time span of definitive feedback where there may be a wait for months or even years before the correctness of decisions and actions shows up, situation in which there is a lack of knowledge concerning cause and effect in which decision makers cannot perceive with any clarity the consequences of their decisions and actions.
Hackney (1965) deals with uncertainty in project cost estimating.

4.3.2 Examples of uncertainty

For examples of uncertainty in tendering and comments see Appendix A.4.4.

4.3.3 Types of uncertainty and assumptions

Bell (1978) suggests that there are two general types of uncertainty: information and performance. Jameson (1978) argues that uncertainty relates to our perception of instability and uncertainty is, in this sence, the psychology of instability.

4.3.3 (Continued)

Hertz (1964) points out that the difficulty is in the assumptions and in their impact. Each assumption involves its own degree of uncertainty, and taken together, these combined uncertainties can multiply into a total uncertainty of critical proportions. Serious errors in assumptions during tendering for large scale projects can have long term repercussions on the contrator's overall business activities.

4.3.4 Internal and external uncertainty

4.3.4.1 General

Contractors attempt to respond to the demands and pressures of their service market environment - the external environment.. But for their staff, organisational structures, procedures, value systems, etc, is their environment - the internal environment.

These two environments are constantly interacting with each other and in doing so, they affect the network of human relationships. Krantz (1976) lists some (See Table 4.3.4.1) elements of uncertainty and variability. Chart 4.3.4.1. illustrates how external, internal, political, information and performance factors contribute to generate uncertainty in a negotiated contract.

4.3.4.2 External uncertainty

Thomson (1967) suggests that uncertainty in the external environment arises from the following two principal sources.

1 Due to lack of undertanding of the relationship between causes and effects of the events taking place within the external environment.

4.3.4.2 External uncertainty

2 A contingency form of uncertainty in which the outcomes of organisational action are in part determined by factors operating in the external environment. The firm can thus never be sure that an action directed at the achievement of a certain end will in fact produce the desired end result.

4.3.4.3 Internal uncertainty

Argyris (1972) has criticized Thomson for ignoring internal uncertainty as a problem within the firm. He points out that the assumption "if the internal environment was managed correctly the firm would be tuned correctly to the requirements of the external environment" by the early theorists does not pay sufficient attention to the nature of the relationship between the firm and its external environment or to the influence of the external environment behaviour of the firm. He has received some support from Duncan (1972) who argues that ' there is a need to examine the impact of individual differences on perception of uncertainty and the complexities and dynamics of the organisation's internal and external environment.

Mumford & Pettigrew (1975) point out that some researchers e.g. Burns & Stalker,Woodward; ignore the equally important contingent factor of individual differences among organisational members.

The above different views can be summarised by the following observations in situations where a tender is submitted on behalf of a Group with one of the divisions chosen to lead the Group's effort.

4.3.4.3 Internal Uncertainty (Continued)

Giving one division a power may reduce or remove the powers from other divisions which could lead to confrontation if they fight to retain their powers. In practice, these confrontations revolve around the argument that divisions are profit centres and therefore they have a freedom to price their part of the work as they wish without any interference from the division which has a leading role in the Group's tenders. As a consequence, undeclared non-co-operation exists resulting in undisclosed profit figues at division levels. The final result of this internal uncertainty is uncompetitive bids. Any actions to cope with this leads to political behaviour producing more uncertainty. Blake-et-al (1964), Lynton (1969) and Walton (1965) highlight the consequences of political uncertainty.

Case study 4.3.4.3.1 and Fig 4.3.4.3.1 highlight the internal uncertainty due to political conflict in a tendering situation.

The sources and causes of uncertainty in tendering situations are listed in Appendix A6.2.3.

4.3.5 Controlling uncertainty

Fig. 4.2.6.1 shows some of the risks at various stages of a project. It should be possible to examine the consistency and the pattern of these risks.

4.3.5 Controlling uncertainty (Continued)

The trade-off approach to control uncertainty i.e. greater undesirable uncertainty is traded off for a less desirable uncertainty, is discussed in multi-attribute utility analysis in Chapter 6.

4.4 Time constraint, occupational stress and quality of decisions

Some of the complexities of pre-selected tendering tasks and the aspects of uncertainty during tendering have been discussed above. From the summary of response (See Table 4.4.2) to Questionnaire 4.4.1 (completed by a small team involved in tendering for overseas projects), an additional major factor - time constraint - was identified with the above two i.e. complexity and uncertainty, as a contributory factor to occupational stress. It has been suggested that a relatively high proportion of their time is occupied in ensuring that their corporate requirements are satisfied. When tendering periods are short, this need to meet internal requirements, according to a tender project manager, creates a two-way time pressure and if it is accute, then it can be a source of occupational stress. Fig.4.4.1 illustrates this phenomenan.

When critical decisions have to be taken under these conditions, the quality of such decisions is known to be at risk. Table 4.4.3 lists some of the decisions taken during tendering and the likely problems as a consequence of these decisions. This diagnostic approach should assist in improving the quality of tendering decisions.

4.5 Practical difficulties in using standard techniques

Contractors would prefer to know whether or not a client is bias towards bids submitted with local collaborations. But it is not always possible to obtain in time, reliable information about a particular client's way of thinking on such matters as above. In the absence of such information, it should be possible for the UK contractors to obtain the required information through government departments e.g. Oversea Project Group, Export Credit and Guarantee Department. By a standard statisical test e.g. χ^2 - Test, it should then be possible to establish the significance of such information. There are however, practical difficulties in obtaining this type of information. In addition to the sources listed in Exibit 4.5.1, many established libraries including the City Library and the library of the Department of Trade - Overseas Section, were approached without success. The suggestion to contact the local MP was not pursued. In absence of any factual information, it was decided to simulate a data. Example 4.5.1 illustrates such an attempt. The result is encouraging in the sense that it can assist management to decide whether a local callaboration has an advantage over bidding alone or with a collaboration other than a local one.

As illustrated in Appendicies A.4.5(1) & (2), other statistical tests, e.g. Expected Value Method, Decision Tree Technique, too can be useful provided the required information is available in time. In practice however, the requirement to assign probability at the preliminary stage when such information is usually scarce, have made these techniques unpopular. The Simulation Technique (Monte-Carlo Method) is a highly sophisticated approach requiring specific skills not commonly associated with tendering work. Hess and Quigley (1963) have outlined this technique in analysing risks in investments.

4.5 Practical difficulties in using standard techniques (Continued)

It is therefore argued that in these situations where project information is scarce but subjective judgements can be made from experience, there is a need for decision aiding tools to transform such judgements into objective means of decision making. These methods are discussed in the applications of systems analysis in Chapter 7 of this study.

Conclusions

Due to external pressures, contractors regularly examine their operating methods but in such re-organisation attempts, the organisation structure as a potential source of internal uncertainty is not given sufficient recognition. Political conflict resulting from such re-organisations is a source of internal uncertainty which can affect tendering performance.

When internal and external requirements have to be complied within a relatively short tendering period, tendering personnel are subjected to two-way time pressure. This is a major occupational stress raiser, others being complexity and uncertainty.

In tendering for large scale overseas projects, uncertainty is at its peak at the initial stage but contractors have to take many crucial decisions during this period. There are practical difficulties in using standard management techniques hence, the need for decision aiding tools to assist managers to transform subjective assessments into objective means of decision making.

CHAPTER 4

CHARTS, TABLES, ETC

CHART 4.2.1.1

INFORMATION OBTAINED IN A CONFERENCE

		TOTAL	FOLLOWING UP	SUB-TOTAL	AWAITING/WATCHING BRIEF	DEAD	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
A	POWER DESAL. PLANT.	2	1	2	2	1	W	A																						
	POWER STATION (THERMAL)	24	12	12	6	6	D	D	D	D	D	D	W	W	W	W	W	W												
	POWER STATION (HYDRO)	6	4	2		2	D	D																						
	ELECT. DISTB.	1	1	1	1	1	D																							
	REACTIVE POWER	1	1	1	1	1	D																							
	NORTH SEA GENERATION	1	1		1	1																								
	GENERATING PLANT (SETS)	2	1	2	1	2	D	D																						
	SUB-STATIONS	1	1																											
	UNDERGROUND POWER TRANS	1	1																											
	ELECTRIFICATION SCHEMES	3	1	2		2	D	D																						
	SUB-TOTALS	41	19	22	8	14																								
B	DESAL. PLANTS	5	1	1	1	1	W																							
	WATER PROJECTS	4	2	2	1	2	D	D																						
	STEELWORKS	2	1	1		1	D																							
	COPPER SMELTER	5	3	2	1	1	D	W																						
	AL. SMELTER/ALUMINA	2	2	1	1	1	W																							
	REDUCTION PLANT	1	1																											
	COAL DEVELOP	2	2																											
	FERTILIZER PLANT	1		1		1	D																							
	CHEMICAL PLANT	2	2																											
	PULP MILL	1		1		1	D																							
	FISHMEAL PLANT	1	1																											
	OIL TERMINAL/REFINARY	12	4	8	3	5	D	D	D	D	D	W	W	W																
	SUB-TOTALS	37	22	17	6	11																								
C	WORKSHOPS	1	1																											
	STORAGE TANKS	1	1																											
	FACTORY PROJECTS	2	2																											
	AIRPORT DEVELOP (HANGERS)	1		1		1	D																							
	MASONARY WORKS	1	1																											
	UNIVERSITY PROJECT	1		1		1	D																							
	FARM BUILDINGS	1		1		1	D																							
	OFFICE BLOCKS	1	1																											
	BRICK FACTORY	1	1																											
	CONSTRUCTION CAMPS	1	1																											
	WAREHOUSES	1		1		1	D																							
	EXPLOSIVE FACTORY	1	1																											
	COMMERCIAL CENTRE	1	1																											
	HOUSING SCHEME/TWNSHIP	2	1	1		1	D																							
	DAM	1		1	1		A																							
	INDUSTRIAL QUAY	1	1																											
	PIPELINE	1	1																											
	MAINTENANCE DEPOT	1	1																											
	PORT FACILITIES/NAVAL DOCK	2	1	1		1	D																							
	SUB-TOTALS	22	15	7	1	6																								
D	MINING TRANSPORTATION	1	1																											
	SALT MINES	1	1																											
	AGRICULTURAL PROJECTS	1		1	1		A																							
	NAVAL BASE	1	1																											
	MILITARY INSTALLATIONS	1		1		1	D																							
	MICROWAVE COMM.	1	1																											
	PROCUREMENT PACKAGES	3	3																											
	SUB-TOTALS	[illegible]	7	2	1	1																								
E	GENERAL & POWER COOPERATIONS	[illegible]	[illegible]	2	1	1	D	W																						
	SUB-TOTALS	[illegible]	[illegible]	[illegible]	1	1																								
	GRAND TOTALS	120	70	50	17	33																								

LEGENDS:
D = DEAD.
A = AWAITING BRIEF
W = WATCHING BRIEF

PROJECT ANALYSIS.

	Nos.	%
TOTAL PROJECTS (INCLUDING COOPERATIONS)	120	
DEAD	33	28%
AWAITING OR WATCHING BRIEF	17	14%
SUB TOTAL	50	42%
FOLLOWING UP	70	58%

CLASSIFICATION OF PROJECTS

CLASS OF PROJECTS		Nos	%
PROJECTS ASSOCIATED WITH POWER GEN/DISTB	A *	41	34%
PROJECTS ASSOCIATED WITH PROCESS AND CHEMICAL INDUSTRIES	B	37	33%
PROJECT MAINLY CIVIL BASED	C *	22	17%
ASSORTMENT OF PROJECTS	D	9	8%
GENERAL & POWER COOPERATIONS	E	9	8%
TOTAL		120	100%

* ASSOCIATED WITH GENERAL LINE OF BUSINESS: 34% + 17% = 51%

EXIBIT 4.2.2.1.

SHOUKRY T

P. O. Box

Tel.

T. X. of

Date 1978

التاريخ

Messrs

Ltd.,

Division

Dear Mr.

I have the pleasure to advise you that the Electricity Authority have obtained the approval of Govern to finance the following project:

- 6 units 500 KW Diesel Mobile Generator
- 15 unit 100 KW " " "
- The Electricity Authority are now preparing the tender conditions which will be ready for sale shortly . Since the period of closin date is limited please telex back authorising me to buy the tende documents when it is available on your accounts and confirm my interest on this project.

Thanks for your prompt action and looking forward to hear from you by telex , remain.

Yours Sincerely

Table 4.2.3.1 Motivating factors in selecting a contractor for an invitation to Bid

1. Ability to raise finance (if required)

2. Reputation for competitive tenders

3. Reputation for executing projects on time, to the specifications., etc.

4. Relevant experience.

5. Resources/known in the field.

6. Willingness to accept contractual terms.

7. Past relations with the client.

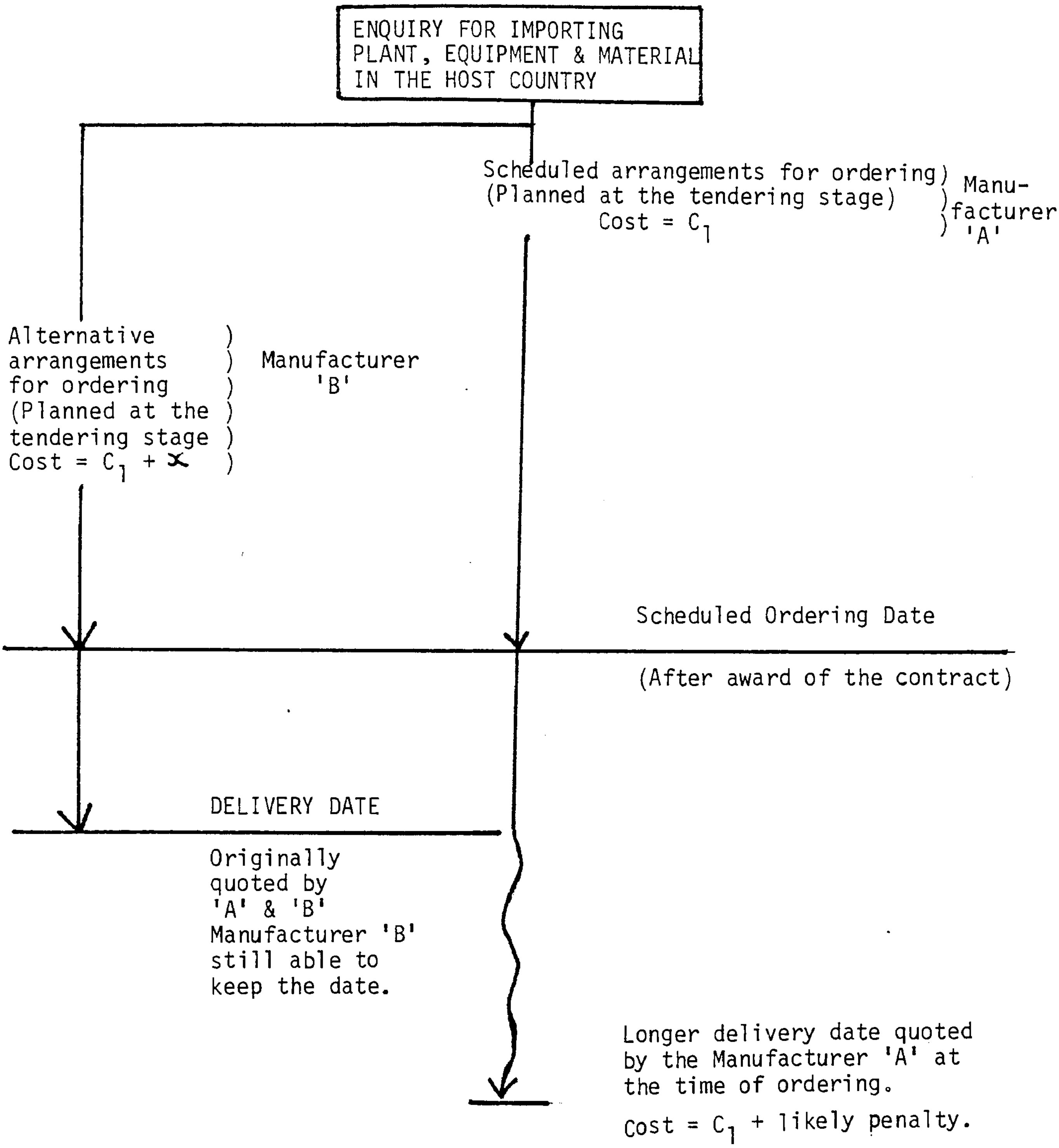
8. Political

   8.1 From politically acceptable country.

   8.2 Exchange of trade missions

   8.3 Long term agreements on aids.

CHART 4.2.4.1



(Place Order with Manufacturer 'B' provided $C_1 + x < C_1$ + Penalty.

TABLE 4.2.4.1

A check list of tasks in preparing and issuing sub-contract documents and vetting S/C offers.

(a) Identify suitable sub-contractors - British or foreign. (Also from the host country). Ensure that they are politically acceptable to the client.

(b) Investigate their financial status, technical capabilities, management and labour resources, etc.

(c) Consider their relevant experience including the experience of working in the territory.

(d) Ensure that they are capable of submitting their bids on time.

(e) Make plans for alternative supply of plant, equipment and material in case any of the preferred suppliers withdraw their offers or the preferred suppliers change delivery dates which are unacceptable or delivery dates could not be met for political or other reasons. This is illustrated by Chart 4.2.4.1.

(f) Prepare technical brief to ensure that the prospective sub-contractors appreciate the scope of the project as a whole and their share of the work.

(g) Ensure that the prospective tenderers are aware of any harsh conditions of contract which they might find unacceptable and therefore decline to bid after studying the documents.

(h) Ensure that the prospective tenderers provide the necessary information for the conceptual design to proceed.

Contd./...

TABLE 4.2.4.1 (Continued)

(j) Carry out sufficient engineering design in order to produce schedule of rates or Bills of Quantities for the S/C enquiry document.

(k) Prepare necessary drawings and schedules.

(l) Prepare the sub-contract specification .

(m) Prepare the conditions of sub-contract and ensure that they agree with the conditions of the main contract.

(n) Prepare the sub-contract programme and ensure that it agrees with the master programme for the main contract.

(o) Prepare the sub-contract tender document.

(P) Ensure that the prospective sub-contractors maintain full interest in the project.

(q) Make the tenderers aware of the importance of timely information on cash flows.

On the receipt of sub-contract bids, check the following:

(a) Omissions, arithmetical errors, etc.
(b) Deviations from the conditions of the main contract.
(c) Qualifications.
(d) Deviations from the specification issued.
(e) Risks i.e. non-performance, delays, currency matters, etc.
(f) Cash flow.
(g) Likely effects of the delay in the award of the main contract on sub-contract bids.

Contd./....

TABLE 4.2.4.1 (Continued)

Note;

In order to be competitive, prime contractors often have to obtain sub-contract bids from more than one firm. The complexity of the overall task of managing sub-contract enquiries increases as the number of sub-contracts and the number of tenderers for each sub-contract enquiry increases. Chart 4.2.5.1 shows the complexity of incorporating various sub-contract information into the final bid.

TABLE 4.2.6.1

Some of the potentially risky events in overseas construction

1. Calling of 'on-demand' bonds.
2. Bankruptcy of a J.V. partner (s) or a sub-contractor(s).
3. Non-performance by a J.V. partner (s) or a sub-contractor (s).
4. Demand for liquidated damages.
5. Bankruptcy of the client.
6. Non-payment or delays in payment by the client.
7. Currency fluctuations.
8. Political actions, war, civil disturbances etc.
9. Contract ratification.
10. Embargo on import of labour, plant and material.
11. Embargo on currency transfer.
12. Termination of the Force Majeure clause.
13. Natural disasters e.g. earthquakes, flooding, etc.
14. Unforseen ground conditions.
15. Higher rate of inflation than expected.
16. Change of Government.
17. Changes in statutory requirements e.g. taxes.
18. Embargo on export of contractor's plant.

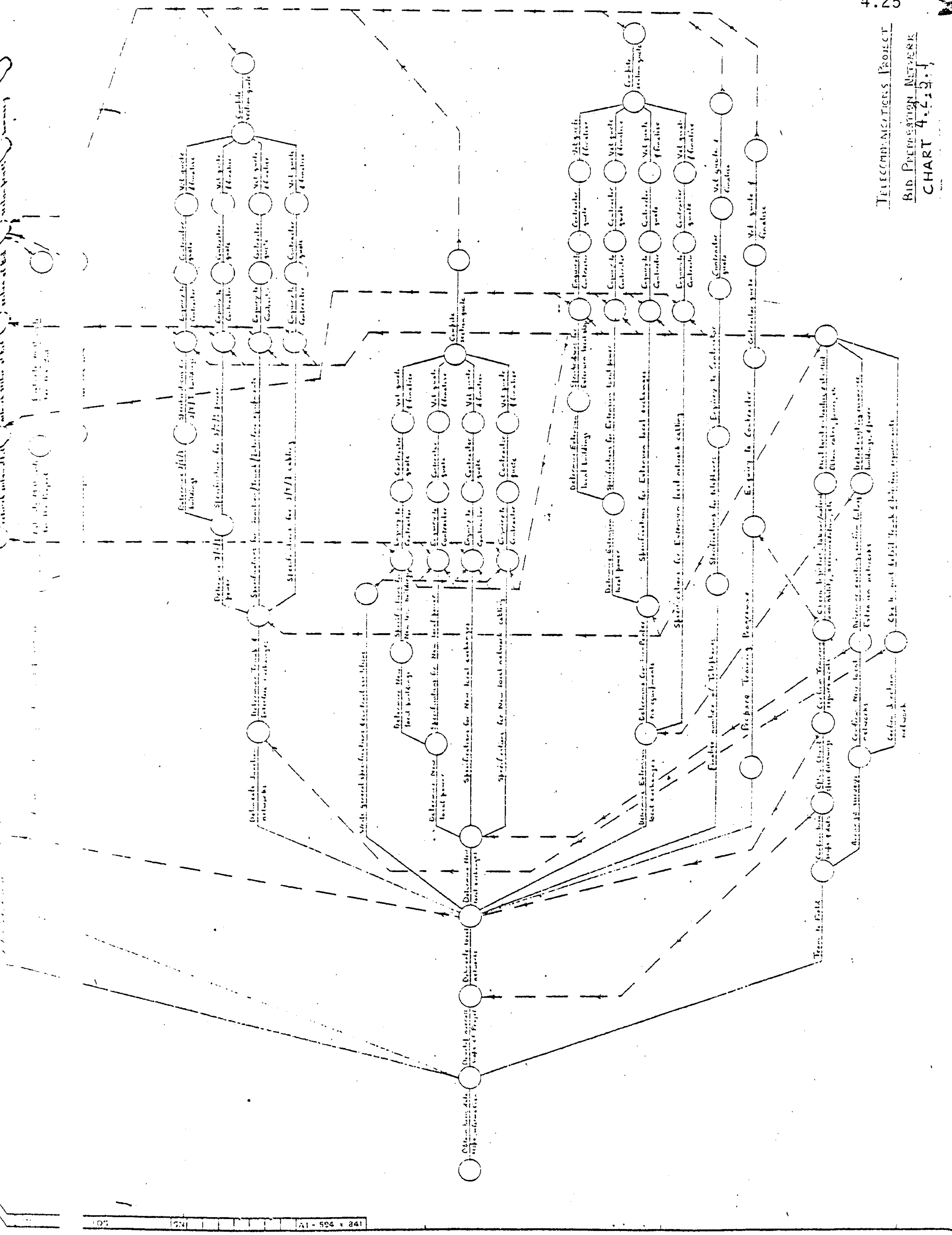
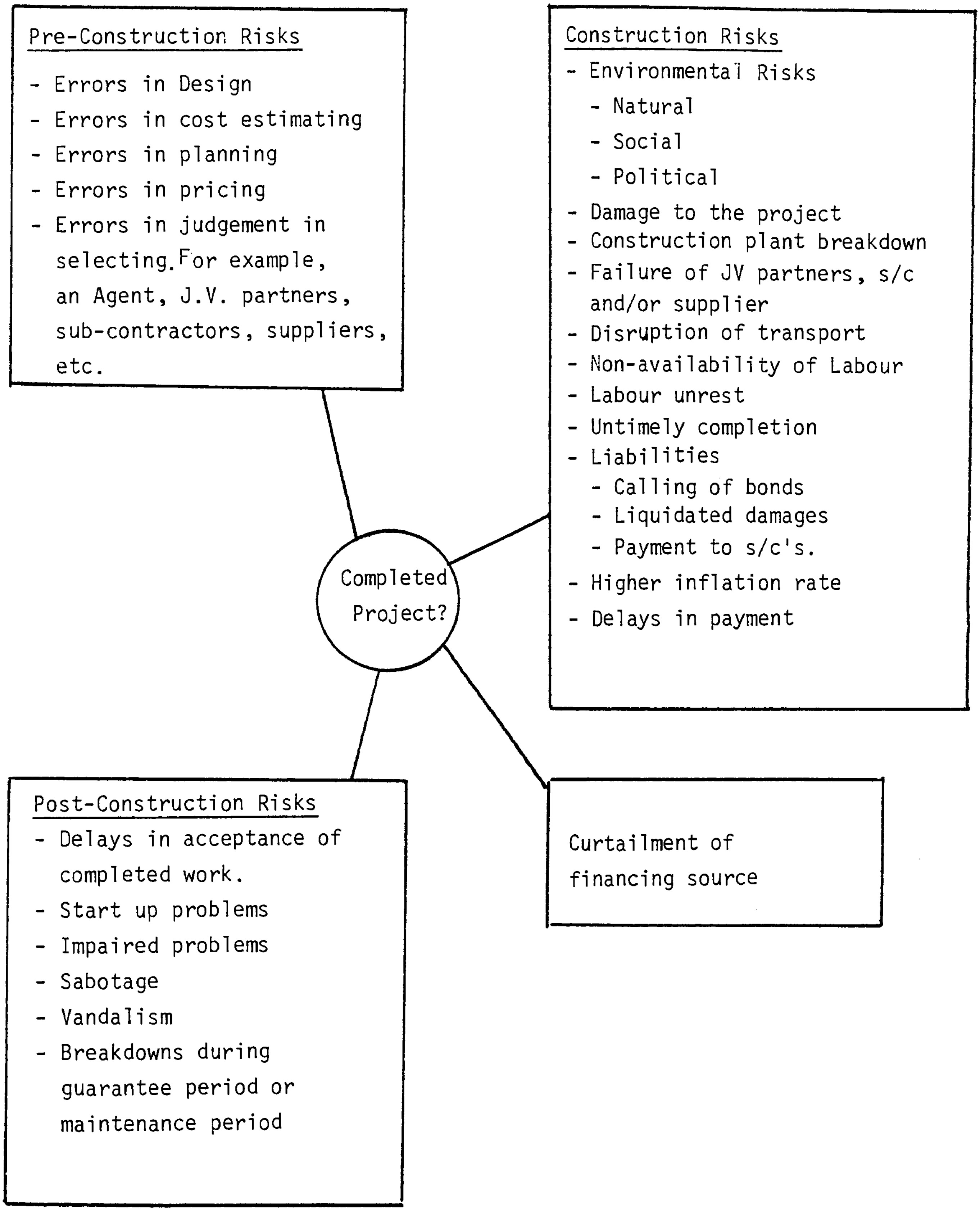

TELECOMMUNICATIONS PROJECT
BID PREPARATION NETWORK
CHART 4.2.5.1

FIG. 4.2.6.1 Risks at Various Stages of a Project



CASE STUDY 4.2.7.1

Recently*, Balfour Beatty, a member of the BICC group won a £100m contract for an electrical transmission system in Hong Kong.

The contract from the China Light and Power Company, is for a 400 kV system in Kowloon and the New Territories of Hong Kong.

The order was gained with British Government co-operation. The Industry Minister co-ordinated the efforts which involved the British Trade Commission, Export Credit Guarantee Department and Lazards, the Industry Department's advisers.

The order is a turnkey package for the design, supply and installation of overhead transmission lines, underground super-tension cables, transformers and reactors. The order has brought substantial work to BICC factories in Hereford, Erith, Prescot and Edinburgh.

The Central Electricity Generating Board's overseas consultancy are to advise China Light & Power Company.

The deal was financed through a syndicate of banks arranged by Henry Schroder Wagg & Company. Financing to the tune of £75m has been supported by the ECGD.

Earlier in that month, General Electric Company & Babcock & Wilcox had been given a £100m contract by the above client for two 350 MW generating sets.

* 1979

Source : Financial Times

CASE STUDY 4.2.7.2

Bharat Heavy Electricals Ltd. (BHEL) won a $90m contract for electric distribution system for Riyadh, Saudi Arabia. BHEL was able to quote a low price and to satisfy the buyers that India had both the capability and the experience required to carry out the complete electrification scheme to the highest standard.

A contract has also been awarded to BHEL for a fourth thermal power station by Malaysia. The Parsi Gudang order follows those in recent years for the Sultan Ismil power station, the Tunku Jaffar and the Prai power stations. Work began in 1975 and is reported to be progressing to schedule, on the complete power station at Tripoli West - an order valued at that time at $150m.

The BHEL success story has been argued as one that could possibly be a model for other nations to study. In the 1960s, the Indian Ministry of Industrial Development had sponsored large-scale expansion of electrical engineering for its own domestic requirements. It had made big investments in government-owned or controlled manufacturing establishments. It then turned to foreign markets in order to use its new capacity to earn foreign exchange. Although the demand for electrical power was growing rapidly everywhere in the world, it was seen that the major contracts were for turnkey projects where the main generating plant, switchgear and all control instrumentation were supplied through a single main contractor.

The purchase, co-ordination and commissioning of these different components required a substantial, skilled organisation and the purchasing authorities for power plants were moving more and more to reliance on single outside suppliers for package deals. Without an organisation qualified to take on such tasks, the Indian Electrical industry would not be in a position to compete for contracts.

Accordingly, the Indian Government urged the formation of a power project consortium. This was set up under the title of Indian Consortium for Power Projects Ltd. (ICPP). It began operations in 1970 and soon won some orders.

The two major members of the consortium were Heavy Electricals (Indian) Ltd. (HEL) & Bharat Heavy Electricals Ltd. (BHEL).

By entering the market for turnkey projects and participating in major international bids, the consortium channelled valuable experience to the member companies and to the government ministries. In handling the design and commissioning of power projects for abroad and for India, the consortium was able to guide the Indian electrical industry for the future.

Because of the lower overheads, the Bharat Heavy Electricals Ltd's tenders can in many cases compete in price and more and more developing countries are choosing to place contracts for electrical engineering with another developing country in preference to one of the industrialised nations.

CASE STUDY 4.2.7.3 COMPETITIVE PRICING FOR A MEDIUM SIZE POWER STATION PROJECT

Case Statement

A main contractor is required to bid a lump sum price for the design, supply, construct and commission test and guaranteeing of a medium size thermal power station comprising steam turbines, oil fired boiler, auxilliary plant and civil works.

The Enquiry Document

The enquiry document is brief and states the outline only of the client's requirements. The bidders are therefore required to:

(a) Prepare an overall engineered concept of the power station.

(b) Optimize the number, type and performance ratios of the main items of equipment e.g. turbines, boilers, switchgear, etc., to provide a competitive and co-ordinated offer.

(c) Submit detailed schedules showing the plant and plant particulars.

(d) Calculate and guarantee station output and performance based on a given fuel.

(e) Submit construction programme.

(f) Submit price.

Complexities

The above tasks become complex because the size of the station is such that the major equipment required is not standard off-the-shelf. Consequently, prices and data relating to the equipment are not readily available. The bidder therefore has to issue numerous detailed enquiry specifications to possible vendors of equipment. The data for such equipment could be assumed, specially designed, obtained from past projects, obtained from one and passed to another, etc.

Certain key data required in order to specify equipment performance requirements can only be obtained from other vendors e.g. steam consumption, steam condition, etc., which are required for the boiler specification are available only from turbine supplier. Although the contractor can estimate to within 10%, the estimate can give rise to either an uncompetitive bid or poor performance figures unacceptable to the client.

A high degree of detailed engineering is required in order to accurately estimate quantities for civil construction, electrical cabling, piping and instrumentation. The engineering however, is based on prime data to be received from suppliers of major equipment.

Local site and construction costs can contribute upto 50% of the total price on overseas projects, particularly when a high expatriate content is used. (CBI figures suggests that a senior expatriate could cost a contractor anything upto £50,000 a year). Data required for estimating construction costs is often not readily available. Consequently, the amount of risk is high which reflects in a high level of contingency pricing.

The main contractor is required to guarantee the performance of the complete power station. To do so he must prepare heat and energy balances using data provided by equipment suppliers and based on his own calculations of heat and energy losses. It is necessary to ensure that the information provided is correct and also the suitability of equipment in different conditions prevailing in the country where the project is planned.

Invariably, the main contractor is required to agree to performance penalties in the event of failure to meet the accepted test limits. Typically, these penalties can be 1% of the contract price for each 1% efficiency drop upto a maximum of 10%. Because the penalty is related to the total contract price, the main contractor may often not be able to recover the claim against his sub-contractor particularly if the value of the sub-contract is small in relation to the contract price.

The same problem applies also to penalties on late completion.

The amount of pre-engineering details required in support of an offer varies with the type of client. With the Eastern Block countries, the amount is high and negotiations tend to be very formal resulting in sets of protocols.

The type, length and format of negotiations varies considerably depending on the territory, political considerations and actions of the other competitors.

Commercial and contractual conditions in many turnkey enquiries tend to be onerous and complicated particularly when bonds are required and buyer/seller credit is to be arranged.

TABLE 4.2.8.1 THE SUMMARY OF COST OF 14 EXPATRIATES IN A MIDDLE EASTERN COUNTRY FOR A PERIOD OF 24 MONTHS (1975 FIGURES).

	£
Salaries	687,890
Paid Leave	79,366
Bonuses	57,302
Accommodation, local transport, medical etc.	169,633
Food (subsidised)	144,000
Air Fares (incoming)	6,774
Cost in UK (Company contributions, air-fares (outgoing) compassionate leave, children allowance, recruitment, kit allowance, etc.	86,399
	£1,231,364

Approx. £44,000 per year per expatriate.

TABLE 4.2.9.1

Some of the items critically examined by Corporate Management

1. Project background, parties in collaboration and the other divisions likely to be involved.
2. General make-up of the tender price.
3. Acceptable currency for payment
4. Cash flows.
5. Some key drawings.
6. Collaboration agreement.
7. Pros and cons of contract conditions.
8. Provision for escalation clause.
9. Staff allocation and resources.
10. Professional indemnity.
11. Construction programme, availability of labour and material.
12. Evaluation of risks.
13. Contract overrun and the period after which it affects the project contribution.
14. Tender letter in a draft form.
15. Performance guarantee etc.
16. Date of access to site.
17. Details of advance payment for material on site.
18. Work visas.
19. Legal matters e.g. special insurance, etc.
20. Special risk for transit to site.
21. Termination of contract - consequences etc.

Chart 4.2.10.1

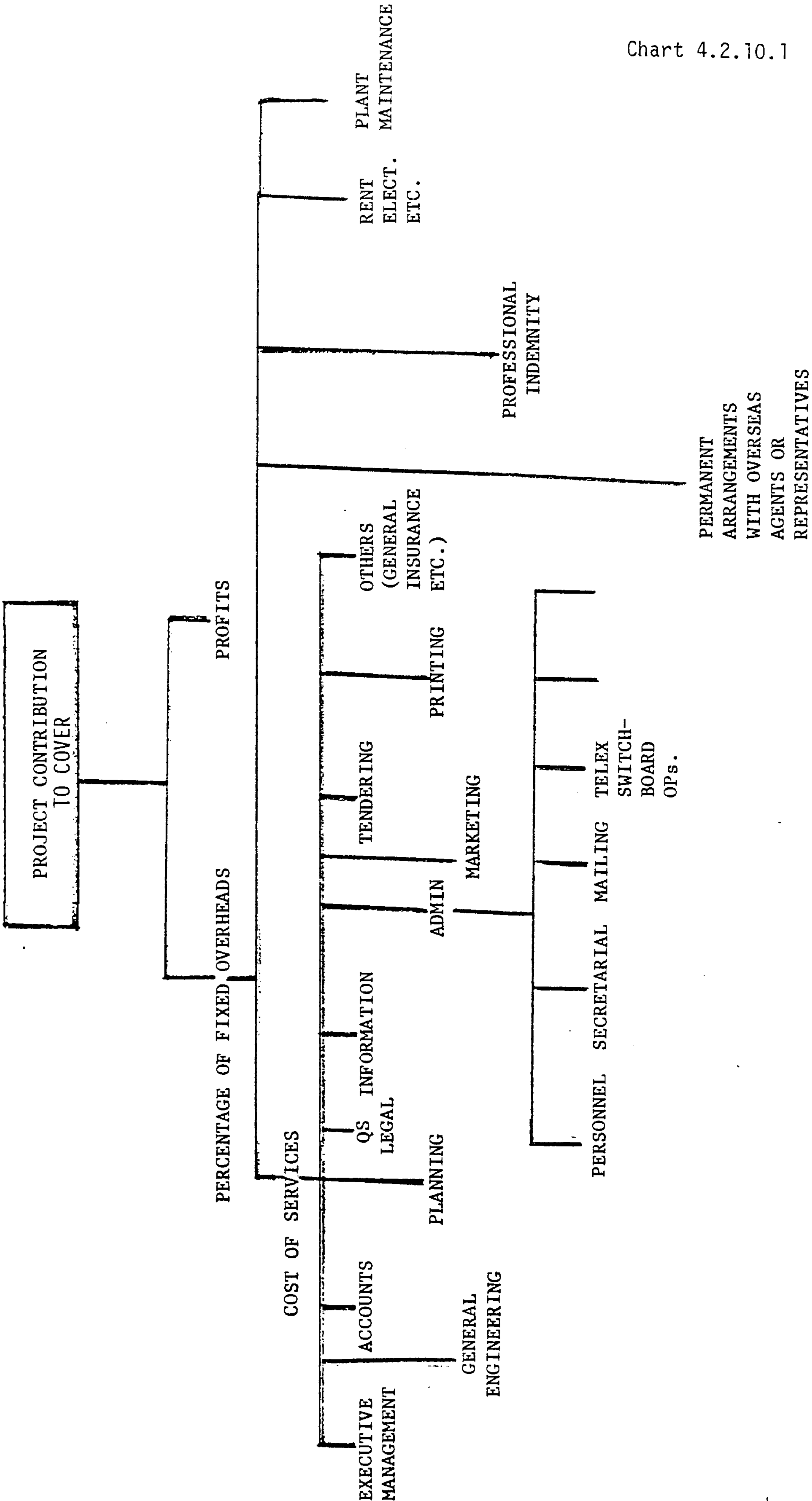

PROJECT CONTRIBUTION TO COVER
PROFITS
PERCENTAGE OF FIXED OVERHEADS
COST OF SERVICES
EXECUTIVE MANAGEMENT
ACCOUNTS
GENERAL ENGINEERING
PLANNING
QS LEGAL
INFORMATION
ADMIN
PERSONNEL
SECRETARIAL
MAILING
TELEX SWITCH-BOARD OPs.
MARKETING
TENDERING
PRINTING
OTHERS (GENERAL INSURANCE ETC.)
PERMANENT ARRANGEMENTS WITH OVERSEAS AGENTS OR REPRESENTATIVES
PROFESSIONAL INDEMNITY
RENT ELECT. ETC.
PLANT MAINTENANCE

Chart 4.2.10.2

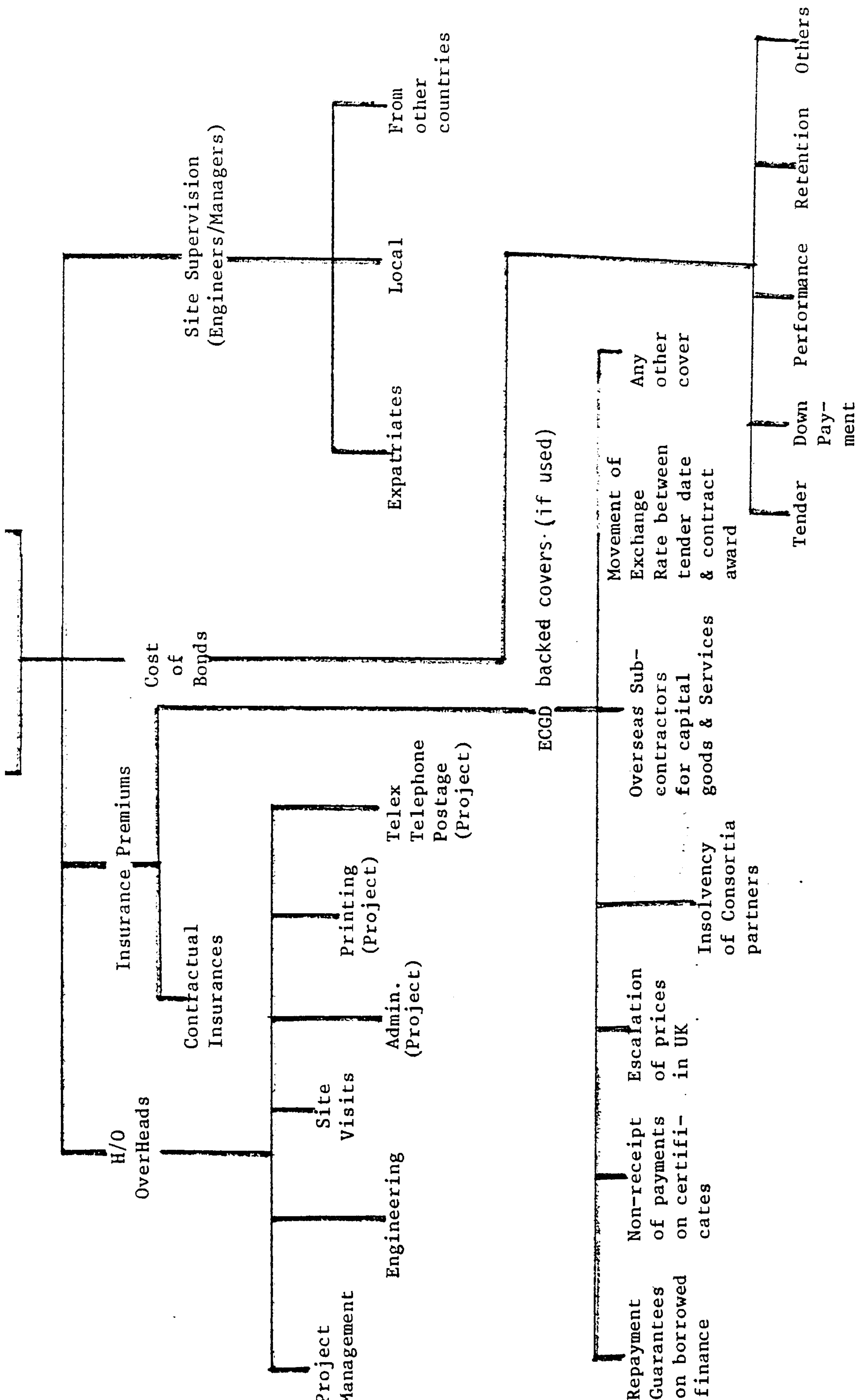

H/O OverHeads
Project Management
Engineering
Site Visits
Admin. (Project)
Printing (Project)
Telex Telephone Postage (Project)
Insurance Premiums
Contractual Insurances
ECGD backed covers (if used)
Repayment Guarantees on borrowed finance
Non-receipt of payments on certificates
Escalation of prices in UK
Insolvency of Consortia partners
Overseas Sub-contractors for capital goods & Services
Movement of Exchange Rate between tender date & contract award
Any other cover
Cost of Bonds
Tender
Down Pay-ment
Performance
Retention
Others
Site Supervision (Engineers/Managers)
Expatriates
Local
From other countries

TABLE 4.2.10.1A.

List of factors influencing the level of contribution from a project

1. Company's corporate policies (which give due consideration to the present work load).
2. Type of project
3. Country
4. Contract period
5. Estimated cost of the project
6. Risks involved:
   - 6.1 Political
   - 6.2 Financial
   - 6.3 Natural
   - 6.4 Commercial
   - 6.5 Technical
7. Total investment in the project i.e. cash flows
8. Manpower resources
9. Information from the past projects
10. Technical complexity
11. Information from the local representative
12. Competition

Note:

Internal pressures to recover a high level of overheads from a project, although not listed above, can influence the final decision on the level of contribution.

TABLE 4.2.10.1B

Matrix of factors influencing the level of contribution and their interaction

	1	2	3	4	5	6.1	6.2	6.3	6.4	6.5	7	8	9	10	11	12
1	-	H	H	H	H	H	H	H	H	H	H	P	P	P	P	P
2	H	-	H	H	H	L	L	H	H	H	P	H	H	H	L	P
3	H	H	-	P	P	H	P	H	H	P	P	P	L	H	H	H
4	H	H	H	-	P	H	H	H	H	P	H	H	L	P	L	L
5	H	H	P	H	-	P	P	P	H	H	H	H	H	P	H	H
6.1	H	L	H	H	L	-										
6.2																
6.3																
6.4																
6.5																
7																
8																
9																
10																
11																
12																

H = High interaction

P = Possible interaction.

L = Low interaction

Table 4.2.11.1

Potential problems in a Group Tender

(a) the difficulty of reconciling individual profit centre objectives and interests with a corporate policy and approach.

(b) the need for regular and effective inter-group communication and co-ordination against a restricted programme.

(c) the difficulty of establishing a team approach to the tendering process from several operating locations.

(d) the need to reconcile individual operating company cost definitions and selling price presentations to permit Group policies to progress against a common approach.

(e) the need to establish a corporate contribution policy and allocation basis to the contracting participants.

(f) the need for a working relationship with legal department for JV agreements.

(g) Co-operation between the parent organisation and the division leading a tender in 'pooling' information and selecting a suitable JV partner(s).

(h) to review the maximum volume of work the Group is prepared to accept in one package.

(j) to review the Group limitations in respect of bonding.

(k) the minimum overall Group contribution for a particular size of the project.

(l) to review the need for a clear corporate policy against defined responsibilities and commercial/financial parameters.

(m) to review the need for a team leader with overall responsibility and authority.

(n) to review the need for early policy decisions regarding:

- Management responsibilities/lines of demarcation
- the identification of a local partner
- a labour policy and pricing approach
- personnel policies and level of remuneration.

(p) to review the procedures which assess the initial cost of a project.

(q) to review the policy of utilizing external organisations to improve the competitiveness

(r) to review the engineering design procedures to ensure 'cost effective' design.

TABLE 4.3.4.1: Krantz's list of some elements of uncertainty & variability

(a) Uncertainty due to political or other governmental decisions.

(b) Uncertainty regarding the rate of technological development or likelihood of tech-targets being met.

(c) Uncertainty in the nature or scope of work to be performed.

(d) Variability in work performance.

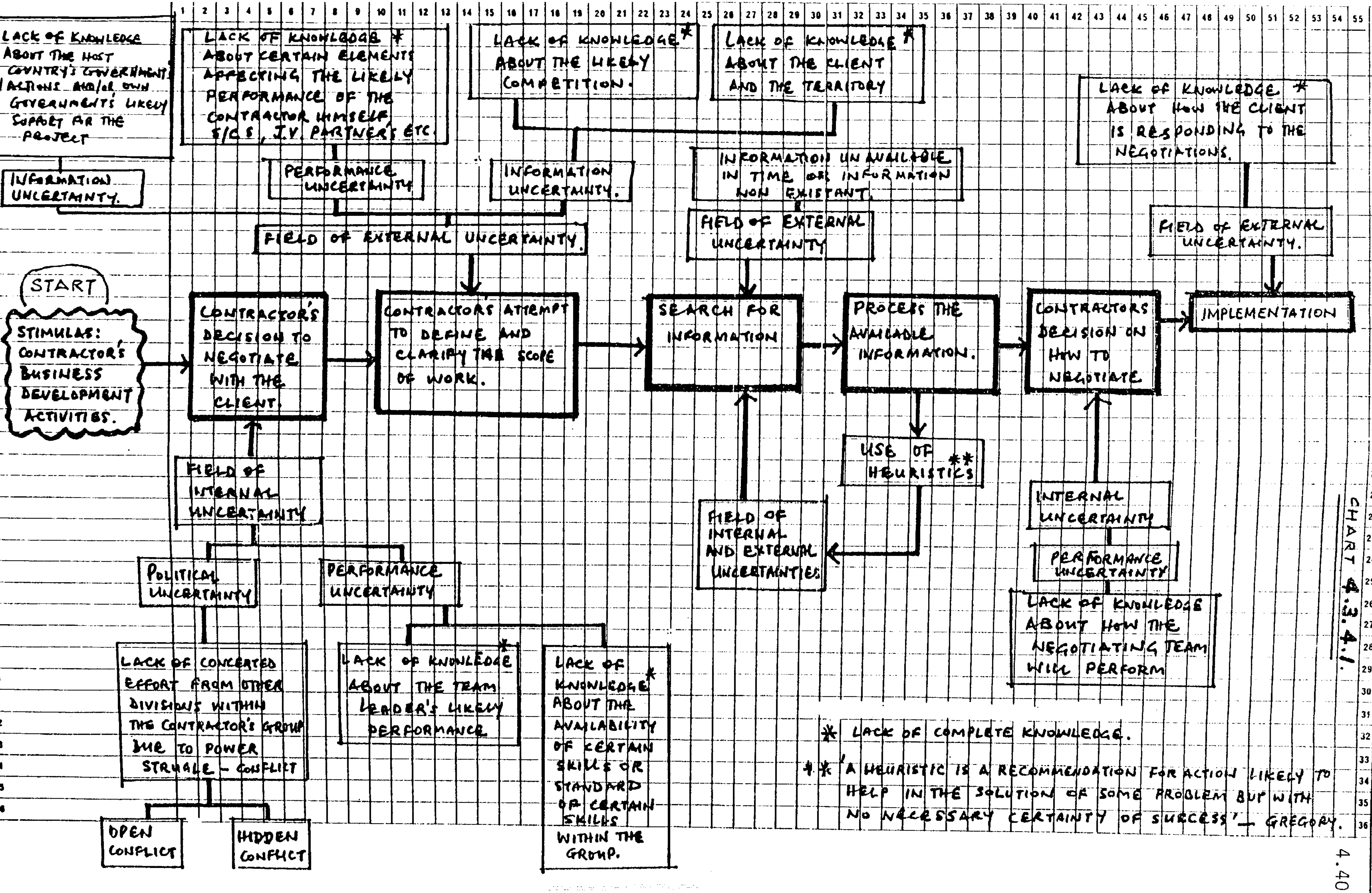
(e) Delays in obtaining top management approach.

(f) Uncertainty in delivery dates for material and equipment.

(g) Uncertainty regarding rate of cost escalation.

(h) Possibilities of test failures necessitating remedial work (possibly even re-design).

CHART 4.3.4.1: SOME OF THE UNCERTAINTIES IN A NEGOTIATED CONTRACT



CASE STUDY 4.3.4.3. 1 :

INTERNAL UNCERTAINTY
DUE TO POLITICAL CONFLICT

A special division (referred to here as Division 'A') was established by a group involved in large scale contracting at home and abroad and was given the role of leading the group's effort in securing new orders. Other divisions however considered Division A's role and associated activities with this role as being forced upon them against their interest. This situation of power struggle continued for a while and developed into a political conflict. Other division's attempts to change Division A's role as a leader when tendering on behalf of the group, were unsuccessful. The corporate management of the group believed that there was a need for co-ordination of the group's effort and considered Division A's role as an essential element within their overall strategy.

This 'imposed authority' on other divisions when tendering on behalf of the group, resulted in non-cooperative attitude by other divisions towards Division 'A' for a specific period of time. The situation is illustrated by Figure 4.3.4.3.1.
The non- cooperative attitude was more than apparent in the following actions during tendering activities.

1. General unwillingness to participate in tendering on behalf of the group.
2. Non-committal responses.
3. Delays in submitting divisional cash flows for incorporating in the group's overall cash flow .
4. Submitting unscrutinized prices.
5. Incomplete submissions.
6. Unwillingness to disclose various contingencies.

The overall result was ineffective submissions of Group tenders.

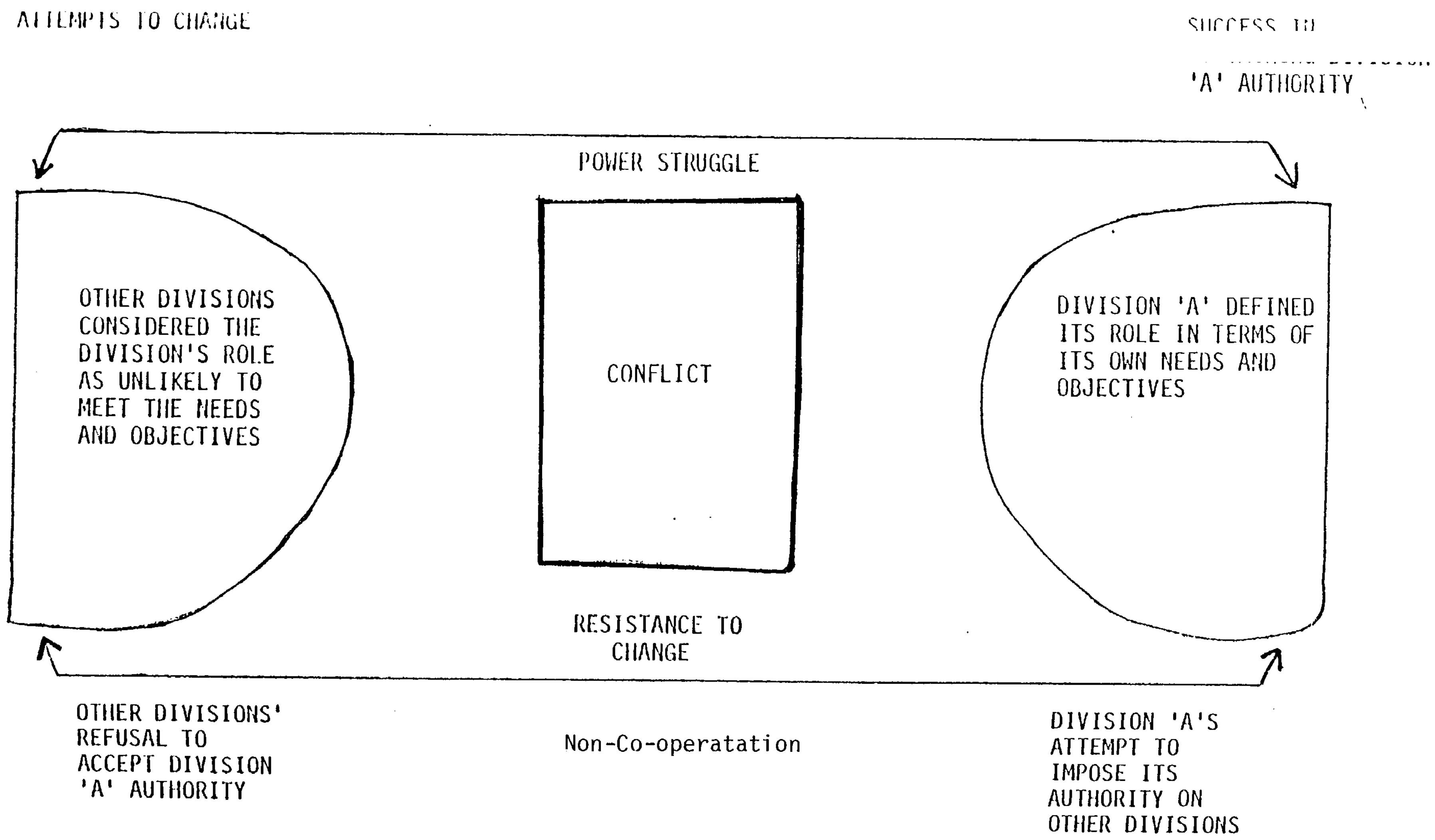

ATTEMPTS TO CHANGE
'A' AUTHORITY
POWER STRUGGLE
OTHER DIVISIONS CONSIDERED THE DIVISION'S ROLE AS UNLIKELY TO MEET THE NEEDS AND OBJECTIVES
CONFLICT
DIVISION 'A' DEFINED ITS ROLE IN TERMS OF ITS OWN NEEDS AND OBJECTIVES
RESISTANCE TO CHANGE
OTHER DIVISIONS' REFUSAL TO ACCEPT DIVISION 'A' AUTHORITY
Non-Co-operatation
DIVISION 'A'S ATTEMPT TO IMPOSE ITS AUTHORITY ON OTHER DIVISIONS

FIG.4.3.4.3.1

UESTIONNAIRE 4.4·1

AUSES OF JOB STRESS DURING TENDERING

O.	QUESTION	YES	NO	LEVEL OF STRESS		
				HIGH	MEDIUM	LOW
	SECTION A					
1.	Did you experience any form of stress during tendering work? (If the answer to Q.1 is yes, then please continue with the following questions dealing with possible causes of such stress).					
	SECTION B					
2.	Work overload					
3.	Responsibility					
4.	Requirement for a competitive price					
	4.1 Normal competitive price					
	4.2 Lowest price possible.					
5.	Personal problems					
	5.1 Singular (e.g. ill health)					
	5.2 Multiple (e.g. combination of two or more problems, ill health, financial, accident, car trouble, bad news, etc.).					
6.	Personality clash (Reversing of decisions, persistent demands, non-compatible boss, etc.).					
7.	Rigid rules and/or organizational problems.					
8.	Conflicting demands.					
9.	Mass of figures and need for accuracy.					
1.	Low rate of successful tenders.					
	SECTION C					
.	Time constraint					
	11.1 Severe constraint					
	11.2 Reasonable constraint					
	11.3 No time constraint (long term negotiable contracts).					

QUESTIONNAIRE 1 (Contd.)

NO.	QUESTION	YES	NO	LEVEL OF STRESS		
				HIGH	MEDIUM	LOW
12.	Complex tendering tasks					
	12.1 Number of alternatives.					
	12.2 Numerous dimensions per alternative to to be considered before taking any decision.					
	12.3 Difficulty in choosing an alternative.					
13.	Uncertainty due to lack of experience in handling a particular task.					
14.	Uncertainty during processing the available information.					
	14.1 Limited quantity of information.					
	14.2 Excessive quantity of information.					
	14.3 The quantity considered too much to process.					
15.	Uncertainty (such as 'jumped' prices, client's reaction to your actions, lack of information, anamolies, uncertainty about results of any action taken, lack of definitive feedback etc.					

Note: For classification of response and summary see Tables 4.4.1 and 2.

Table 4.4.1

CLASSIFICATION OF RESPONSE TO QUESTIONNAIRE . 4.4.1

Code Nos:

01, 02 Managers

03 Business Development staff

04, 05 Project Engineers.

Note:

For summary see Table 4.4.2

Respondents

01, 03, 04.

ESTION o	YES					NO					LEVEL OF STRESS														
											HIGH					MEDIUM					LOW				
de No.	01	02	03	04	05	01	02	03	04	05	01	02	03	04	05	01	02	03	04	05	01	02	03	04	05
TION A																									
1	✓	✓	✓	✓	✓																				
TION B																									
2	✓		✓	✓												✓							✓	✓	
3	✓		✓	✓												✓							✓	✓	
4.1											✓		✓	✓											
4.2											✓		✓	✓											
5.1											✓		✓	✓											
5.2	✓		✓	✓																					
6	✓		✓	✓														✓	✓		✓				
7			✓	✓		✓										✓							✓	✓	
8	✓		✓	✓																			✓	✓	
9						✓		✓	✓									✓	✓		✓				
0	✓							✓	✓		✓														
TION C																									
1.1	✓		✓	✓							✓		✓	✓											
1.2	✓			✓				✓								✓								✓	
1.3						✓		✓	✓																
2.1	✓		✓	✓							✓		✓	✓											
2.2	✓		✓	✓										✓		✓							✓		
2.3	✓		✓	✓										✓		✓							✓		
3			✓	✓		✓													✓				✓		
4.1						✓		✓	✓					✓				✓	✓						
4.2	✓		✓	✓																					
4.3	✓		✓	✓							✓		✓	✓											
5	✓		✓	✓												✓			✓				✓		

Table 4.4.2

SUMMARY OF RESPONSE TO QUESTIONNAIRE 4.4.1

(Response from members of staff working in the tendering department)

Total number interviewed	5
No. responded	3
Answers still awaiting*	2

* Except to question 1.

QUESTION NO.	RESPONSE YES	RESPONSE NO	LEVEL OF STRESS HIGH	MEDIUM	LOW
SECTION A					
1	5	-	-	-	-
SECTION B					
2	3	-	-	1	2
3	3	-	-	1	2
4.1	-	3	-	-	-
4.2	-	3	-	-	-
5.1	-	3	-	-	-
5.2	3	-	-	2	1
6	3	-	-	1	2
7	2	1	-	-	2
8	3	-	1	2	-
9	-	3	-	-	-
10	1*	2	1	-	-
SECTION C					
11.1	3	-	3	-	-
11.2	2	1	-	1	1
11.3	-	3	-	-	-
12.1	3	-	3	-	-
12.2	3	-	1	1	1
12.3	3	-	1	1	1
13	2	1	-	1	1
14.1	-	3	-	-	-
14.2	3	-	1	2	-
14.3	3	-	3	-	-
15	3	-	-	2	1

* When overall responsible for the tender.

Note: For classification of response see Table 4.4.1

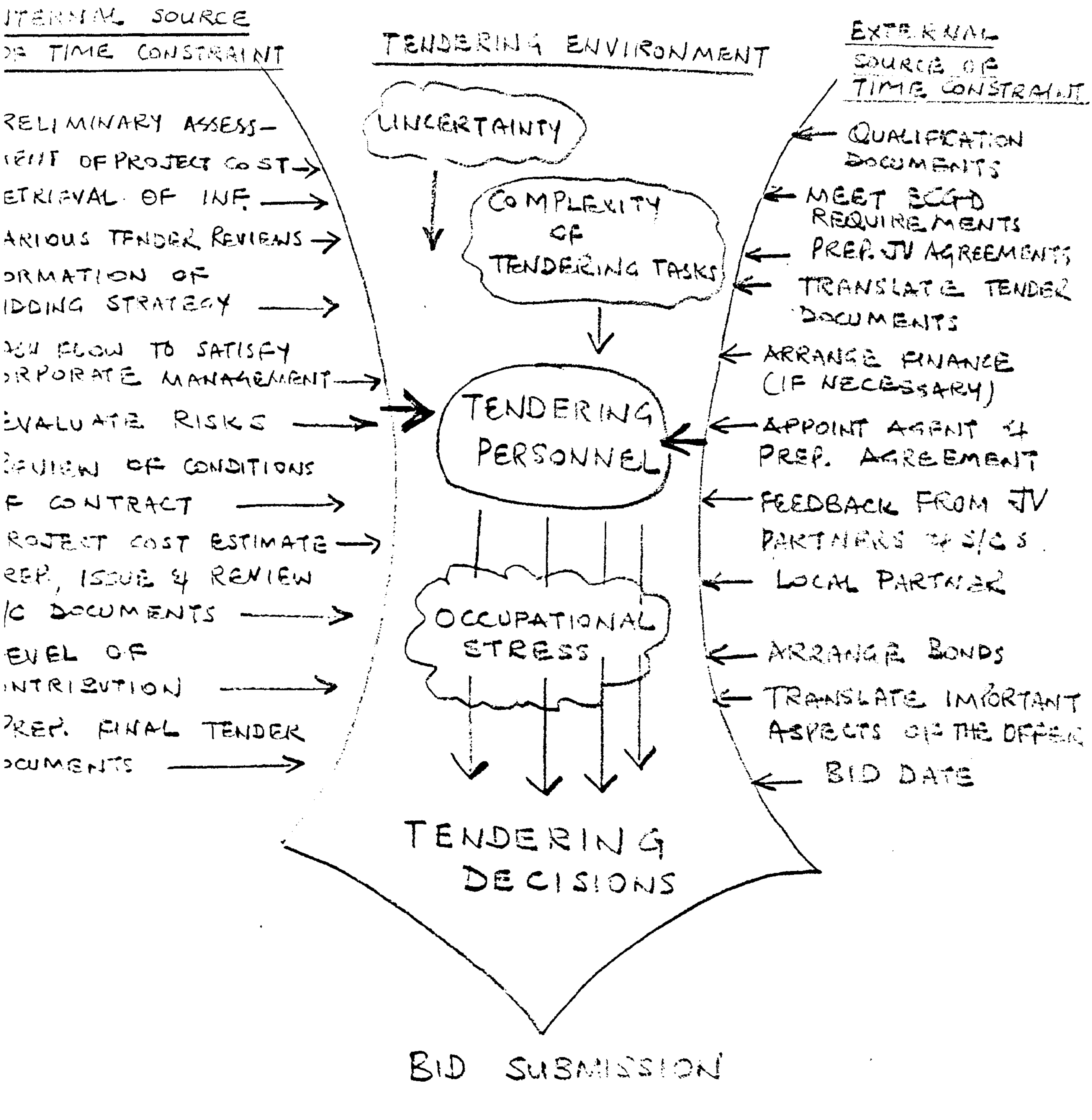


FIG. 4.4.1 : MAJOR FORCES ACTING DURING TENDERING AND THEIR INFLUENCE ON TENDERING DECISIONS.

TABLE 4.4.3

CONTRACTOR'S DECISIONS DURING TENDERING AND POSSIBLE RESULTS DURING THE CONTRACT STAGE

PART A

NO.	SOME DECISIONS DURING TENDERING	LIKELY PROBLEMS
1	Tender price based on higher production rate.	4,5,7
2	Equipment, construction methods etc. too sophisticated for local standard.	4,5
3	No alternative arrangements for supply of material.	3,8,11
4.	No local participation.	12
5	Majority of labour and material imported.	1,7
6	All supervision by expatriates.	7
7	Tender price based on an official inflation rate in the host country.	7,12
8	Project not evaluated from political risk point of view.	10,12
9	Client's bad reputation ignored.	8,11
10	Tender price based without first hand information on basic costs in the host country.	2,3,4,5,6,7,8,10,11,12,13
11	Provision for supervision by expatriates with limited overseas experience.	1,4,5,6,7,8,9,11,12
12	Provision for a sub-contractor with limited overseas experience.	4, 5, 6, 8, 9, 11, 12, 13
13	No contingencies.	12
14	Tender programme accepted without any critical review.	4,6,7,8,12

CONTD..

TABLE 4.4.3 (Contd.)

PART B

NO.	LIKELY PROBLEMS DURING CONTRACT STAGE	LIKELY REASONS
1	Communication problem	5,11
2	Delays in delivery of material	3,10
3	Higher custom duties than expected	10
4	Lower rate of production than expected	2,10,11
5	Bad Workmanship	2,10,11
6	Work behind schedule	10,11,14
7	Higher cost of construction	1,4,5,6,7,10,11,14
8	Delays in Contract payments	9,11
9	Industrial disputes	10
10	Change in political power in the host country adversely affecting client's contractual obligations	8
11	Performance bond in danger of being called	9
12	Contract in unsatisfactory financial position	4,7,13
13	Dismal performance by the sub-contractor	10,12

XPO T CREDITS GUARANTEE DEPARTMENT

O Box

Aston University

ontent has been removed for copyright reasons

Thank y for your letter of 6 December, which has been passed to me by Mr . Infortu tely, I doubt that the statistics kept by the Department would be of any assista e to you in your research.

The Dep tment's cover for construction projects is provided on a specific basis, which m ns that the contractor does not have to declare every contract to us. When an pplication for cover is received, it is examined and, if it is eligible, an offe is sent to the contractor outlining the terms and conditions on which the Departm t is prepared to give cover. If this offer is accepted, then a guarantee is issu . and recorded, but non-acceptance does not necessarily mean that the contrac r's bid was unsuccessful. It may be that the contractor decided that the conditi s on which the offer was made were unacceptable. The contractor does not always iform the Department why the offer has been declined, or allowed to lapse, and ev where reasons are given, they are not recorded.

As you ll appreciate, therefore, the Department's statistics relate only to succes l bids and, as the contractor can select the contracts for which cover is requir , may not represent a true cross-section of the contractor's business. You may be ble to obtain a more representative sample for analysis from one of the follow g sources:

1. The Export Group for the Constructional Industries
   3 Dean Trench Street
   Smith Square
   London SW1P 3HE

2. The Overseas Project Group
   Department of Trade
   1 Victoria Street
   London SW1H OET

Yours ncerely

Extens

cc Mr ch

EXAMPLE 4.5.1 : Use of χ^2-Test.

TEST (FROM ASSUMED DATA A AND B) WHETHER CONTRACT AWARDS TO DIFFERENT TYPES OF BIDS (LOCALLY COLLABORATED AND NON-COLLABORATED) DEPENDED UPON THE NATIONALITY OF A CLIENT

DATA A

TABLE 1 - OBSERVED FREQUENCIES

Client's Nationality	TYPE OF BIDS		Total
	Locally collaborated Bids	Non-Collaborated Bids	
Saudi Arabian	70	17	87
Kuwaiti	43	29	72
Iraqi	40	13	53
Jordanian	60	29	89
Total	213	88	301

NULL HYPOTHESIS

Contract awards to locally collaborated bids and non-collaborated bids are independent of the nationalities of the above clients.

TABLE 2 - EXPECTED FREQUENCIES

Client's Nationality	TYPE OF BIDS		Total
	Locally collaborated Bids	Non-Collaborated Bids	
Saudi Arabian	62	25	87
Kuwaiti	51	21	72
Iraqi	37	16	53
Jordanian	63	26	89
Total	213	88	301

TABLE 3: CALCULATIONS FOR χ^2

O	E	O-E	$(O-E)^2$	$\frac{(O-E)^2}{E}$
70	62	8	64	1.03
43	51	-8	64	1.25
40	37	3	9	0.24
60	63	-3	9	0.14
17	25	-8	64	2.56
29	21	8	64	3.04
13	16	-3	9	0.56
29	26	3	9	0.35
			TOTAL:	9.17

DECISION ON CONFIDENCE LIMIT (BASED ON SERIOUSNESS OF LIKELY ERROR)

TYPE I ERROR

In rejecting the null hypothesis when it is true, the contractor may decide to follow a collaborated approach rather than bid on his own. All other factors being equal, this decision alone should not influence the award of contract.

The error is therefore less serious

TYPE II ERROR

In accepting the null hypothesis when it is false, the contractor may decide to tender without a local collaboration. The fact that one client is likely to be more biased towards local collaboration than the other clients, his decision to tender without a local collaboration may cost him the contract.

The error is therefore serious as far as the contractor is concerned.

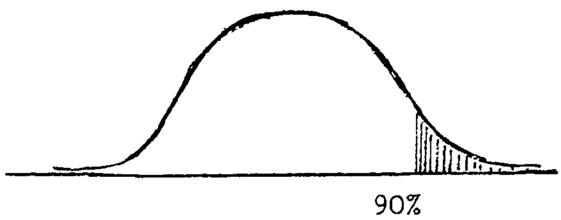
Try and avoid type II error by reducing the level of confidence to say 90%.

Degrees of Freedom

$\nu = (4-1)\ (2-1) = 3$

Tabulated value of χ^2

Enter the table showing percentage points of the χ^2 distribution with 3 degrees of freedom and 90% confidence level.



$\chi^2 = 6.251$

$\nu = 3$

90%

Calculated value of $\chi^2 = 9.17$

$\therefore$ Reject the null hypothesis

Conclusions: (Data A)

The difference between observed frequencies and expected frequencies is not simply due to a chance i.e. the difference is statistically significant to suggest that there is a degree of association between contract awards to locally collaborated bids and the nationality of a client.

In other words, some clients in the above countries are more biased towards locally collaborated bids than others.

Table 3 suggests that the biased tendency is more in the Saudi and Kuwaiti clients than Iraqi and Jordanian clients.

DATA B

TABLE 4: OBSERVED FREQUENCIES

Client's Nationality	TYPE OF BIDS		Total
	Locally Collaborated Bids	Non-Collaborated Bids	
Saudi	70	11	81
Kuwaiti	43	7	50
Iraqi	40	6	46
Jordanian	60	7	67
Total:	213	31	244

TABLE 5: EXPECTED FREQUENCIES

Client's Nationality	TYPE OF BIDS		Total
	Locally Collaborated Bids	Non-Collaborated Bids	
Saudi	71	10	81
Kuwaiti	44	6	50
Iraqi	40	6	46
Jordanian	58	9	67
Total:	213	31	244

TABLE 6: CALCULATIONS FOR χ^2

O	E	O-E	$(O-E)^2$	$\frac{(O-E)^2}{E}$
70	71	1	1	0.01
43	44	1	1	0.02
40	40	NIL	-	-
60	58	2	4	0.07
11	10	1	1	0.1
7	6	1	1	0.16
6	6	NIL	-	-
7	9	2	4	0.44
			TOTAL	0.80

Confidence Limit 90%

Degrees of freedom ν = 3

Tabulated χ^2 for $\nu = 3$, 90% = 6.251

Calculated χ^2 = 0.80

$\therefore$ Accept the null hypothesis

Conclusions (Data B)

The difference between observed frequencies and expected frequencies is merely due to a chance i.e. the difference is statistically insignificant to suggest any association between contract awards to locally collaborated bids and the nationality of a client.

In other words, the clients are unbiased towards contractors approach (collaborated or non-collaborated) regarding submitting bids.

CHAPTER 5

TASK COMPLEXITY AND DECISIONS UNDER TIME CONSTRAINT

CHAPTER 5

TASK COMPLEXITY AND DECISIONS UNDER TIME CONSTRAINT

SYNOPSIS

The complexity of a task is defined as a function of alternatives and the number of dimensions per alternative. The quality of a decision can be affected if the decision task is complex and to be performed under a severe time constraint. It can create uncertainty hence a potential source of occupational stress. Fig. 5.6.1 shows how various sources of stress can influence tendering performance. A heuristic method for feasible (but not necessarily optimal) solutions is one way to deal with such an undesirable decision environment.

5.1 Introduction

This chapter discusses how the decision maker's information processing ability is related to the performance of a task. An existing mathematical model showing the relationship between task complexity, decision time and information processing ability is examined for its relevance in tendering situations.

A performance - satisfaction model has been modified to suit the tendering environment. Preference analysis and heuristic method are discussed as a means to deal with uncertainty. Occupational stress has been considered as an important factor influencing tendering decisions.

5.2 Task Complexity

5.2.1 Definition

The complexity of a tendering task can be defined as a function of alternatives and the number of dimensions per alternative.

5.2.2 Alternatives & Dimensions Per Alternative

Case study 5.2.2.1 shows some of the alternatives and dimensions per alternative in tendering situations that are necessary to be considered before taking a course of action. Depending upon his commitments, the contractor may be forced to select a project or projects from many prospective business enquiries. Alternatively, he may decide to put in a concerted effort for a project he thinks has a better chance of success and make token efforts for others; or irrespective of other commitments, he may decide to put in equal efforts for all the tenders.

Some of the alternatives available for a project contractual organisation and the dimensions per alternative are illustrated in Charts 5.2.2.1 to 10. The complexities of contractual roles are discussed in Appendix A5.2.1.

Some of the alternatives open to main contractors for obtaining sub-contract prices are as follows:-

a) Prepare detail schedules for sub-contractors to price so that the information can be easily extracted from their bids. This may require detail engineering to be carried out prior to the sub-contract enquiries. It will increase his cost of tendering.

b) Issue a brief specification on a performance basis. This may require a major effort to extract the required information from sub-contract bids under a severe time constraint.

In selecting a project to tender, various dimensions of the available alternatives need detail scrutiny. Table 5.2.2.1 shows some of the dimensions of large scale overseas projects.

In risk analysis discussed in Chapter 6, a contractor may have to select a course of action from such alternatives as Avoid, Transfer, Eliminate, Retain and Prevent. The dimensions of each of these alternatives are discussed in detail, in that chapter.

5.2.3 Interacting Dimensions

The complexity of a task increases as the number of dimensions and the number of interacting dimensions per alternative increases. For example, the level of contribution from a project depends upon many factors. The degree of influence of these interacting dimensions on the level of contribution is shown in a notional matrix form in Table 4.2.10.2. Contractors often find it difficult to decide on the level of contribution especially when the number of interacting dimensions is large.

5.2.4 Difficulty in Making a Choice

Selection of suitable projects to bid is one of the primary tasks contractors' tendering departments have to face.
If the selected project is found later to be unsuitable, the contractor not only have to bear the tendering cost of actual wasted resources but also the cost of lost opportunities.

The main sources of difficulty in making a choice in the above case are as follows:-

i) interacting dimensions per alternative.

ii) a lack of explicit corporate policies.

and

iii) a lack of information.

Other examples of the difficulty in making a choice are as follows:-

i) in deciding the level of contingency in a tender.

ii) in selecting suitable tendering personnel.

iii) in selecting a suitable local representative.

iv) in selecting a suitable sub-contractor.

v) in ascribing probabilities to likely events.

vi) in making a tender response in absence of objective information.

A number of senior tendering personnel have identified a lack of explicit policies on corporate preferences as a major source of difficulty for middle management in decision making.

At times, the disparity between the central and the local objectives can contribute to this difficulty. (For empirical evidence, see Easton (1974)). This and the other sources listed above, create uncertainty.

5.2.5 Preference Analysis to Reduce Uncertainty

The research in the area of preference can be divided into the following two categories:-

a) mechanistic

and

b) subjective

METRA Group's [(Roy (1973), Luce (1956), etc] work has dealt with the mechanistic category i.e. building outranking relations in decision making while the multi-attribute utility approach (Raiffa, Keeney, Fischer, etc) has dealt with subjective assessment of the decision makers trade off preferences to reduce uncertainty.

Appendix A5.2.2 discusses the mechanistic approach with practical examples.

The preference relations of the estimated cost function in Example A5.2.2.1 in the above appendix can be expressed as shown in Fig. 5.2.5.1.

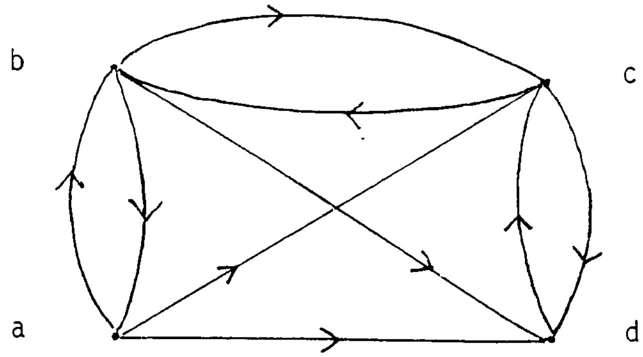


Fig. 5.2.5.1

The preferences are: a is preferred to c (aPc)

a is preferred to d (aPd)

and b is preferred to d (bPd)

There are indifference relations between a and b, b and c and c and d.

The multi-attribute utility approach is discussed in Chapter 6.

Although the mechanistic approach in the above Appendix appears relatively simple, it should be appreciated that it was applied to a mono-criterion situation. Under a multi-criteria situation, the solution can be extremely complex. Nevertheless, the clarity aspect of the graphical presentation as shown in Fig. 5.2.5.1, has certain appeal.

The above discussion including the Appendix has covered preference analysis in the area of selecting projects for tender, but it should be possible to extend this to other areas.

5.3 Time Constraint

The majority of tendering tasks have to be carried out under time constraint. But when tendering documents require translating before a significant progress can be made and or tendering periods reduced from initially allocated time, this severity of time constraint often affects tendering performance. Incomplete or imperfect information also contributes to this situation.

Case study 4.2.7.3 highlights the quantity of work involved in overall engineered concept when tender documents are issued with brief specifications.

Porter (1977) highlights the need to carry out comprehensive research when estimating the cost of such projects. He argues that insufficient tendering periods affect labour and material analysis and the tendency is to insert budget rates.

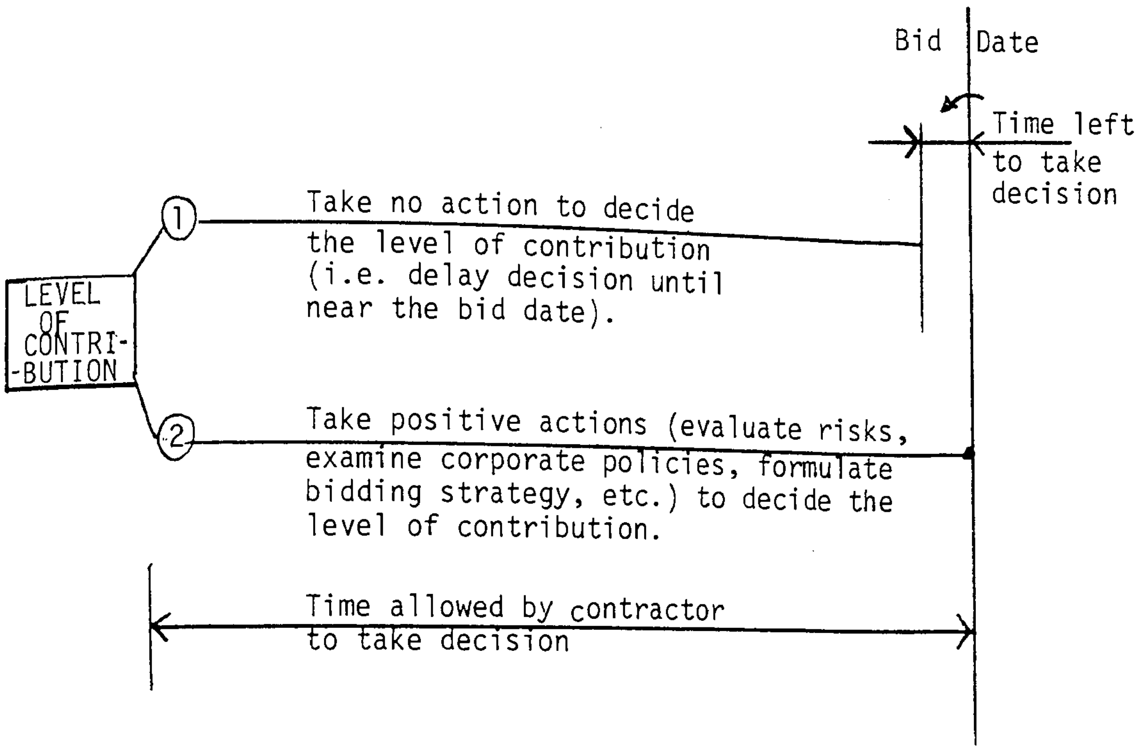


Figure 5.3.1

Sometimes contractors themselves create a situation whereby a decision has to be taken under a severe time constraint.

Figure 5.3.1 illustrates this point diagramatically. In deciding the level of contribution from a project it is necessary for contractors to carry out certain tasks well in advance in order to have sufficient background information to take the decision as shown by route 2. Route 1 shows the consequence of postponing or not carrying out these tasks until a few days before submitting the tender which invariably results in having to take the decision under a severe time constraint.

A severe time constraint can adversely affect a decision making process as illustrated by Case Study 5.3.1. Although, a manager argued that the decision to go ahead in the above case study should have been reconsidered, others argued that contractors treat such changes in tendering environment as the hazards of overseas tendering, accept them & try to do the best they can under the circumstances.

One way of 'doing the best' is to trade off complexity for uncertainty. When faced with crisis or near crisis, the tendency is to use an intuitive 'hit and miss' approach of problem solving. Severe time constraint can introduce simple and basic arithmetical errors as illustrated by Case Study 5.3.2. A manager highlighting the importance of an independent check said that all the arithmetic including basic rates and major cost items should be checked. He also pointed out the increased risk of the transforming error when using calculators in such adverse conditions.

As illustrated by the results of Case Study 5.3.3, although a severe time constraint appear to affect complex tasks more adversely than simple tasks, nevertheless, the standard of performance (judged by quantity and quality) of both, simple and complex tasks, is affected by the severity of the constraint.

One of the conclusions of the above Case Study is that a task performance is adversely affected by the increase in the severity of time constraint.

The possibility of making errors due to a severe time constraint and the associated anxiety is often a source of stress. Some evidence of this can be seen in the response to Question 11.1, Section C of Questionnaire 4.4.1.

The stress induced by time constraint appears to affect the actual decision time. Under these circumstances, the tendency is to treat the alternatives in an ad-hoc manner or simply ignore them (this is discussed in detail in Paragraph 5.5) affecting the quality of the decisions taken under such adverse condition.

Although tendering personnel in general, are aware of the existence of such stress (commonly known by such terms as worry, strain, etc.) there appears to be a lack of complete comprehension of the effects of stress on quality of decisions taken under such stressful situations.

The other effect of time constraint is a lack of timely acquisition of information. This was one of the causes of stressful situation in Case Study 5.3.1, especially when the information was vital to the overall competitiveness of the contractors procurement package offer.

5.4 Occupational Stress

5.4.1 Definition

When a decision maker ignores the limit (unquantifiable limit) of his information processing ability he finds the information too much to process. Thus he is exposed to uncertainty and as a consequence, an element of stress is introduced. Kahn et.al. (1964) refer to this as occupational stress.

5.4.2 Brief Review of Literature

French & Caplan (1973) in presenting the overall picture of how organisational stress affect individual strains (see Figure 5.4.2.1), ignore complexity, time constraint and uncertainty identified as the major factors likely to contribute to stress in tendering personnel. Norfolk (1977) has also overlooked these factors. Hogarth (1972) on the other hand, has developed a mathematical model suggesting a functional relationship between decision time and task complexity. He refers to 'critical point' when a decision maker reaches his maximum information processing ability. Payne (1976), in supporting the relationship between task complexity and cognitive strain has developed a hypothesis (See Section 5.4.4 Analysis).

Einhorn (1971) has suggested a similar explanation of decision making in complex situations.

Norfolk (1977) lists sources (events) of stress within one's own personal environment (see Table 5.4.2.1).

Toffler(1970) described the shattering stress and disorientation that are induced in individuals by subjecting them to too much change in too short a time as 'future shock'.

For further review of literature on occupational stress, see Appendix A.5.4.1.

Referring to qualitative and quantitative work overload, French & Caplan's experiment suggests that they are the causes rather than effects of physiological strains. When overload is reduced, the strain decreases. In this respect, it resembles to physical properties of stress and strain illustrated by Figures 5.4.2.2 and 3.

5.4.3. Performance Satisfaction

Porter-Lawler (1968) suggested that the amount of task performer's effort depends upon the satisfaction he gets from the reward for such efforts. This is shown in their model in Figure 5.4.3.1(a).

Lucas (1978) modified this model by taking into consideration cognitive aspects as shown in Figure 5.4.3.1(b).

Tendering situations however, need further modifications to Lucas's model. As discussed before, there are stress factors which affect the performance of tendering personnel. The modified version of the Lucas's model is shown in Figure 5.4.3.1(c). The model considers such potential stress raisers as limit of information processing ability, task complexity, various constraints and the degree of severity of such constraints.

5.4.4 Analysis

Most of the above referred studies link stress with either organisational behaviour or individual behaviour or some combination of these two. Only a few such as French & Caplan (1973), Marshall & Cooper (1979), Hogarth (1972) and Payne (1976) have shown a link between stress and personal ability. But French & Caplan's and Marshall & Cooper's studies refer more to personality aspect of a person's ability. For example, French & Caplan argue that manager's personality - extrovert or introvert, plays an important role in stress situations. Marshall & Cooper refer to personality as a measuring device to detect stress. They suggest that the manager who is most likely to show psychological stress symptoms is the one who has a 'calculating' personality, who is less bright and is being over worked and does not have much autonomy.

A few such as Hogarth's and Payne's studies have attempted to crystalise the link between stress and personal ability by mathematically analysing the complexity of a task and relating it to the personal ability of an individual carrying out such task. For example, Hogarth's study suggests that a decision maker dealing with a complex task can reach the limit of his information processing ability and in such situations he is likely to experience cognitive strain. As a consequence his decision time can reduce by an alarming rate thereby increasing the likelihood of making errors in his judgement. The relationship between decision time and task complexity is illustrated in the following Figure 5.4.4.1.

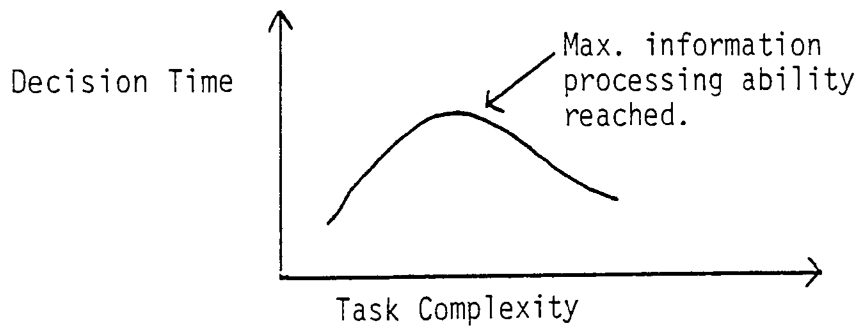


Figure 5.4.4.1

The Hogarth's model attempts to establish this relationship. In tendering situations where time constraint is severe, Hogarth's predictions are useful as a guide.

Payne's study on the other hand examines how decision makers react to cognitive strain. He claims the validity for his following hypothesis:
"Increases in the complexity of a decision situation will result in decision makers resorting to choice heuristics in an effort to reduce cognitive strain".

The study examines the information processing strategies by controlling the variation in the complexity of a preselected task.

Payne claims that his results demonstrated that the information processing leading to choice will vary as a function of task complexity. His research is in some way a follow-up on human problem solving exercise by Newell & Simon (1972) which suggested that 'in performing complex tasks individuals utilize different heuristics that will keep the information processing demands of the situation within the bounds of their limited capacity'. But an individual's capacity for solving a problem is influenced by the time factor involved. Time plays a critical role in the majority of tendering tasks. The complexity of these tasks has already been highlighted in the previous chapter. It is therefore necessary to examine critically the relationship between decision time and the task complexity and their likely influence on tendering decisions.

5.5 Decision Time and Task Complexity

In tendering for large scale overseas projects, situations often exist in which the consequences of any action tendering personnel may decide to take are unpredictable. They lead to uncertainty. Detail scrutiny through questionnaires can provide the necessary information but too often the response is inadequate. Ideally, such situations demand sufficient time to analyse the complexities of the task in hand. In tendering situations this rarely happens. A contractor submits his bid on time only to find that the bid date has been extended. The extension at times is not long enough to re-think and revise the bid to his advantage. Apart from minor modifications, he is not in a position to take advantage of the extension to the tendering period. In the majority of cases, such extensions are 'designed' to suit the interest of the client rather than giving a true opportunity to contractors. No matter how scrupulous a manager is, there is always a chance of misjudgement of a given situation. Contractors therefore have to consider the likelihood of making errors of judgement and the consequences of such errors i.e. cost of such errors not only in financial terms (e.g. tendering cost of an unsuccessful tender) but in the cost of lost opportunities.

When faced with a choice between several alternatives, the two factors need consideration are as follows:-

i) the cost of time involved in a particular decision procedure.

ii) the cost of making an error.

Hendrick-et-al (1968) suggest that when people are confronted by a task which they regard as hopelessly complex, there may be a tendency to give up trying to compare the alternatives. Instead, choice may be made compulsive. Some evidence to this statement was observed in the method of approach to complete the questionnaire issued by the Participation Unit (similar to a committee with a task of establishing a level of staff participation in the company's activities) of a company.

'Staff Questionnaire - Communication', (Appendix A5.4.2) was issued to all the members of the staff. The majority of junior and admin staff found some of the questions extremely difficult to understand. Questions on matters such as lateral communication, vertical communication, company growth, prospective business enquiries, suggestions for improving communication etc., were considered by these members of the staff as difficult to grasp and hence they treated questions with YES or NO situations, to quote a member of the staff, by 'a toss of coin'.

There are two groups of decision analysts. One group has treated decision making as a part of behavioural theory and the other has considered it strictly on operational research basis. Hendrick's-et-al treatment of decision making comes under the former category. Pollay (1970 a) claimed that the complexity notion of Hendrick's-et-al was only a partial explanation and that in some decision situations expected cost and expected value of decisions are considered.

Gregory (*) shows that an individual provides an action through role obligation, motivation, application of skill, use of resources, etc. even though there are pressure groups surrounding him. This theory of individual behaviour is more likely to be associated with tendering personnel than Hendrick's-et-al or Pollay's. It is quite possible for a tendering person, because of his inherent persevering aptitude, to overstep his limit of information processing ability rather than him 'giving-up' as Hendrick -et-al suggest. The Case Study in Appendix A5.5.1, provides some evidence to the above statement. Even though one candidate overstepped his limit of information processing ability he did not give up. He persevered to complete the task in hand. Although all the candidates were professionally qualified and had experience of tendering, nevertheless, their persevering quality was the critical factor which enabled them to complete the task in hand.

Table 5.5.1, lists experimental situations used by behavioural scientists and operational researchers for testing their models and theories.

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* Private communication.

5.6 Hogarth's Model

5.6.1 The Model

Hogarth (1972) suggested a mathematical model to examine the relationship between decision time and task complexity. His model is based on the kinds of cost a decision maker * considers when faced with a choice between several alternatives. The cost such as:-

i) cost of time involved in decision procedure

ii) cost of making errors

[* Moore and Thomas (1976) describes a decision maker as either a single executive to whom a measure of authority for decision-making has been delegated by the company or a group with a similar set of delegated responsibility.]

Although the cost of time involved in decision procedures is important to contractors, the cost of making errors can have a significant effect on their performance. Case Study 5.3.2 highlights this point.

Hogarth's model postulates that the cost of time is an increasing function of the amount of time spent on decision and the degree of cognitive strain induced by the choice situation.

Number of errors is assumed to be an increasing function of:

i) number of alternatives

ii) number of dimensions per alternative

iii) difficulty of choice between alternatives.

Hogarth admits that his model is described in terms of observable variables functionally linked to an unobservable variable of the psychological process - cognitive strain.

He argues that the cost of time in performing a task is not, as Pollay (1970 b) suggests, a linear function of the amount of time spent on the task because he assumes that the cost of the time does not decrease proportionately as the cognitive strain decreases. This is an important hypothesis of his model which concerns the effects of cognitive strain. Some evidence to this statement can be seen in Case Study 5.3.1. The estimator concerned experienced severe strain during the tendering period and required some time off to recover from his exhaustive tendering activities. Therefore, for the contractor, the cost of the estimator's time did not decrease as cognitive strain decreased (i.e. even after the tender was completed).

French and Caplan's findings in connection with strain due to work overload suggest that when overload is reduced the strain decreases. Hogarth potulates that although cognitive strain may decrease, it may not necessarily result in a reduction in the cost of time.

Prabhu (1976) suggests that this non-linearity (i.e. the cost of time not linear to cognitive strain) may also be due to some other non-measurable factors. At the tail end of a complex task instead of the cost curve following a normal pattern, it often takes an upward turn due to slowing down of rate of production ('making it last' attitude). This may be due to uncertainty in the minds of the task performer about the next job. In the accountancy term it is known as 'busy making loss' or 'busy fools' situation.

In the final analysis, the Hogarth's model does not throw light on many other aspects which appear to have certain influence on decision time. Fig. 5.6.1 attempts to show, in some form of order, how various sources of stress, i.e. environmental, organisational, individual, act on a decision maker. This induces psychological and physiological strain with an adverse effect on decision time. Hogarth suggests that when the decision maker's limit of information processing ability is reached, he experiences cognitive strain and in this situation his decision time is affected.

Although many factors - organisational and individual - have been identified as the sources of stress, tendering personnel considered these as of low to medium level stress. (See response to Questionnaire 4.4.1). Task complexity, time constraint and uncertainty however, are more likely to cause a high level of stress in tendering situations. Hence in Fig. 5.6.1, they are shown as the major sources of stress. Fig. 5.6.2 shows modifications to French & Caplan's theory of occupational stress and its effect (Fig. 5.4.2.1).

Although Hogarth does not mention uncertainty, it appears that a decision maker confronted with a complex task and time constraint is likely to experience difficulty in choosing between alternatives. If the time constraint is severe, no matter what persevering quality he may have, it is more likely that he will follow ad-hoc methods to reach a decision which can lead to uncertainty and stress resulting in a reduction in the decision time. This is likely to deteriorate the quality of his decision, i.e. cause errors in judgement and ultimately affect his own and the organisational performance.

Kahn & Quinn (1968) suggest that responses to stress - increased rigidity, agressiveness, selective perception and intolerance for ambiguity - impair the individual's cognitive and perceptual ability.

Deutsch (1969) lists some of the well-known indicators of cognitive collapse.

1. a reduced range of perception i.e. fewer alternatives are seen.
2. a reduced time perspective, an individual focuses on the immediate rather than long term consequences of alternatives.
3. increased rigidity and polarisation of thought processes.
4. increased impulsiveness and defensiveness.

Mumford and Pettigrew (1975) found that the situation of cognitive collapse results in the following:-

a. misjudgements

   and

b. misperceptions.

In the context of the above, Hogarth's predictions are a useful guide in tendering decision situations.

5.7 Heuristics

5.7.1 General

Newell & Simon's (1972) research on human problem solving suggests that in performing complex tasks individuals utilize primary strategies followed by different heuristics in order to keep the information processing demands of the situation within the bounds of their limited capacity.

Gregory (1978) defines heuristic as a 'recommendation for action likely to help in the solution of a problem but no necessary certainty of success'. In other situations, it can be a rule of thumb or a lead in the attempt to solve a problem.

Algorithms in operational research are sets of procedures mostly for solving complex problems suited to computer processing. The use of programme loops in the solution of a problem until it has achieved the desired accuracy is an important aspect of the procedures. Such algorithms usually start with a feasible solution which is similar to the method of solving a difficult equation by guessing at the answer and calculating the effect of this in the equation. If it is not correct for the first time, the 'answer' is modified and tested repeatedly with increasingly fine adjustments until the desired degree of accuracy is achieved.

Heuristic methods rely much on intuition, discovery and experience in working similar problems. (The term is related to 'Eureka' which Archimedes is supposed to have uttered as he leapt from his bath, having solved a problem by discovering the principle of up thrust on an immersed body).

Payne (1976) examined the information processing strategies used by his subjects to reach a decision. He claims that 'increases in the complexity of a decision situation will result in decision maker's resorting to choice heuristics in an effort to reduce cognitive strain'. He suggests that the less cognitively demanding decision procedures, conjunctive and elimination-by-aspects (both dicussed in Chapter 6), might be called early in the decision process as a way of simplifying the decision task by quickly eliminating alternatives until only a few alternatives remained as choice possibilities. The subject might then employ one of the more cognitively demanding choice procedures e.g. additive difference model (also discussed in Chapter 6), to make the final evaluations and choice.

Einhorn (1971) suggests similar explanation of decision making in complex situations.

Payne (1976) suggests that preferential choice among multi-dimensional alternatives can be sufficiently complex to require heuristic processing. He states that 'research on problem solving has also shown individual behaviour to be highly adaptive to the demands of the task'. This suggests that the heuristics used by decision makers may be systematically related to certain characteristics of the decision situation. This is illustrated by the following example:

In a weekly business development meeting, a long list of business opportunities were to be discussed by the contractor's Business Development Manager. The list was unusually long. The manager responded as follows:

"As there are a number of PB (prospective business) enquiries to get through in this meeting, I think we won't have sufficient time to scrutinize each and every one. The list contains a number of 'projects' identified by Mr. Kinato of Timbaktu. So far, none of the projects identified by him have got off the ground. In the present list, there are three 'projects' which I would consider non-starters. My reading of the situation from the recent visit to the territory is that raising finance - internally or externally - for the type of projects Mr. Kinato has identified is virtually impossible. I therefore recommend that we safely ignore each and every one of his projects on the list. What do you think gentlemen?"

The heuristic utilized by the manager was to eliminate from further consideration all the projects identified by Mr. Kinato. It is not the final decision but a recommendation for action to 'clear the ground' and the manager is asking others to comment. From Gregory's definition, it was a recommendation for action likely to help in the solution of the problem of utilizing the meeting's time for only those PB's with high probabilities of reaching the tendering stage. But there could have been a project (or projects) among the list of projects identified by Mr. Kinato with a chance of reaching the tendering stage. In this context, his recommendation for action did not have the necessary certainty of success.

Wiest (1964), Wagner (1964), Brand-et-al (1964), Pascoe (1965) have all used heuristic methods to allocate resources.

5.7.2 Use of Heuristics in Other Fields

Many theorists and researchers have compiled lists of heuristics some for general purpose and some such as one produced by Polya (1945) for a more specific purpose to deal with mathematical problems. Within the field of chemical engineering, Gregory & Bridgewater (1972) suggested the following heuristic to deal with the high investment problem so common in the industry.

'Choose the alternative with the fewest process steps'

In the field of energy and safety, Wells et-al (1976) have produced lists of highly specified technological heuristics to deal with the above problem. Gregory (1978) considers this work as a 'compilation of useful working rules', because these lists were compiled from extensive surveys of published reports. He believes that it is possible to improve these rules by classifying these in terms of the stages in design where they may be applied.

One of the advantages of the notion of heuristics is its application in situations where it is difficult to obtain solutions. Under such situations, a heuristic 'battery' for firing many 'shots' in an attempt to hit the target, is an useful device.

Gregory (1972) has compiled from his personal experience and other people's experiences lists of a general nature heuristics for identifying problems and for identifying solutions. Instead of using 'ordered' search, Osborn (1953) preferred 'brain storming' sessions especially in poor knowledge situations. Rickards & Freeman (1977) have made a survey of the application of the brain storming technique. According to Gregory (*), the most common general heuristic used in simplifying a problem is to 'break the problem into components'. The heuristic that may follow this can be:-'develop a model'.

When considering all the major factors of organisational stress in tendering situations - complexity, time constraint and uncertainty - a heuristic method can produce feasible though not optimum solutions. This is illustrated in Fig. 5.7.2.1.

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* Private communication.

5.8 Conclusions

At the planning stage, it is essential to examine in detail, the complexities of various tendering decisions. Alternatives, dimensions per alternative and possible difficulties in choosing between alternatives due to interacting dimensions, should be discussed at the earliest opportunity to avoid taking decisions under adverse conditions. Because of changes in tendering environment, trading off complexity for uncertainty (e.g. 'jumped' prices) is not uncommon. In critical decision situations, it can lead to occupational stress affecting the individual and organisational performance. Under such conditions, information processing ability plays a vital role in making rational decisions.

Although the cost of time involved in decisions is important, the cost of making errors can have a significant effect on performance. Hence the need for optimization. Considering all the major factors involved in decision in tendering situations, a well tried heuristic method can produce feasible solutions.

CHAPTER 5

CHARTS, TABLES, ETC

CASE STUDY 5.2.2.1: ALTERNATIVES AND DIMENSIONS PER ALTERNATIVE

A contractor was tendering in a joint venture situation and had to make a choice between the following hree alternatives :-

Alternatives

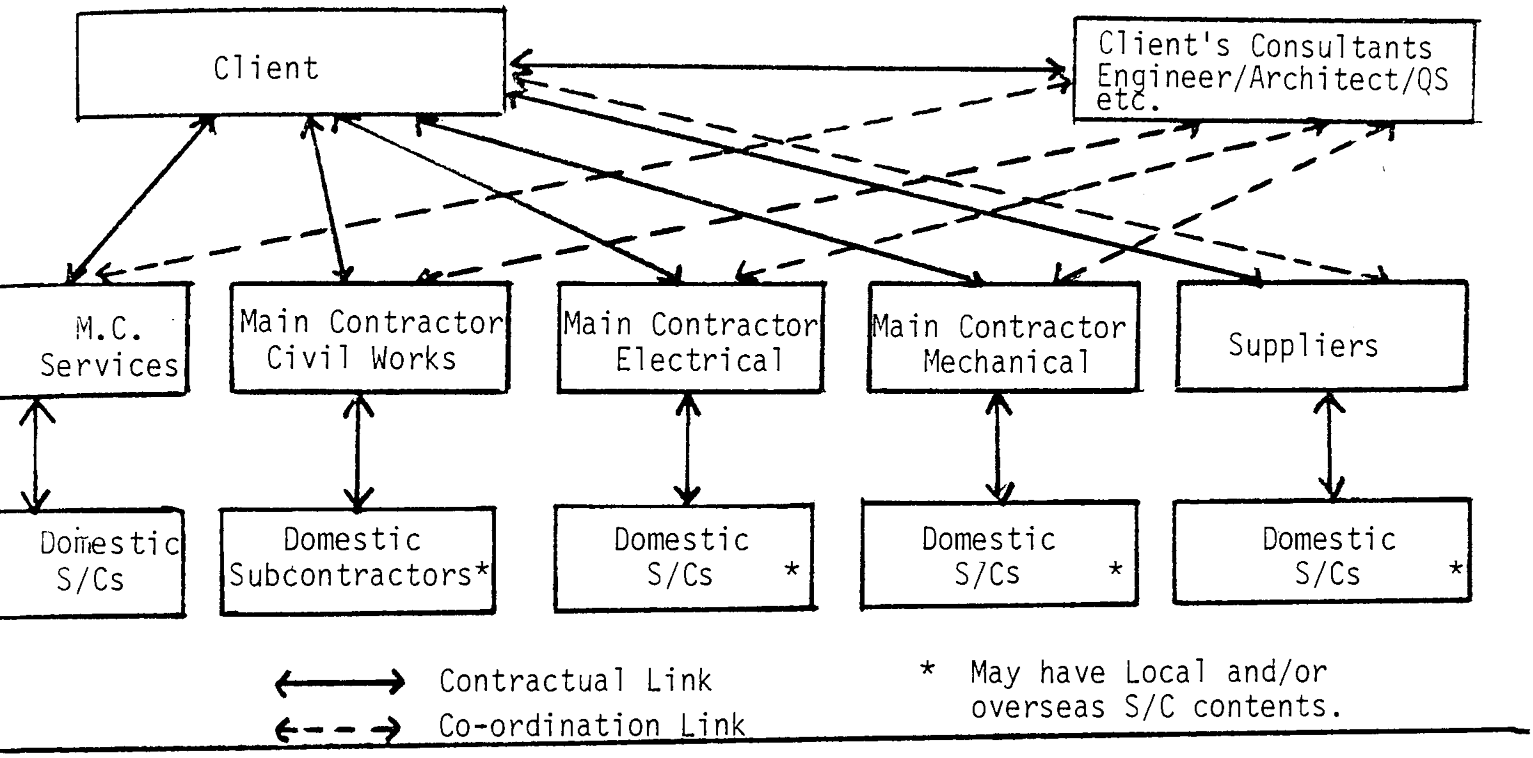
Alternative A	Alternative B	Alternative C
Carry out full share of his work.	Carry out part of his share himself and sub-let the rest.	Sub-let whole of his share of the work and manage the sub-contracts

Dimensions per Alternative

A.1 Establish the project team.	B.1 TO B.5 } Same as A.1. to to A.5	C.1 Appoint s/c management team.
A.2 Study the tender documents.	B.6 Select sub-contract tenderers.	C.2) TO) C.5) Same as A.2 to A.5
A.3 Prepare tender programme & prepare project policy statement.	B.7 Prepare & issue sub-contract enquiries.	C.6) TO) C.13) Same as B.6 to B.13.
A.4 Identify various inputs in the tender.	B.8 Co-ordinate s/c tenderers.	
A.5 Co-ordinate with the Client, JV partners, etc.	B.9 Select prospective s/cs.	
A.6 Prepare cost estimates.	B.10 Prepare cost estimates.	
A.7 Scrutinize the tender.	B.11) TO) B.13) Same as A.7 to A.9.	
A.8 Submit the tender.		
A.9 Follow up.		

MAIN CONTRACTOR
CASE 1(A)

(Power Generation Type Contract)



MAIN CONTRACTOR
CASE 1(B)

CHART 5.2.2.2

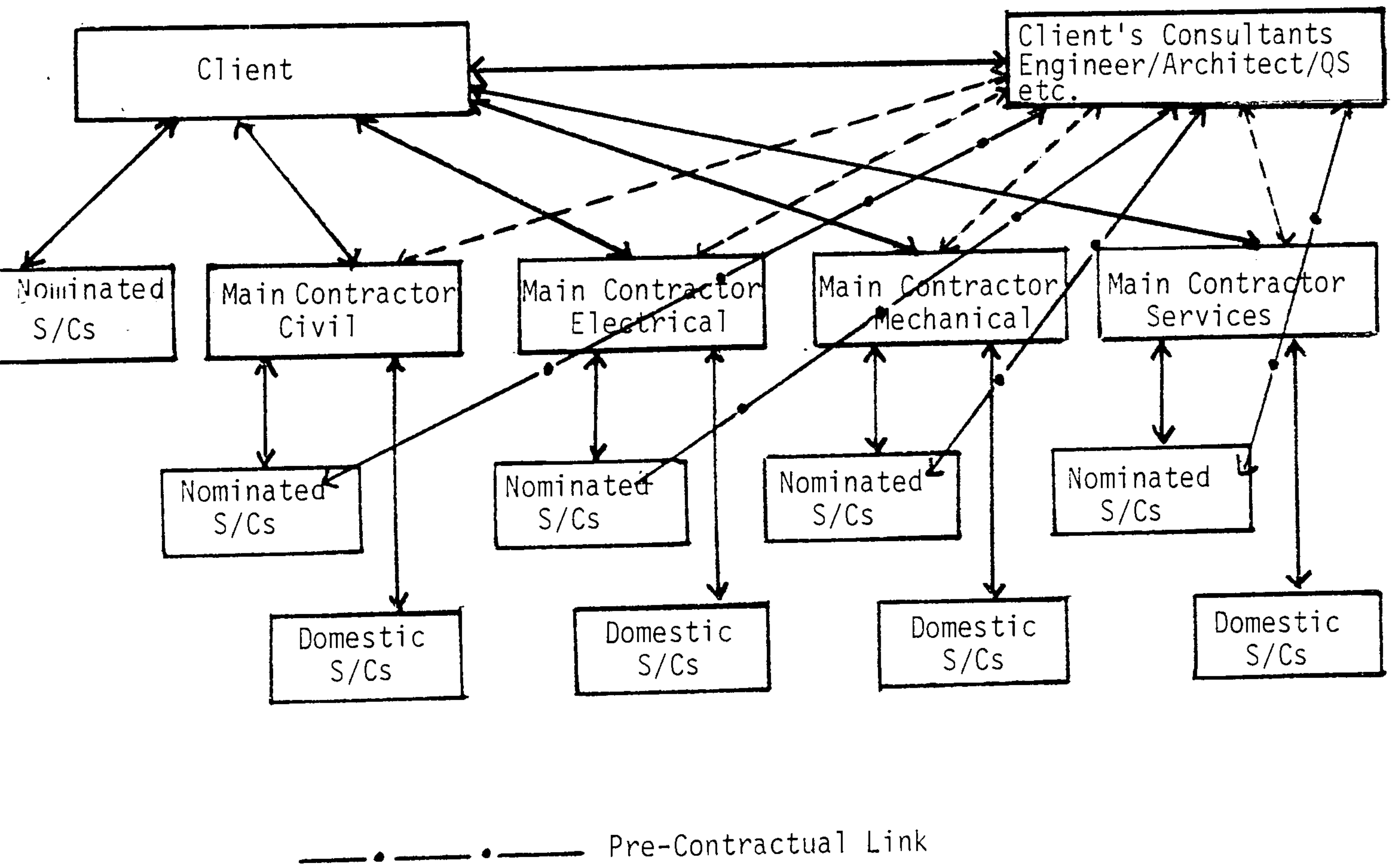
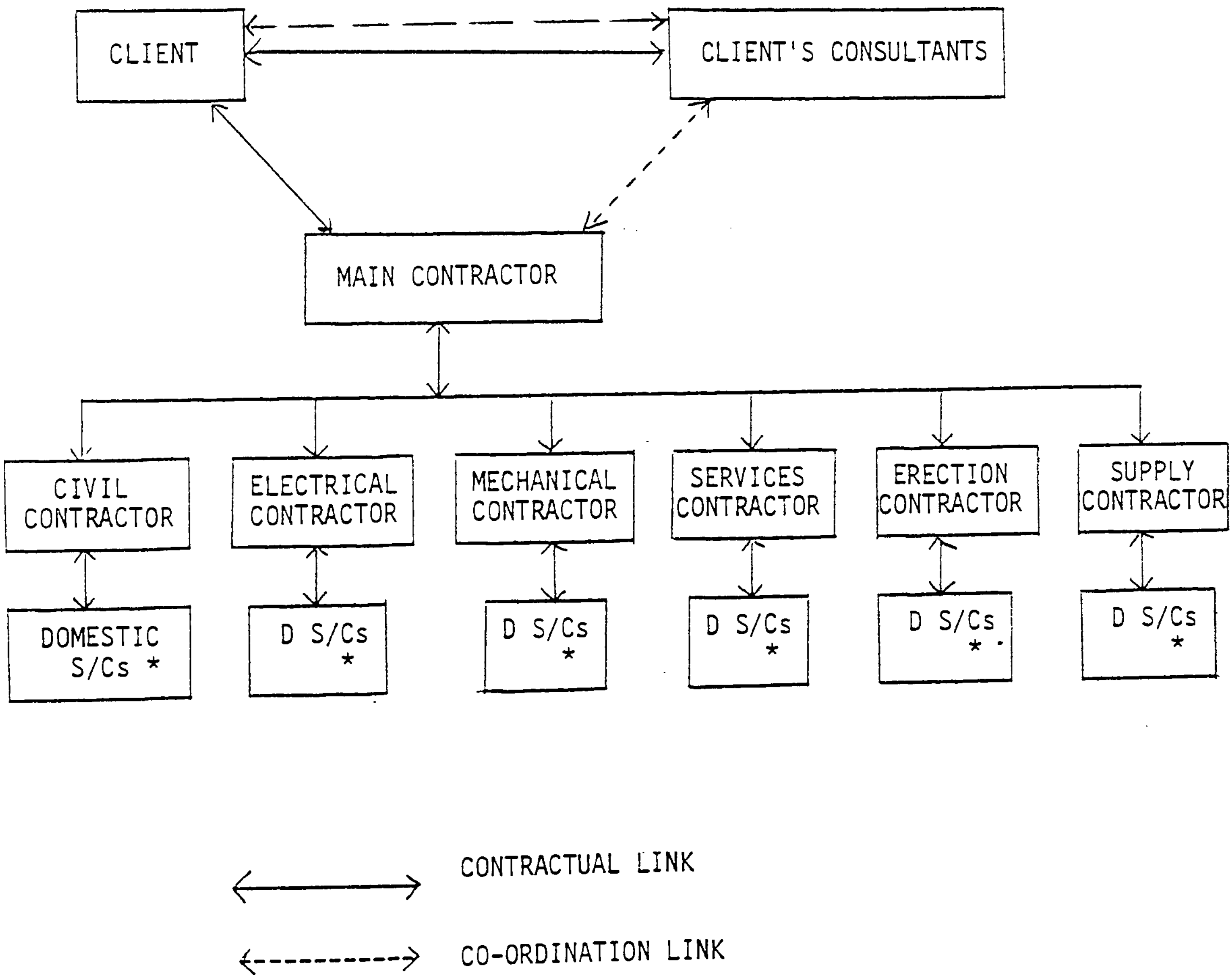


CHART 5.2.2.3

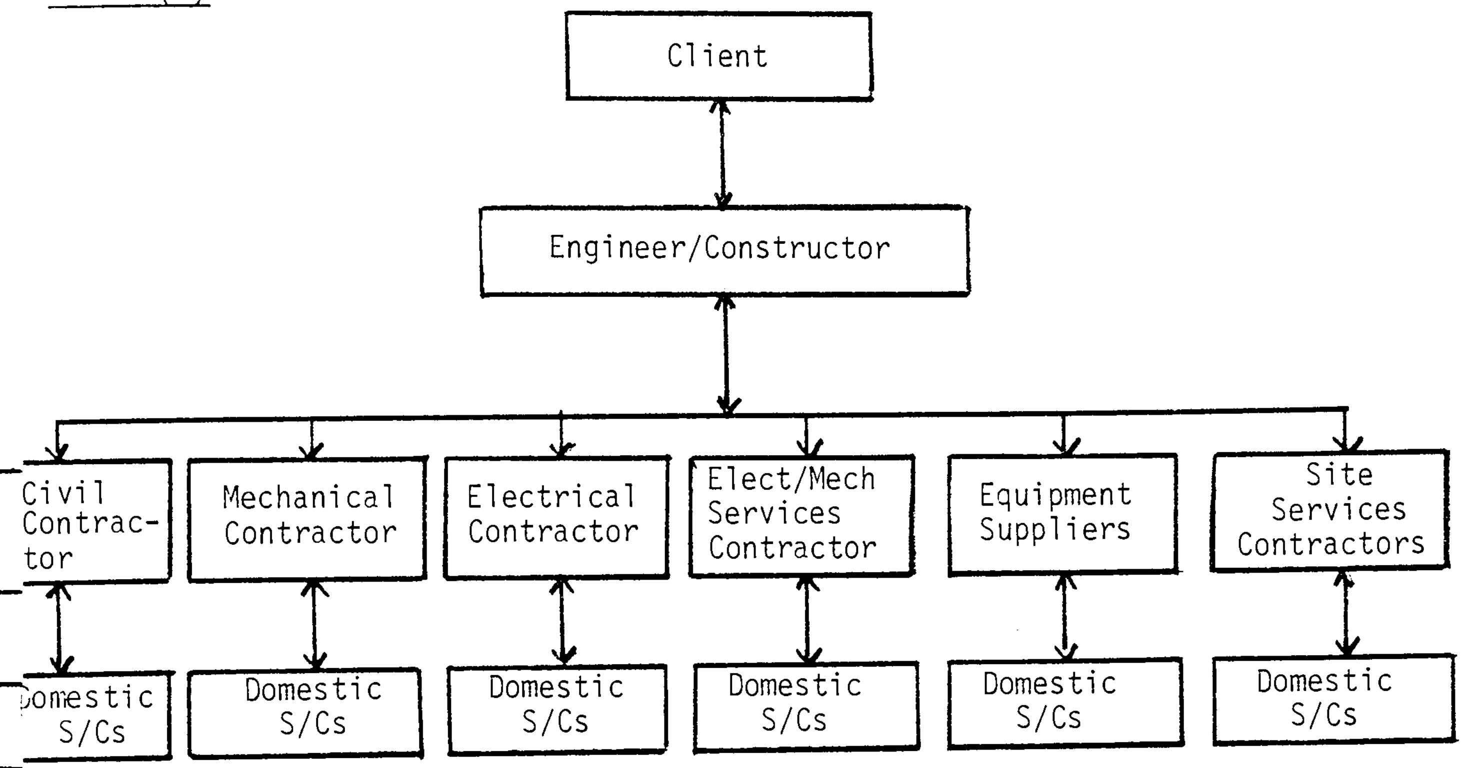
MAIN CONTRACTOR

CASE 1 (C)



ENGINEER/CONTRACTOR (Turnkey Contract)

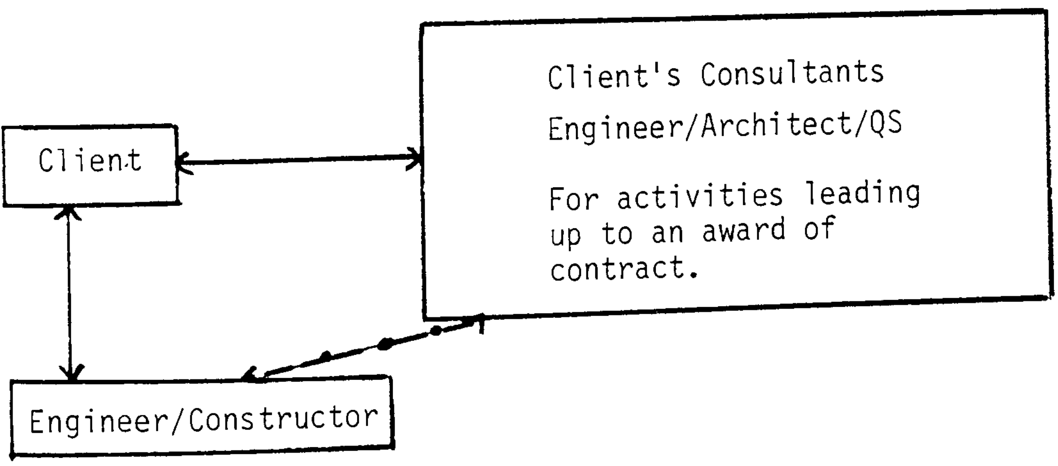
CASE 1(A)

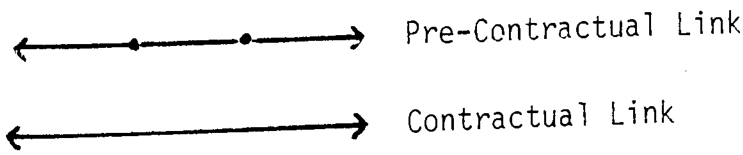


ENGINEER/CONTRACTOR CHART 5.2.2.5

CASE 1(B)

As above but with the following box





IGINEER/CONSTRUCTOR (E/C)

ASE 1 (C)

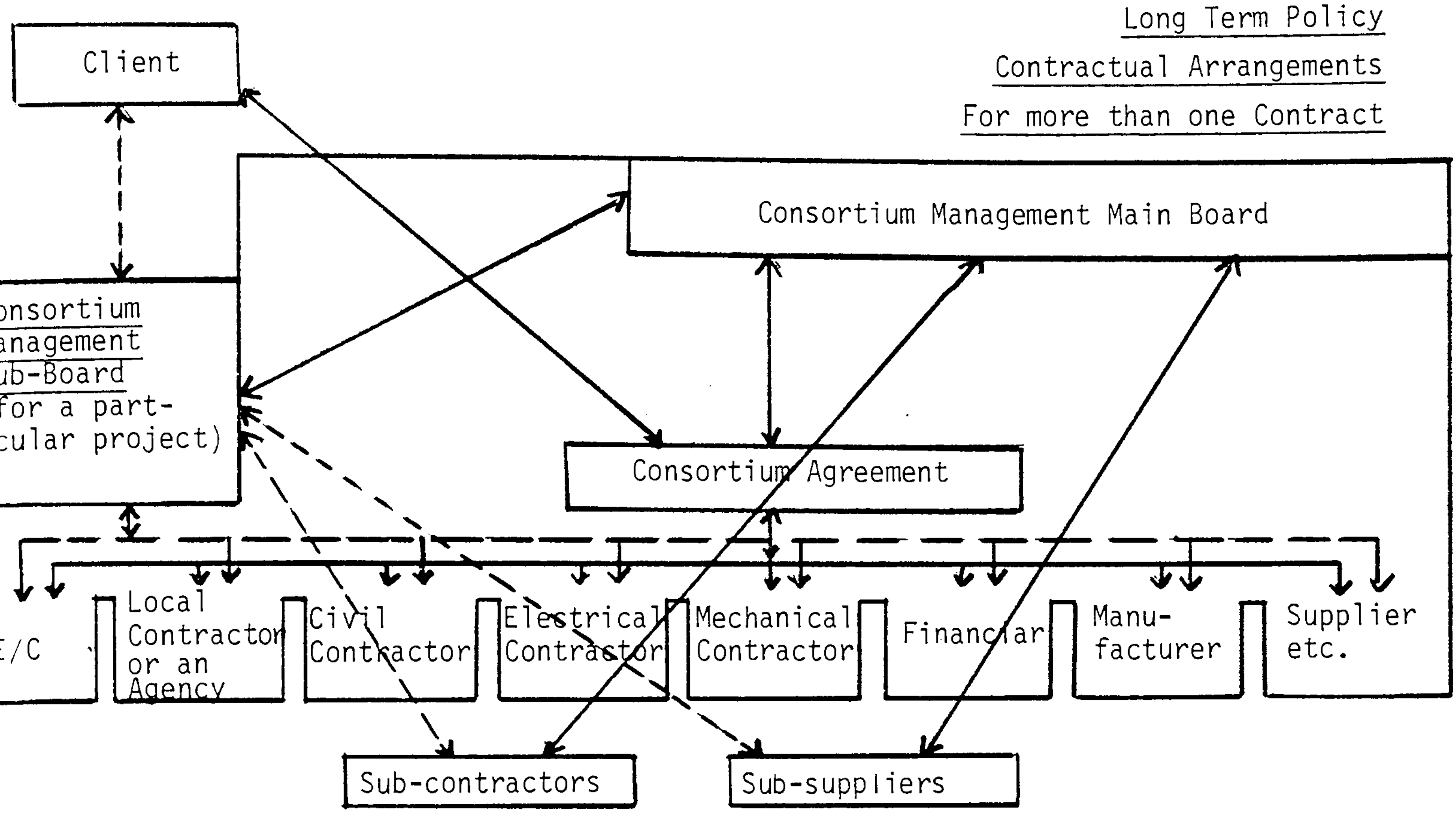
Turnkey Contract

(Consortium)

Long Term Policy

Contractual Arrangements

For more than one Contract



NOTES:

1. Consortium of more than one of the above contractors (or any other combination)

2. Client may or may not employ consultant for activities leading up to contract award.

3. All consortium partners are jointly responsible (like any other company partnership) but at times can be jointly and severally responsible for execution of the contract to the specification.

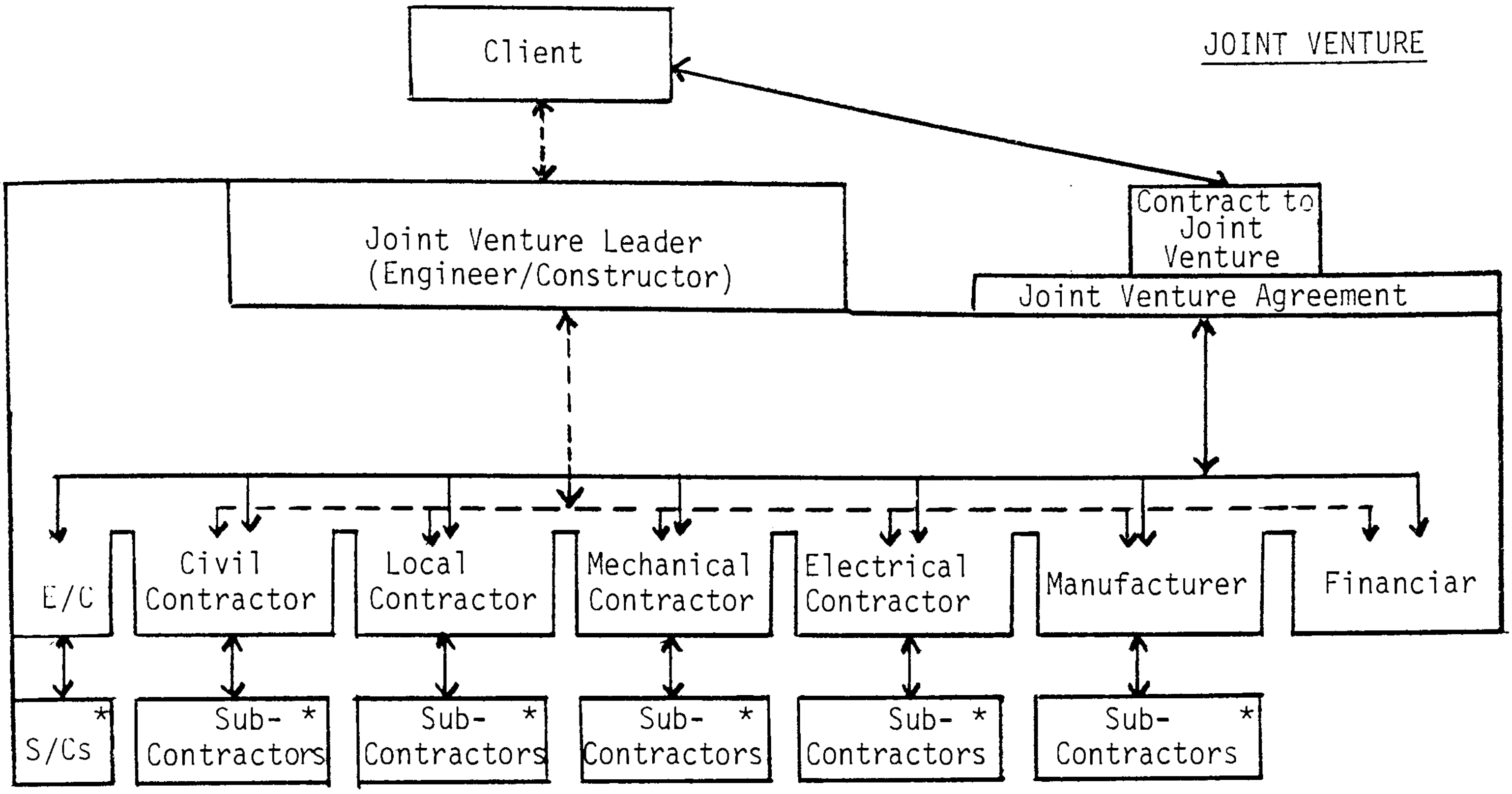
4. Sub-contractors and sub-suppliers for a particular project have contractual link with the consortium main board.

←- -→ Co-ordination Link

←——→ Contractual Link

CASE 1 (D)

(Turnkey Contract)



NOTES :

1. Joint venture or more than one of the above contractors (or any other combinations).

2. Client may or may not employ consultant for activities leading up to contract award.

3. Joint venture partners are separately responsible for their share of the work but at times can be jointly responsible for overall execution of the project to the specification.

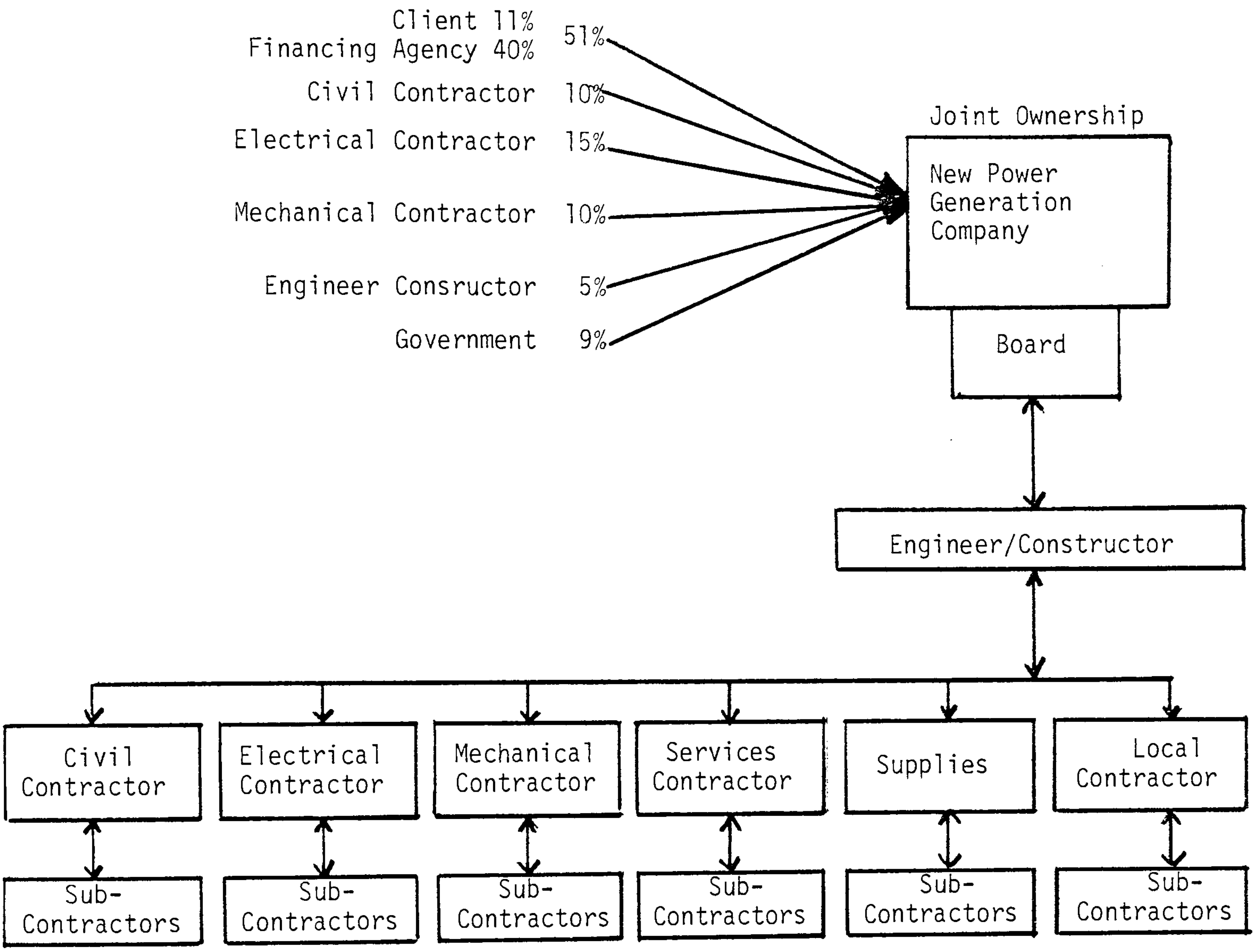
4. Individual partners may employ subcontractors individual partner is responsible for his subcontractor's work.

* May have local and/or overseas content.

ENGINEER/CONSTRUCTOR

CASE 1 (E)

EQUITY PARTICIPATION



NOTE: Figures in percentage are indicative only.

CHART 5.2.2.9

MANAGING CONTRACTOR

CASE 1 (A)

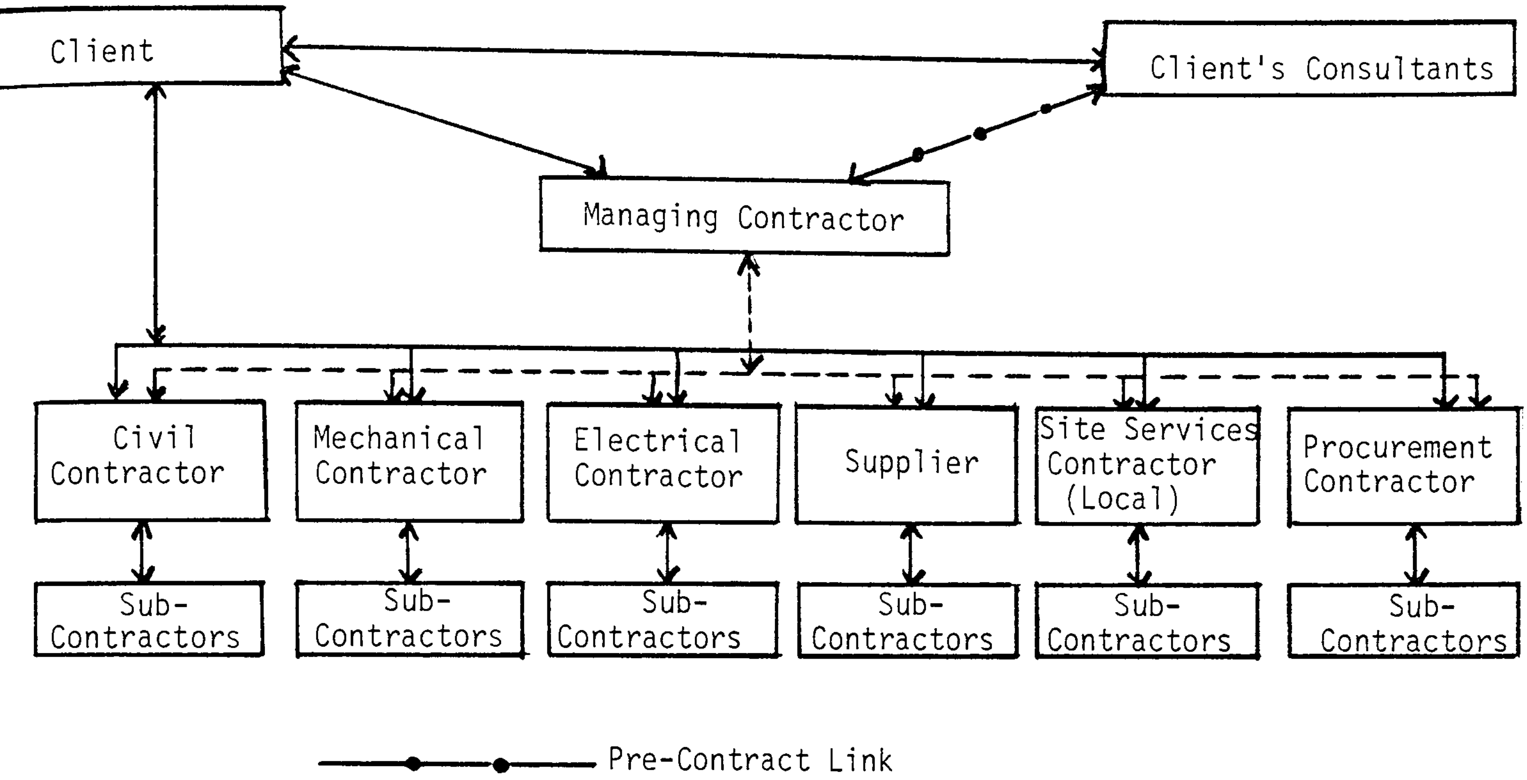


CHART 5.2.2.10

MANAGING CONTRACTOR

CASE 1 (B)

As above but without the box for Client's Consultant. In this case the Managing Contractor is responsible for engineering design and assumes many other responsibilities.

TABLE 5.2.2.1

SOME OF THE DIMENSIONS OF LARGE SCALE OVERSEAS PROJECTS

1. Type of Project.
2. Territory.
3. Contract Period.
4. Tender Period.
5. Available Project Information.
6. Contractor's Resources.
7. Basis of Contract (likely role and conditions).
8. Estimated Value of the Share of the Work in the Project.
9. Client's Reputation.
10. J.V. Partners.
11. Sub-Contractors.
12. Local Representation.
13. Government Involvement.
14. Currency Matters.
15. Current Liability in the Territory.
16. Risks - Financial/Commercial/Technical.
17. Tendering Cost.
18. Technical Knowhow.
19. Finances (if required).
20. The Conditions of Contract.

CASE STUDY * 5.3.1

ESTIMATING UNDER A SEVERE TIME CONSTRAINT

(* Quoted in a Seminar)

A contractor was tendering for a large procurement contract (approx. US$ 50m) consisting of well over 200 specialist items of plant and machinery associated with large scale mining projects. The enquiry was issued by an overseas client.

Within days of starting work on the tender, the contractor was notified that the original 8 weeks tendering period had been reduced to 5 weeks in order to suit the financial authority.

The contents of the enquiry were of highly specialist nature and the contractor had only one estimator specialist in the field. The complex task of obtaining prices in writing, ensuring the suitability of technical content of various offers, delivery periods, etc, was made difficult due to the severity of time constraint. It introduced an element of uncertainty due to many omissions of items in the received offers, inability to obtain prices for some critical and major cost items on time, suppliers qualifying their offers technically as well as commercially when it came to firm estimates etc.

The contractor had little option but to 'jump' prices for items for which he was unable to get firm prices and had to use a high contingency where it was impossible to obtain any prices at all in time for the main bid. As a consequence, there was a high level of uncertainty regarding the competitiveness of the contractor's bid.

The estimator concerned experienced a severe stress during the tendering period and took some time off to recover from his exhaustive tendering activites.

Case Study 5.3.2

A precast concrete units manufacturer received an enquiry for a large number (approximately 225,000 ft.) of specially designed units to be delivered to site. A senior estimator working under a severe time constraint made a simple error in calculating the cross section of the unit. He did not allow for the shape (See Fig. 5.3.2) of the unit which required a major deduction in the total cross sectional area.

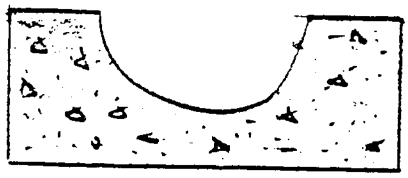


Fig. 5.3.2

It resulted in the following errors:

	Incorrect	Correct
Wt. of the Unit	1260 lbs.	504 lbs.
Wt. of the Unit/ln.ft.	109 lbs.	44 lbs.
Concrete Cost/Unit	£ 2.98	£ 0.72
Total cost of production/unit	£10.54	£ 2.96
Total cost per linear foot	£ 0.92	£ 0.25
Total cost per linear foot delivered	£ 1.14	£ 0.27

The cost of error

The manufacturer lost the order.

CASE STUDY 5.3.3: EFFECTS OF TIME CONSTRAINT ON TASK PERFORMANCE

5.3.3.1 Background of the Case Study

An eight year old girl, who was described in her school report as 'a steady persistent worker and well above average in mathematics', volunteered to solve simple addition and subtraction problems in a normal homely atmosphere.

A typical sample of the problems is given below:

9 + 2, 7 + 5, 8 + 9, 9 + 5, 9 + 9, 12 - 7, 13 - 5, 16 - 9, 14 - 8 and 17 - 8.

There were 2 sets of 20 addition problems and 2 sets of 20 subtraction problems. The problems were taken from the school standard mathematics book, Godard & Grattidge (1974). The authors recommended 2 minutes to solve each set of 20 problems. Sets A & B were addition problems and sets C & D were subtraction problems. The problems were dictated to the girl and she was expected to write only the answers.

During a discussion with the girl's class teacher, it was discovered that children in the class find subtraction problems difficult when compared with addition problems. It was for this reason addition problems were treated as a simple task (s) and subtraction problems as a complex task (c). Mott (1972) gives support to this treatment.

A minimum of seven days were allowed between different stages of the experiment in order to overcome the 'memory' factor.

The task performance was measured in terms of quantity and quality.

Quantity measured in terms of amount of task performed i.e. number of problems attempted.

Quality measured in terms of accuracy of the task performed i.e. accuracy of the answers.

5.3.3.2 DATA: 1ST STAGE: SATURDAY NO.1

Notes (1) No time constraint

(2) 20 problems in each set.

TABLE 5.3.3.2.1

Orininal Time Taken	Tasks			
	Simple		Complex	
	Set A	Set B	Set C	Set D
Time (seconds)	98	104	116	118
Number attempted	20	20	20	20
% attempted	100%	100%	100%	100%
Number of problems correct	20	20	20	20
% correct from 20	100%	100%	100%	100%
% correct from number attempted	100%	100%	100%	100%
Average time per problem (in Seconds)	5.05		5.85	

2ND STAGE: SATURDAY NO.2

TABLE 5.3.3.2.2

	Tasks					
	Simple			Complex		
	Set A	Set B	Ave	Set C	Set D	Ave
Time Allowed (secs)	90	90	90	105	105	105
% original time	92%	87%	89.5%	90.5%	89.0%	89.75%
Number of problems attempted	20	19	-	17	18	-
% attempted from	100	95%	97.5%	85%	90%	87.5%
Number of problems correct	19	18	-	16	15	-
% correct out of 20	95%	90%	92.5%	80%	75%	77.5%
% correct out of number attempted	95%	95%	95%	94%	83%	88.5%
Ave time per problem (in seconds)		4.62				6.0

3RD STAGE: SATURDAY NO.3

TABLE 5.3.3.2.3

	Tasks					
	Simple			Complex		
	Set A	Set B	Ave	Set C	Set D	Ave
Time allowed (secs)	70	70	70	90	90	90
% Original time	71%	67%	69%	77.5%	76%	76.75%
Number of problems attempted	18	19	-	16	15	-
% attempted	90%	95%	92.5%	80%	75%	77.5%
Number of problems correct	17	16	-	14	15	-
% correct of out of 20	85%	80%	82.5%	70%	75%	72.5%
% correct out of number attempted	94%	84%	89%	87.5%	100%	93.75%
Ave time per problem (in seconds)			3.75			5.81

4TH STAGE: SATURDAY NO.4 TABLE 5.3.3.2.4

Time allowed (secs)	60	60	60	60	60	60
% Original time	61%	57%	59%	52%	51%	51.5%
Number of problems attempted	15	16	-	13	11	-
% attempted	75%	80%	77.5%	65%	55%	60%
Number of problems correct	13	13	-	10	10	-
% correct out of 20	65%	65%	65%	50%	50%	50%
% correct out of number attempted	86.5%	81%	83.75%	77%	91%	84%
Ave time per problem (in seconds)			3.87			5.00

5.3.3.3 Analysis

From tables 5.3.3.2.1 and 4 it can be seen that

(a) as the time allowed was reduced from 100% to 59% for simple tasks, the quantity of simple tasks performed dropped from 100% to 77.5%, a drop of 22.5%.

(b) as the time allowed was reduced from 100% to 51.5% for complex task, the quantity of complex task performed dropped from 100% to 60%, a drop of 40%.

(c) as the time allowed was reduced from 100% to 59% for simple tasks, the quality of simple tasks performed dropped from 100% to 65%, a drop of 35%.

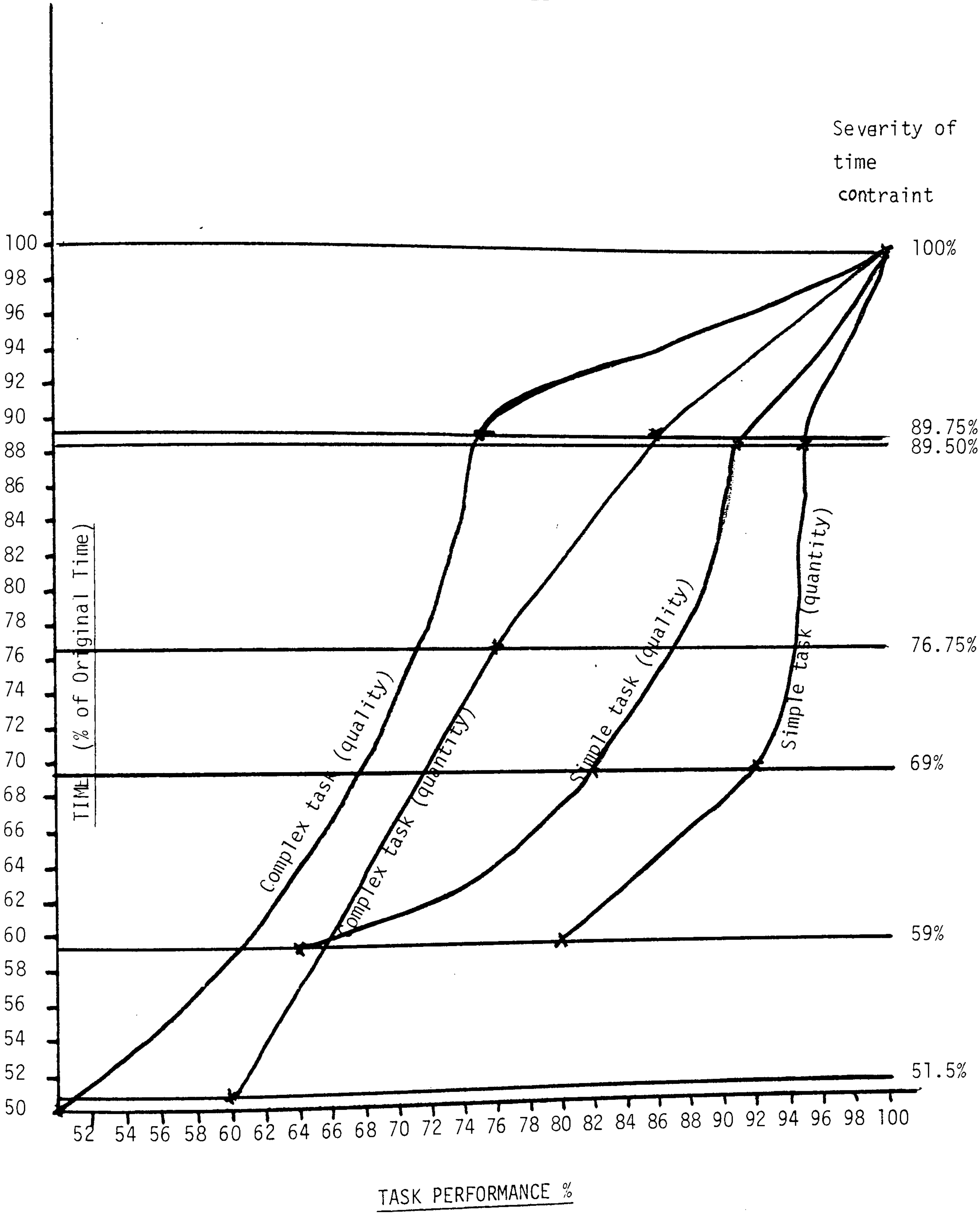
(d) as the time allowed was reduced from 100% to 51.5% for complex tasks, the quality of complex tasks performed dropped from 100% to 50%, a drop of 50%.

The above figures can be plotted as shown in Figure 5.3.3.4. Although 'quality' has been defined as percentage of problems correct out of 20, one may also think of it as the following ratio:

$$\text{Quality} = \frac{\text{Number correct}}{\text{Number attempted}}$$

Furthermore curves can be plotted for performance against time as shown in Figure 5.3.3.5.

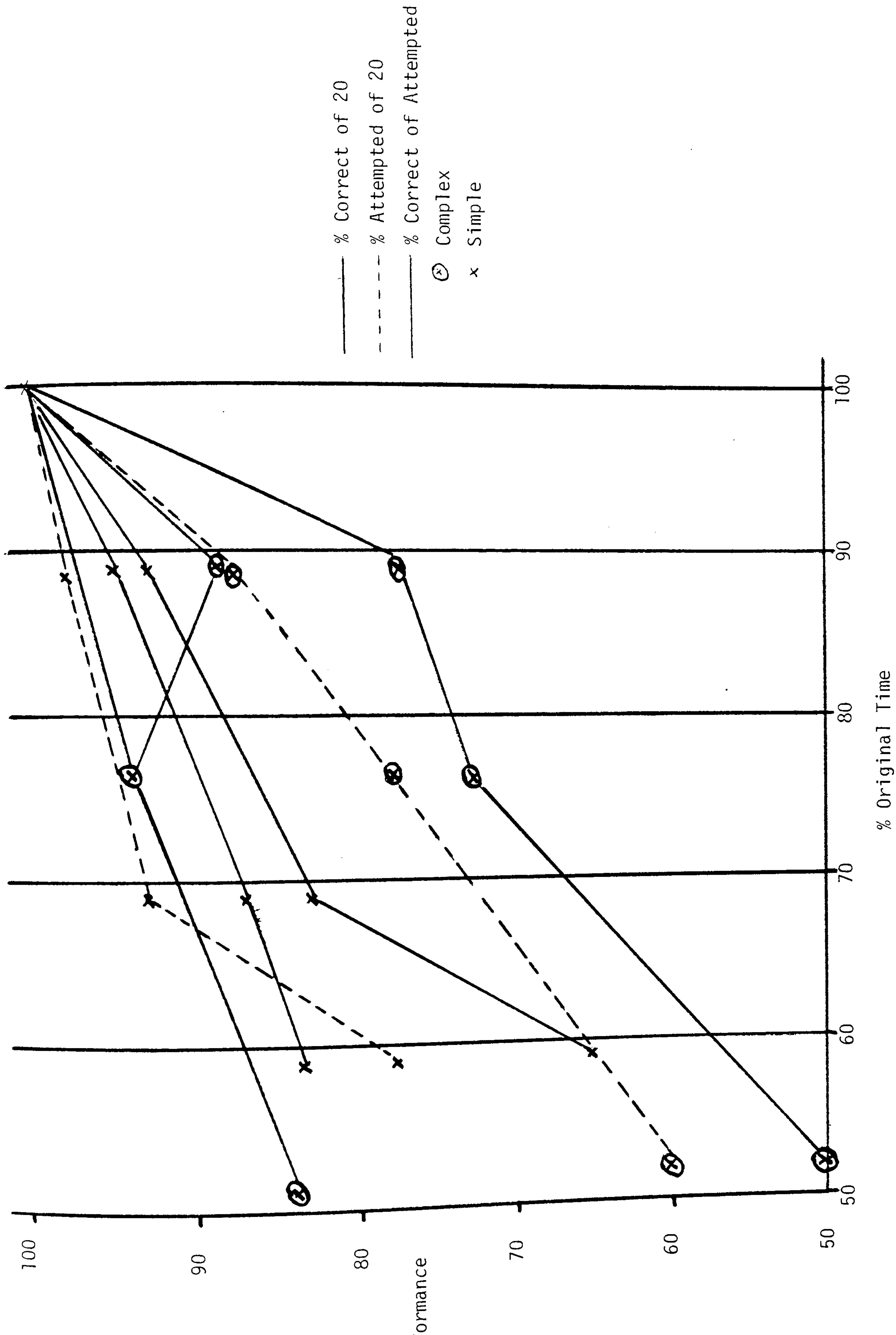
FIGURE 5.3.3.4



Quantity = % problems attempted out of 20

Quality = % problems correct out of 20

FIGURE 5.3.3.5.


% Correct of 20
% Attempted of 20
% Correct of Attempted
Complex
Simple
% Original Time
100
90
80
70
60
50
100
90
80
70
60
50

5.3.3.4 Conclusions

As the severity of time constraint is gradually increased:

(a) the task performance (quality & quantity) appears to be gradually reduced.

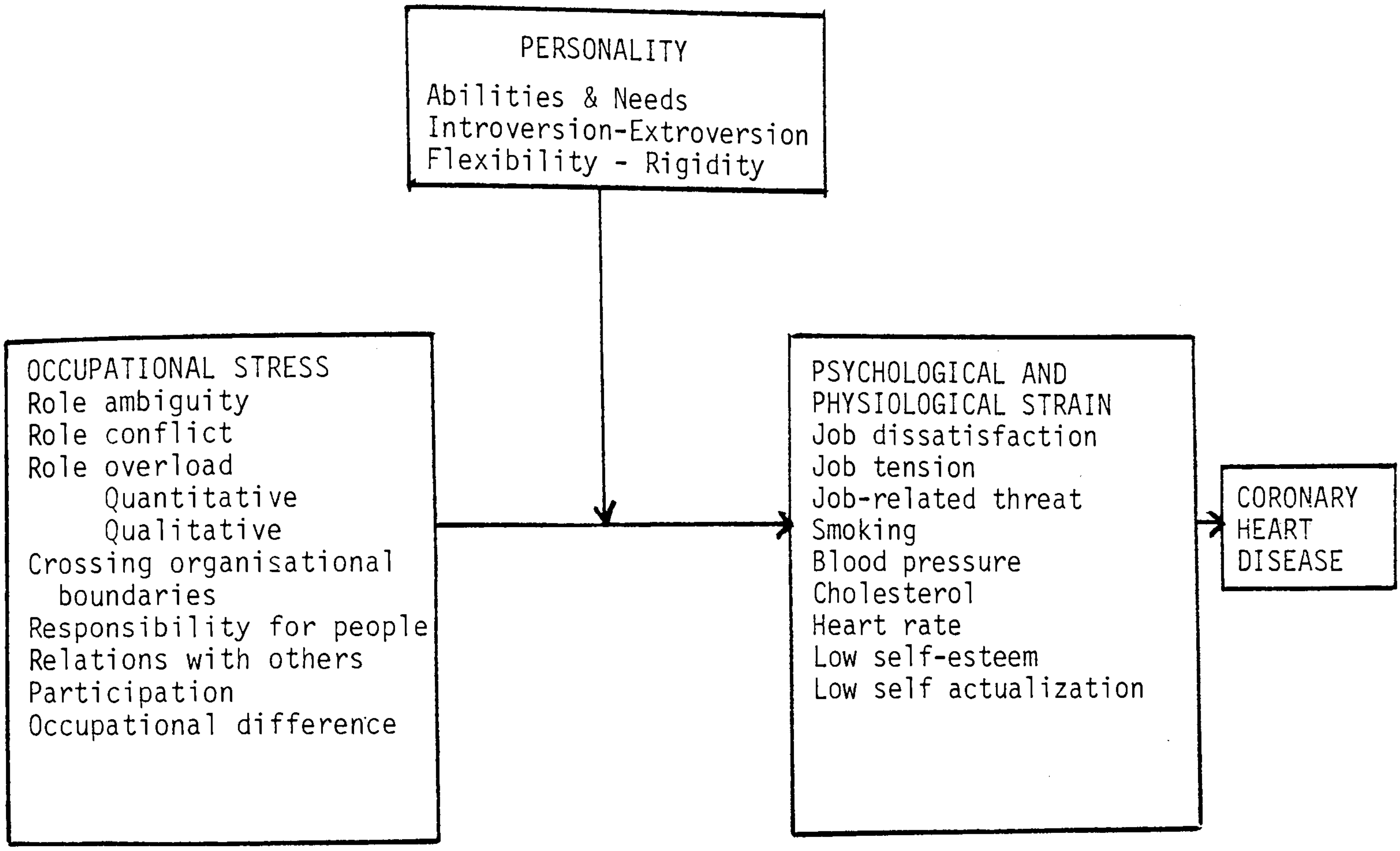
(b) the rate of drop in the quantity of task performance appears to be higher for complex tasks than for simple tasks.

(c) the rate of drop in the quality of task performance appears to be higher for complex tasks than for simple tasks.

(d) there appears to be a tendency for increase in the number of errors both in simple and complex task as the severity of time constraint is increased i.e. a task performance appears to be adversely affected by the increase in the severity of time constraint.

FIGURE 5.4.2.1

French & Caplan: (1973) How organisational stresses affect individual strains contributing to coronary disease



Horizontal arrows show the effects of environmental stresses on individual strain which in turn affects heart disease. The vertical arrow shows the conditioning effects of personality variables.

Table 5.4.2.1

Norfolk's stress value of life changes*.

* From Norfolk (1977)

Event	Score	Event	Score
Death of spouse	100	Trouble with in-laws	29
Divorce	73	Wife beginning or stopping work	29
Marital separation	65	Outstanding personal achievement	28
Jail term	63	Beginning or ending school	26
Death of close member of family	63	Revision of personal habits	24
Personal injury or illness	53	Trouble with boss	23
Fired from job	47	Change in hours or conditions of work	20
Marital reconciliation	45	Change in residence	20
Retirement	45	Change in schools	20
Change in health in member of family	44	Change in recreation	19
Pregnancy	40	Change in social activities	18
Sex difficulties	39	Mortgage or loan less than £6000 (1975)	17
Gain of new family member	39	Change in sleeping habits	16
Change in financial state	38	Change in number of family get-togethers	15
Death of close friend	37	Change in eating habits	15
Change of different type of work	36	Vacation	13
Change in number of arguments with spouse	35	Minor violation of the law	11
Mortgage over £6000 (1975)	31		
Foreclosure of mortgage or loan	30		
Change of responsibility at work	29		
Son or daughter leave home	29		

FIG.5.4.2.2.

STRESS

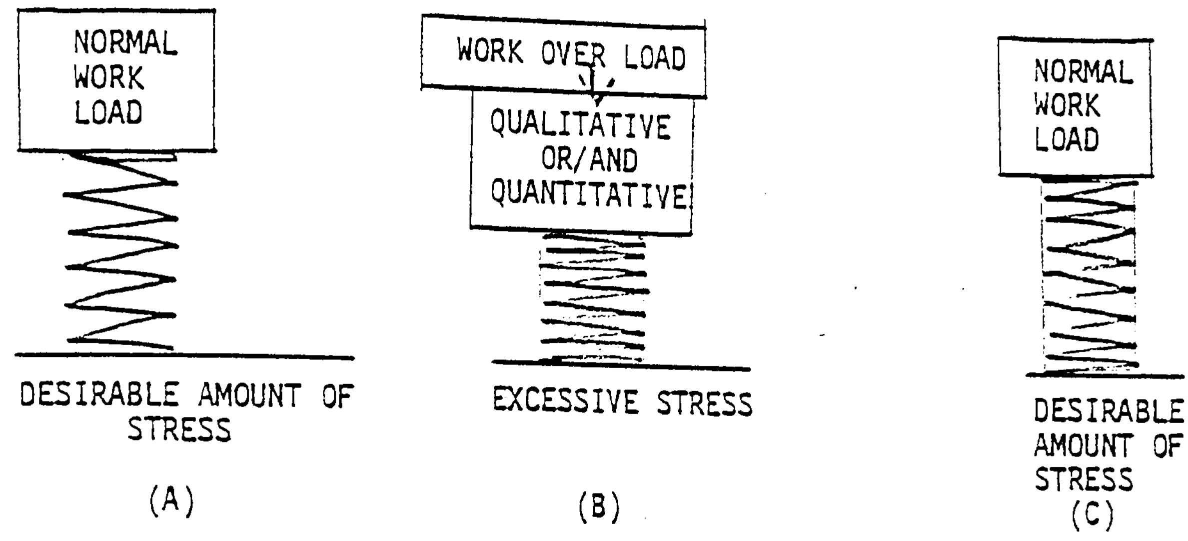


FIG. 5.4.2.3.

STRAIN

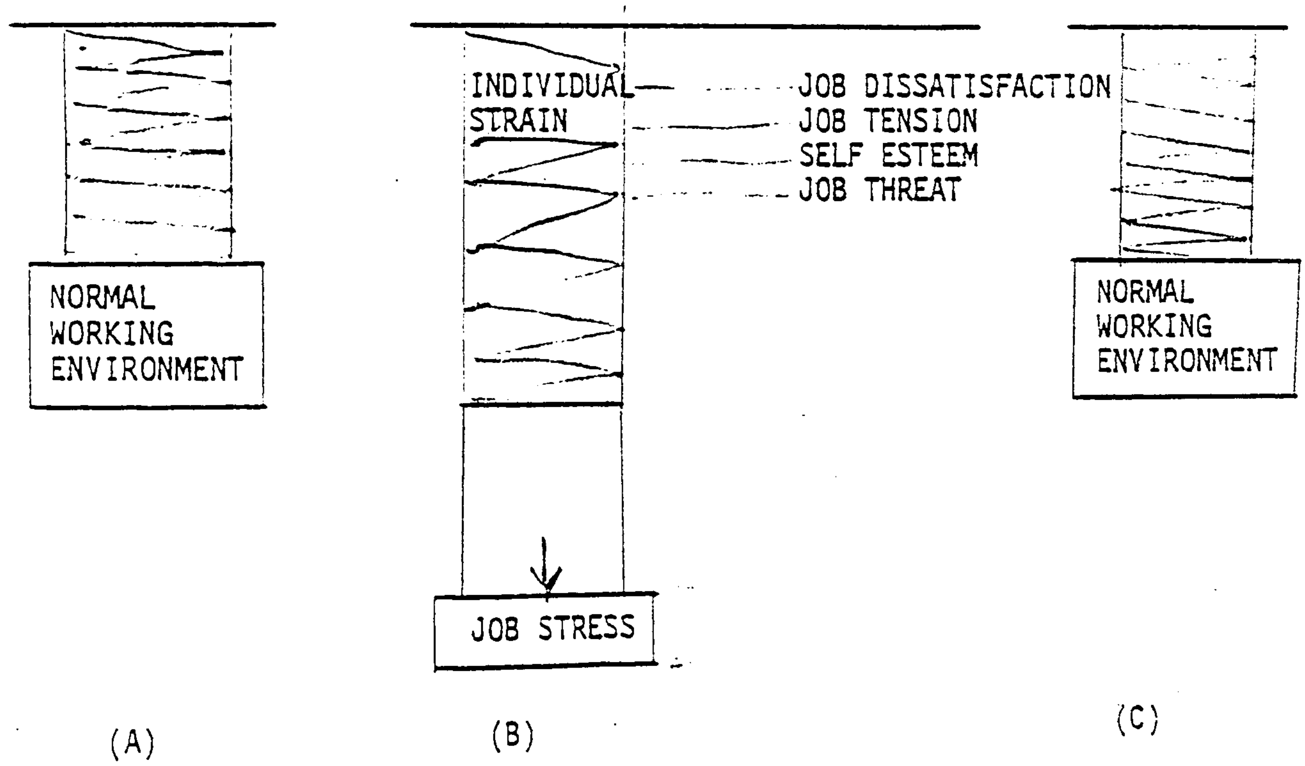


FIG. 5.4.3.1 : PERFORMANCE SATISFACTION MODELS

FIG. (a) : PORTER – LAWLER MODEL (1968)

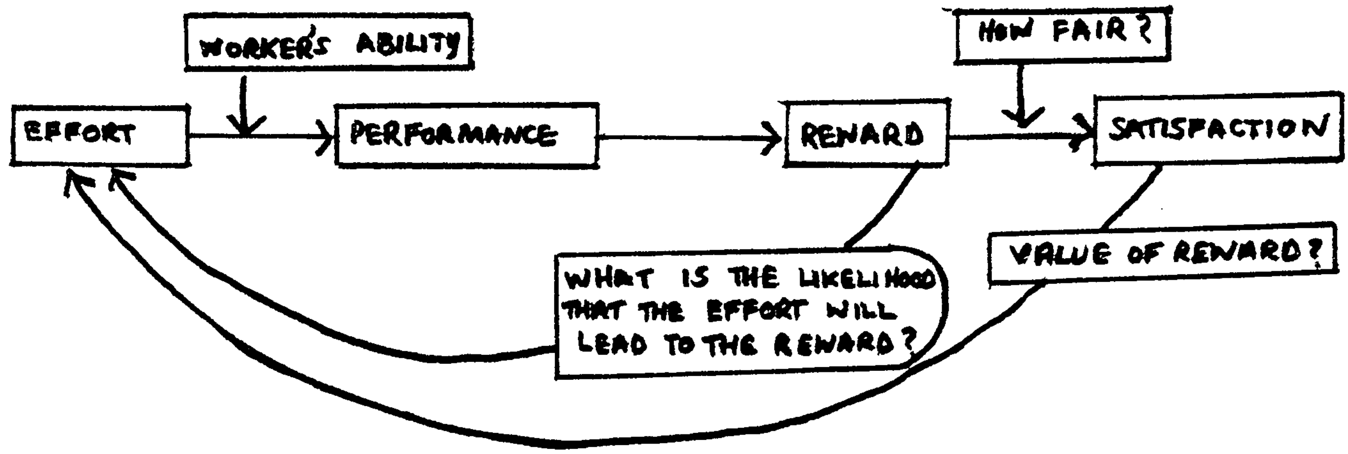


FIG (b) : LUCAS MODEL (1978)

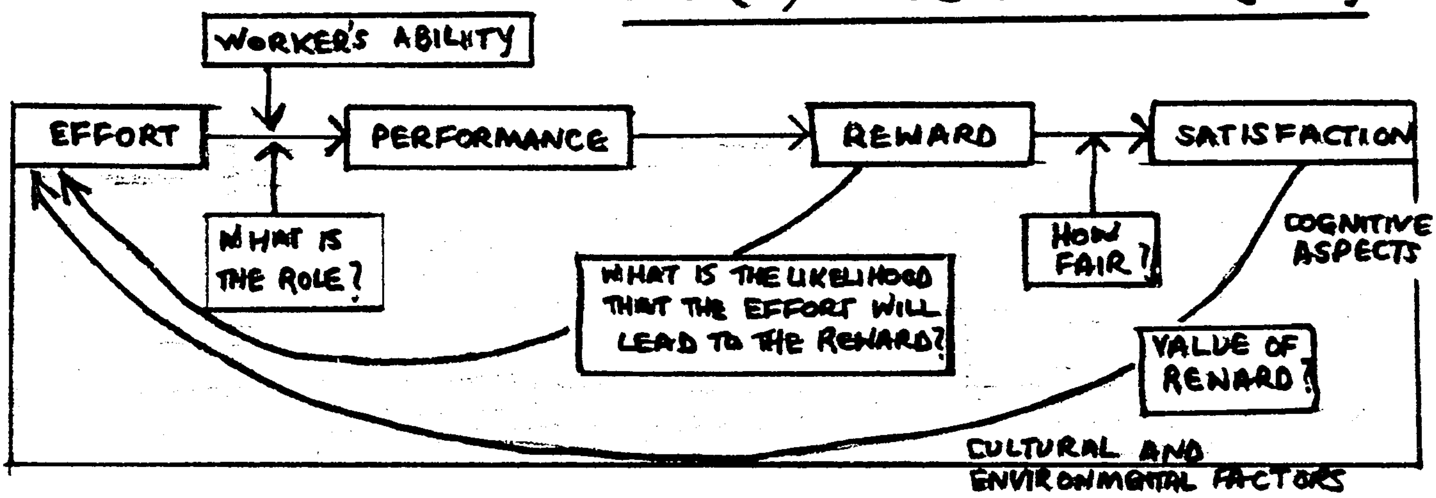


FIG. (C) : MODIFICATIONS TO ABOVE MODELS FOR TENDERING SITUATIONS.

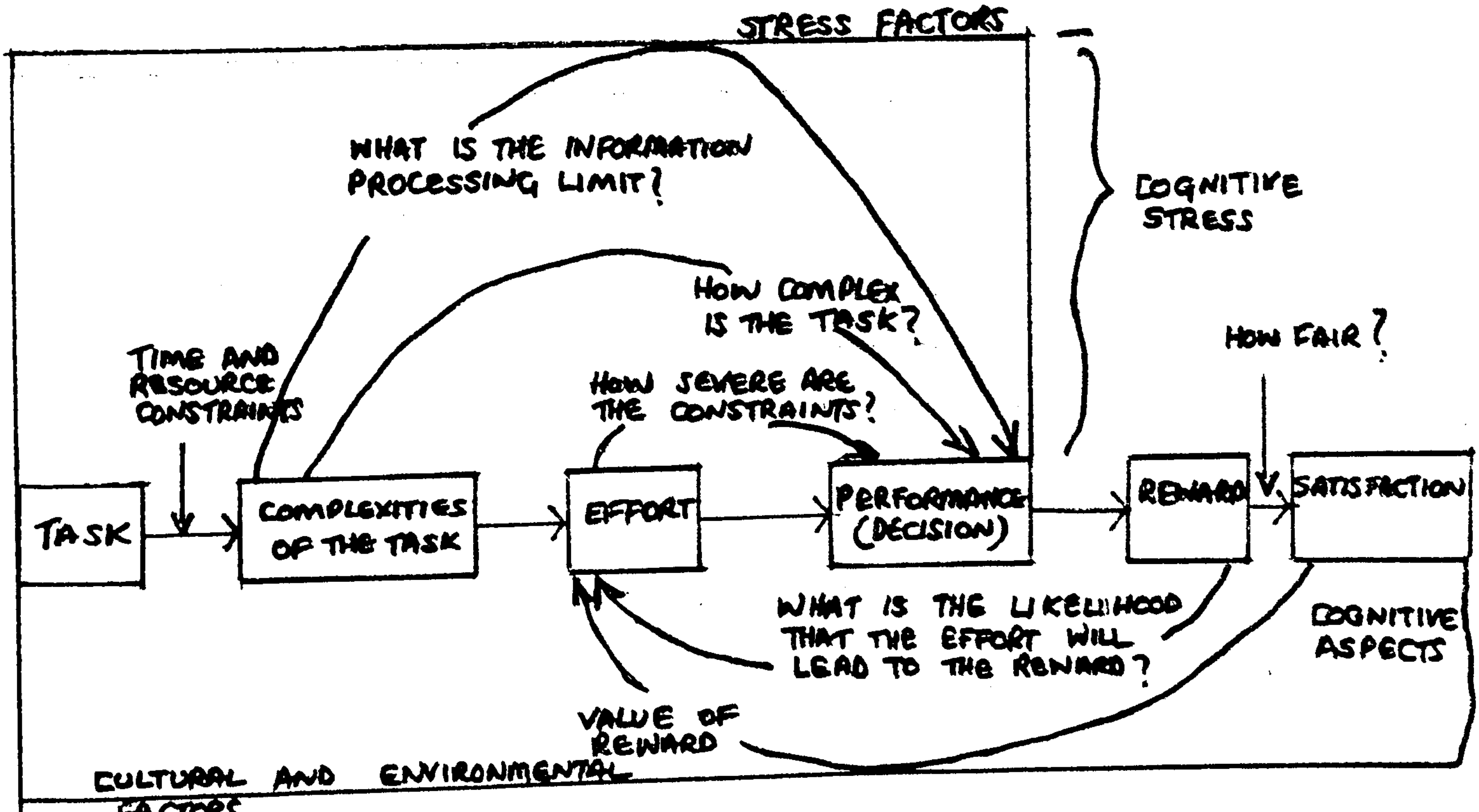


TABLE 5.5.1

EXPERIMENTAL SITUATIONS USED BY BEHAVIOURAL SCIENTISTS AND OPERATION RESEARCHERS FOR TESTING THEIR MODELS AND THEORIES

1.0 Unfamiliar environments to tendering situations

1.1 Kiesler (1966)
Used children to choose one of four alternatives (candy bars) in his experiments in the field of decision time.

1.2 Hendrick et.al (1968)
Observed college students choosing neckties in a similar work to Kiesler (1966).

1.3 Tversky (1967)
Asked prison inmates to state minimum selling prices for commodity bundles comprised of packets of cigarettes and candies, when testing additivity assumptions in a multi-attribute utility model.

1.4 Hoepfl and Huber (1970)
In a similar field of work i.e. multi-attribute utility theory, Hoepfl and Huber asked engineering students to evaluate the teaching ability of hypothetical professor.

1.5 Von Winterfeldt (1971)
Asked subjects to evaluate the attractiveness of hypothetical apartments described by fourteen attributes.

1.6 Fischer (1972)
Asked subjects to assign wholistic risky utilities to two samples of hypothetical compact cars described by either three or nine attributes.

1.7 Pollay (1970)
Used business students who had to choose between alternative research and development projects (imaginary in his work in the area of task complexity).

1.8 Raiffa (1968)
For his contribution in the area of multi-attribute utility theory, Raiffa used hypothetical gambler and lottery tickets situation.

1.9 Fischer (1973)
Studied preferences by students for risky job alternatives described by three attributes.

1.0 (Contd.)

1.10 Tversky (1972)
Studied choice of two holiday tours in his investigation into subjective preference ordering.

1.11 Murphy and Winkler (1973)
In their work in the field of subjective probability forecasting, they used experiments carried out in operational settings using weather forecasters as their subjects.

2.0 <u>More familiar environments to tendering situations</u>

2.1 Coppleson et.al. (1970) and Einhorn (1972)
Studied the problem faced by the physicians studying biopsy slides.

2.2 Hogarth (1972)
Investigated the decision process in the above experiment.

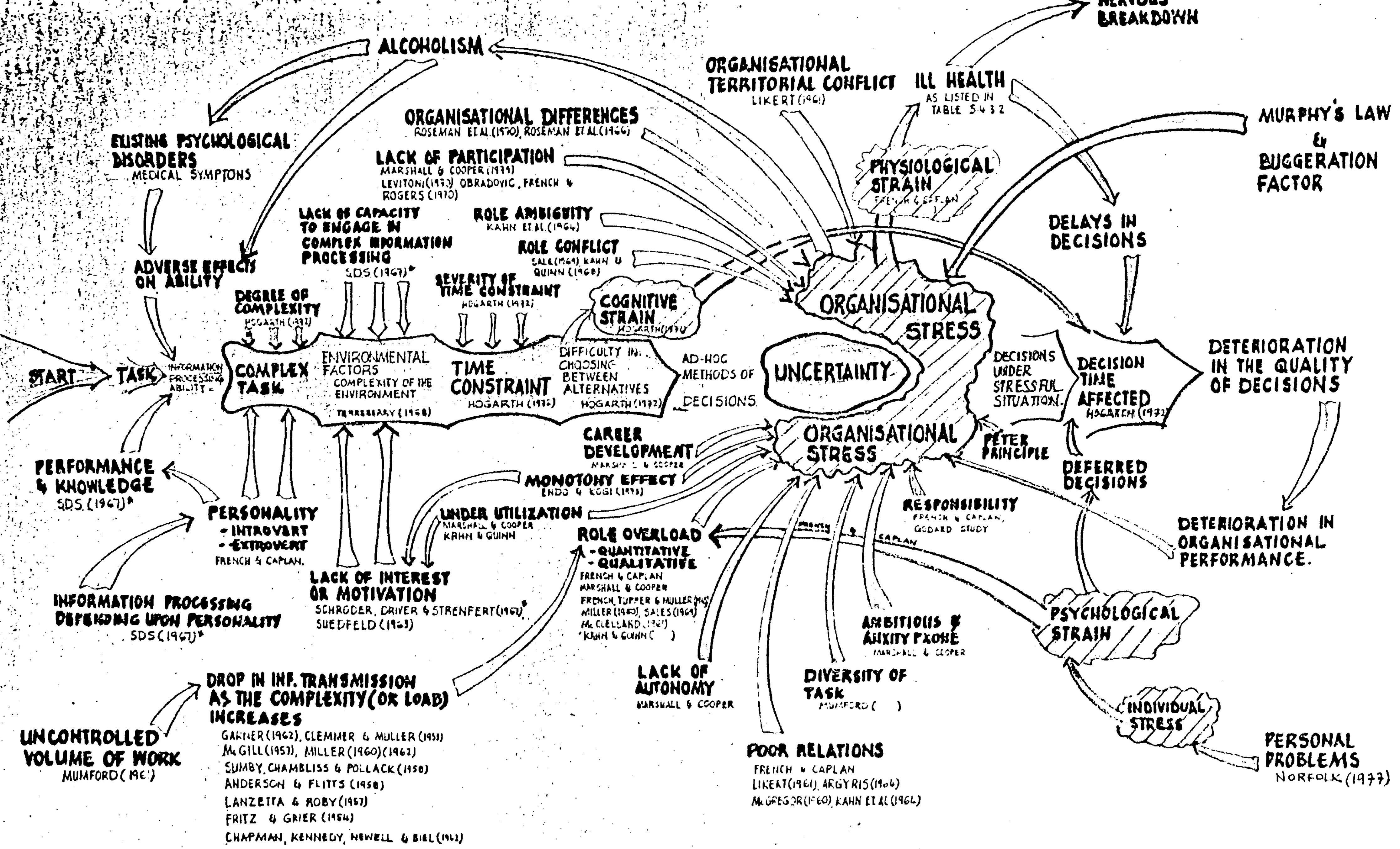
2.3 Milliken (1973)
Used past projects and people concerned with these projects in his work in the field of measurement of bias in project planning.

2.4 King (1967)
Analysed certain US Government contracts for similar study.

2.5 Kidd and Morgan (1969)
Used action research in the CEGB organisation for investigation into major overhauls of generating equipment.

2.6 Jankowicz (1973)
Used business games situation in his work on the scoring rule theory.

2.7 Kidd (1975)
For work in the similar field, Kidd studied stock market predictions.



SUCCESSFULL PERFORMANCE IN MOST COMPLEX REACTIVE TASK ENVIRONMENTS REQUIRE:

a) SUFFICIENT PERFORMANCE SKILL & KNOWLEDGE b) A NEAR OPTIMAL LEVEL OF INTEREST & MOTIVATION c) ADEQUATE COMPETENCE IN INTERPERSONAL RELATIONSHIPS & d) CAPACITY TO ENGAGE IN COMPLEX INFORMATION PROCESSING* SDS* (1967).

FIG. 5.G.1 : ORGANISATIONAL STRESS

FIG 5.6.2.

HOW ORGANISATIONAL STRESS AND PERSONAL STRESSFUL ENVIRONMENT AFFECT INDIVIDUAL STRAINS AND ULTIMATELY THE ORGANISATIONAL PERFORMANCE

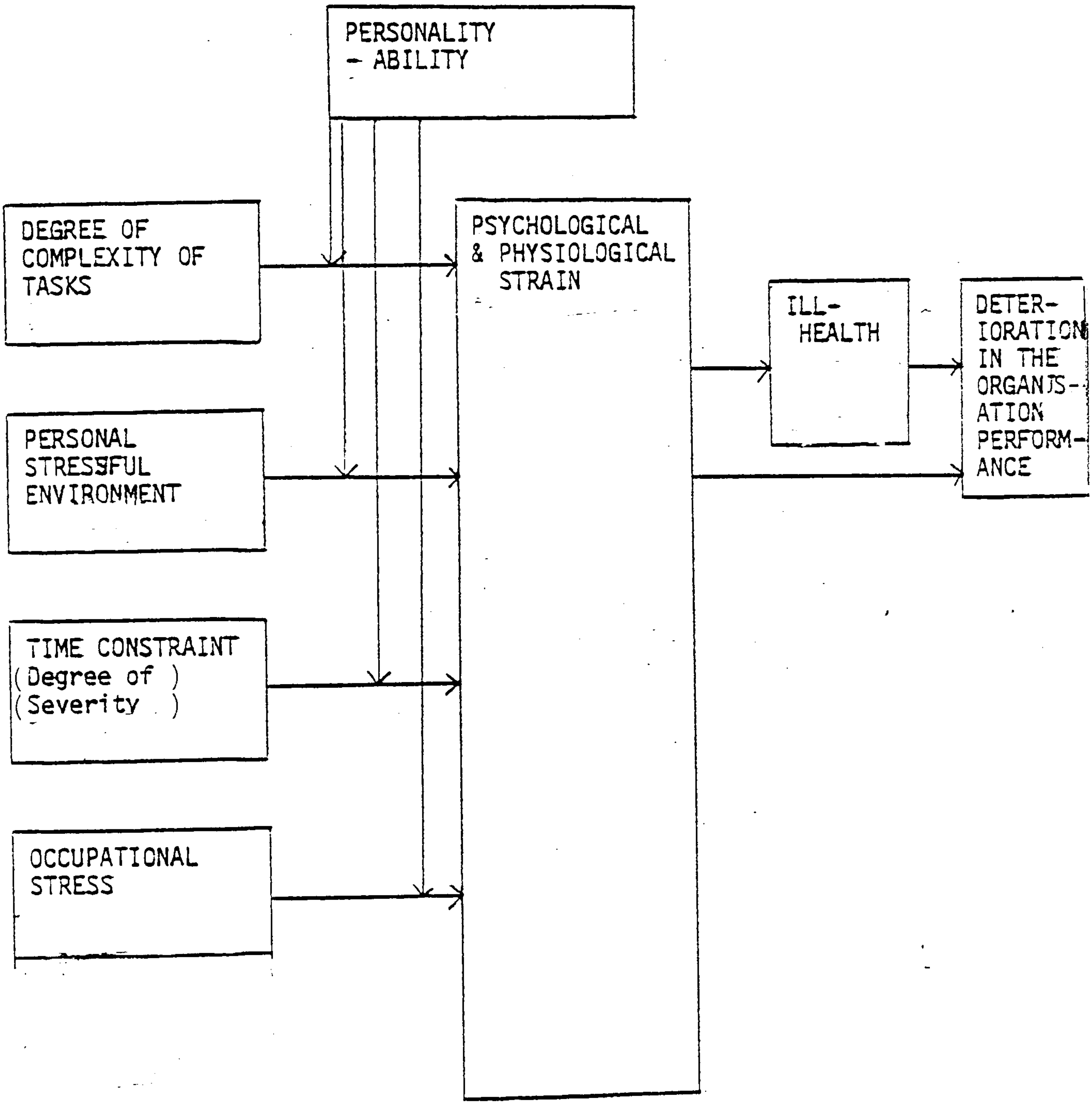


FIG. 5.7.2.1.

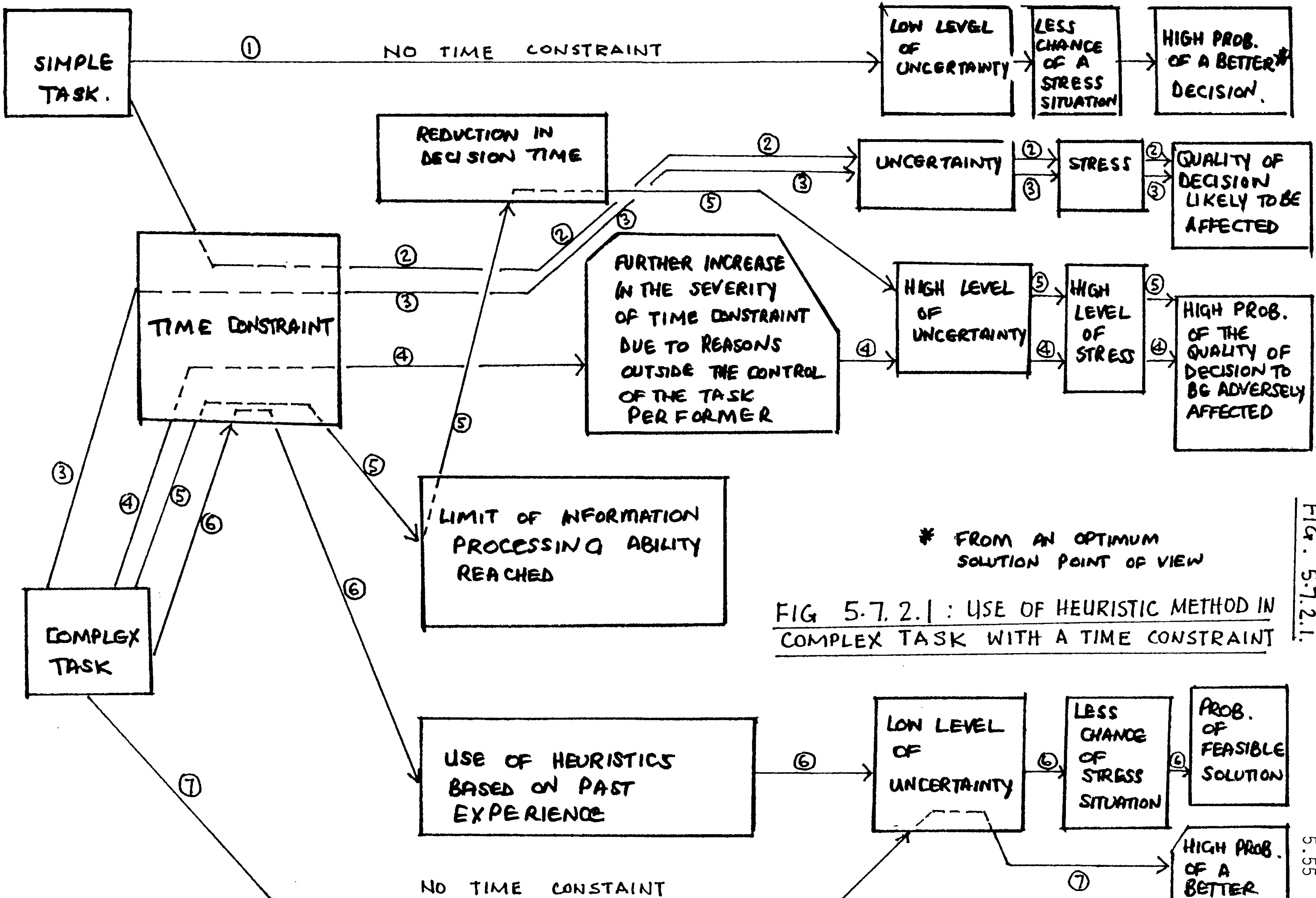


FIG 5.7.2.1 : USE OF HEURISTIC METHOD IN COMPLEX TASK WITH A TIME CONSTRAINT

CHAPTER 6

DECISION MAKING IN RISKY SITUATIONS

CHAPTER 6

DECISION MAKING IN RISKY SITUATIONS

Synopsis:

The main objective of this chapter is to develop a structured approach to risky decisions in tendering. The data for risk analysis and multi-attribute utility analysis is based on numerous informal discussions with senior managers associated with tendering. Time and again the scepticism about Decision Theory was evident through criticism and queries such as what is it? what does it do? Tendering decisions are dynamic and full of uncertainty, can it deal with these situations? Contractors perceive risk differently hence the conventional approach to risk analysis is unsuitable; what motivates tendering personnel is unclear; they have to process a great deal of information under a time constraint therefore they tend to use specific strategies, can it deal with this? and so on. The earlier part of the chapter attempts to deal with this scepticism.

The above objective has been achieved by utilising aspects of decision theory and problem solving such as decomposing complex problems, assessment of risk through 'ATERP' (Avoid, Transfer, Eliminate, Retain & Prevent) actions, trade off procedures and by using the methodology to deal with multiple attributes.

It has been demonstrated through worked examples of project risk profile and multi-attribute utility theory (MAUT) that a structured approach to decision making in risky situations can lead to sensible decisions. It also underlines the fact that appropriate information search and processing strategies are vital for improving the efficiency of the decision making process.

6.1 Introduction

This chapter deals with problems of choice which cannot be solved without a pre-decisional stage of finding choice alternatives, weighting evidence and judging values. The notion of 'utility' is fundamental in decision making when dealing with multi-objective situations. The role of MAUT - a model which simplifies the handling of utilities of more than one attribute at a time - is examined when faced with a choice between risky alternatives. In leading up to this more recently expanded aspect of Decision Theory, the relevant interfacing aspects of decision making are reviewed.

6.2 Decision Theory

6.2.1 An aspect of Decision Theory - Risky decisions

Decision Theory which attempts to understand decision behaviour by describing in an orderly way, what variables influence choice is mainly based on psychological and economic theories.

The most important aspect of the theory as far as tendering decisions are concerned, deals with risky decisions*

* Risky decisions: The decision maker has only partial or imperfect information and is expected to assign subjective probabilities to each of the possible consequences of each of the sources of action under consideration.

because the great majority of crucial tendering decisions fall into this category. Lucas (1978) refers to this as the final stage of the six-stage conscious decision making activity. (See Table 6.2.1.1). Dill, cited by Ansoff (1976), refers to this category as 'evaluation' decisions. (See Table 6.2.1.2).

6.2.2 Decision making studies - Situational factors, utility and trade off

A general review of earlier studies in decision making including the controversy about various assumptions is given in Departmental Paper * No 6.1 (Hereafter referred to as DP No..)

The emphasis of more recent studies is on realistic and practical settings. Wendt & Vlek (1975) believe that decision behaviour is strongly determined by situational factors hence the need to understand interaction between decision maker and the relevant task environment.

In tendering, situational factors such as current corporate policies, workload, need to acquire new work, etc, can influence contractors' decisions and therefore the utility of a project can vary according to different situational factors.

> The utility of a project from a contractor's point of view at any given time can be the fulfilment of the contractor's needs at that particular time derived from executing the project.

* Papers written for discussion with Mr. J.B. Kidd, Lecturer, Management Centre, University of Aston and the Associate supervisor for this study.

The utility aspect and its measurement is briefly reviewed in D.P. No. 6.2. The methodology of the measurement of utility is fully illustrated in practical examples (Section 6.10.3.2), in this chapter. The above examples also make an extensive use of the trade-off approach - a structured way of deciding how much of the undesirable attributes are acceptable to get the benefit of the correlated desirable attributes. For example, in a tender, contribution from a project can be considered as a desirable attribute while the resulting liabilities as a whole an undesirable attribute. The trade-off aspect of Decision Theory is applied in Section 6.10.3.2.

6.2.3 Scaling, weighting and combining attributes

In measuring utility, one of the problems is to deal with individual preferences of attributes in a satisfactory way. The techniques developed during the past few decades have helped to solve the problem - which combinations of attribute levels one would prefer to which other ones and between which one would be indifferent?

The techniques developed by Kneppreth, at. el. (1974) for both scaling and assigning weights to attributes are considered by Decision Theorists such as G W Fischer , as adequate - The step-by-step analysis of the decomposing procedure in Appendix A6.5.1, uses these techniques and are found to be reasonable for practical purposes.

Another problem dealt with in the recent years is the aggregation of individually weighted attributes into an overall value of the respective alternative.

The Additive Combination Rule has been successfully used in the above analysis in Appendix A6.5.1. Individual preferences have been dealt with in detail in practical example under MAUT.

6.2.4 Use of Decision Theory in tendering decisions

Contractors are often tempted by large schemes in developing countries and as a result, commit their most scarce business development/marketing resources in pursuit of such schemes. Because of their size, such schemes usually have built in attractions such as:-

- opportunity to generate cash
- opportunity to utilise resources
- opportunity for further business, etc.

Unfortunately, a large number of these schemes never get off the ground or are abandoned and a few which go through the tendering process usually attract a large number of international contractors. The chances of success in such extremely competitive situations are therefore very low. Contractors therefore face risk of not only having to bear the actual cost of tendering for such projects but also the cost of lost opportunities.

Two classes of variables are visible in cases of the above kind:-

1. The evaluation of the relative attractiveness of cash generation, and

2. The evaluation of the chances of successfully bidding for the contract.

The former class of variables refers to measures of utility and the latter refers to measures of probability. These two intervening variables structure the key questions of decision theory. These are discussed in D.P. No. 6.3
Worked examples of measures of utility and probability in practical situations are included under MAUT discussion.

Bidding strategy models (see IOB* No. 75) make extensive use of Decision Theory but some contractors have reservations about these models because of the need to acquire information about competitors which is not always practical in overseas tendering. The other objection is for its extensive use of historical information. They argue that:-

- no two projects are alike
- tendering environments can vary
- contractors own policies may change

therefore historical information is not likely to be of any use. But some contractors (e.g. Costain) are known for their use of bidding models to attempt to improve their chances.

An alternative approach to bidding strategy is simmulation using Pseudo-random numbers but many managers consider it as a theoretical exercise.

The utility approach has not been used in tendering decision situations hence this study concentrates on this approach. It was also subject to criticism when tried in a contractor's office.

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* Institute of Builders Publication No.75

6.2.5 Contractor's criticism of Decision Theory

When interviewing a senior manager in the above contractor's office for his preferences in multi-attributes (For details see examples under MAUT) through simple hypothetical questions, he responded initially by branding the approach as "a typical theorist's approach, remote from the practical problems faced by international contractors". Yet, if a decision maker is prepared to 'reveal' his preferences without some kind of structure, one has to assume that

- he has made 'optimal' decisions in the past
- it is possible to separate his perceptions (i.e. probabilities) in previous problems from his preferences (i.e. utilities).

These two assumptions led Keeney and Raiffa (1976) to conclude that the 'revealed preferences' along simply do not provide enough information necessary to structure the analysis of a given problem, especially when interdependent uncertainties and multiple objectives are involved. Answers to hypothetical questions when consistently put together can, according to the above authors, provide the information necessary to arrive at a specific utility function. The notion of utility is not new. Its recorded existence dates back to Bernoulli in the eighteenth century.

At other times, the approach was seen by the contractor as similar to the one followed by psychologists. The main difference between psychology and decision theory is that the former looks at the past experience while the latter looks mainly at the current situation for all the variables that control the decision.

Referring to the criticism of evaluation of subjective judgement through hypothetical questions, Keeney and Raiffa (1976) argue that subjective judgement can assist in quantifying unquantifiables. For example, art experts who usually are reluctant to give an objective formula for ranking the quality of paintings, but should, if given a choice, be able to tell their preferences for one painting from the other. Keeney and Raiffa argue that if they can rank orders, numbers can't be far behind.

Referring to engineering projects, Pilcher (1973) suggests that a means should be found to evaluate alternative ways of carrying out a project. The systematic approach in decision making can assist in evaluating alternatives. A decision tree technique (See Section 4.5) is a typical example of evaluating alternatives systematically.

Arguments for and against a systematic approach in decision making are given in Table 6.2.5.1. A systematic approach can assist in decision situations where conflicting objectives exist. Bell, Keeney and Raiffa (1978) have treated this aspect in detail. Sources of contribution to decision theory include mathematicians, economists, philosophers, pilots, engineers paratrooper and so on. D.P. No. 6.4 briefly reviews these sources and cites a few applications of decision theory in U.S.A. Hurta (1980), internationally recognised risk expert, has made extensive use of Decision Analysis (See Appendix A.6.2.1)

6.2.6 Dynamic decisions

Single-stage decision system

Rapoport (1975) described the single-stage decision system as a box with three elements - inputs, external events and decision - going into the box and two elements - return and outputs - leaving the box. The system is illustrated in Fig. 6.2.6.1. on the following page.

The above five factors are also identifiable in tendering situations. They are as follows:-

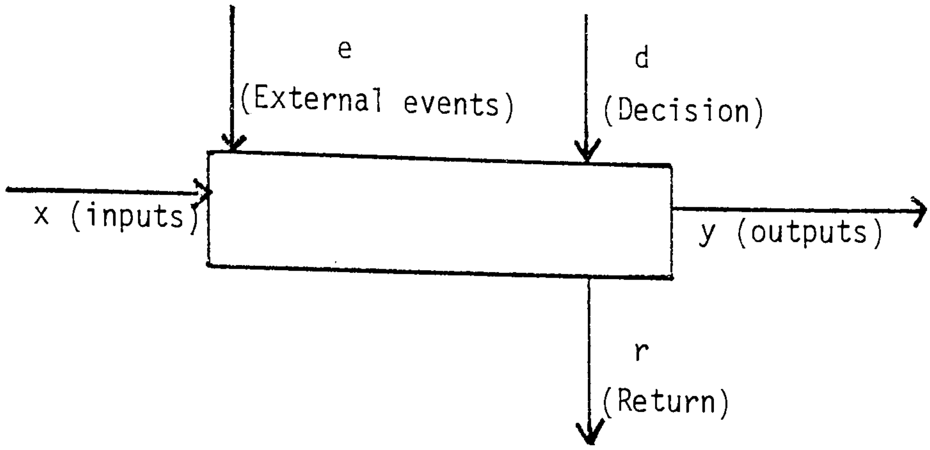
x = preliminary information about a project.

e = sterling crisis or political unrest in the country where the project is planned, or similar random variable with unknown probability distribution.

d = a directive from the corporate management regarding acceptable role in the project, or such similar decision which will control the operation in the box.

r = opportunity for the Company to generate cash, or opportunity to reduce the risks in the project or such similar payoff.

y = the state in which the decision maker is geared up to take a decision.



x = input state which provides all known relevant information about inputs to the box.

e = possible external events referred to as state of nature. It is a random variable with a probability distribution not fully known. (As suggested by Pilcher (1973).)

d = A decision variable that controls the operation of the box.

r = A stage return measuring the pay off or utility of the box i.e. r = f (x, e, d).

y = state that provides all relevant information about outputs from the box.

Fig. 6.2.6.1: Single-Stage decision system.

Dynamic Decision System

In practice, however, the decision to proceed with a tender enquiry or not to proceed is not so clear cut as mentioned above because such decisions are not isolated.
Pilcher (1973) suggests that in certain cases, a decision taken at the present time will lead to the necessity for a further decision(s) at a later date depending, in the main, on the outcome of the events in the following period. Many of these events, according to Pilcher, 'will be quite beyond the control of the decision maker and will be the result of chance to a greater or lesser extent'.

Thus there is a series of such 'operation boxes' with a decision output from the previous box becoming an input for the following box with a new set of variables. This process continues until a decision is reached.

Rapaport in fact is aware of this and refers to it as a dynamic decision task situation. To deal with this situation, he introduces the sixth factor and refers to it as a stage transformation t, a single-valued transformation expressing each component of the output as a function of the input state x, the state of nature that obtained e and the decisions d. The process continues for N stages where N may or may not be assumed known to decision maker. The decision maker is assumed to maximise some criterion function.

Edwards (1962) noted that in dynamic situations, the environment in which the decision is set may be changing. Fig. 6.2.6.2 shows how the environment can change in tendering decisions. For instance, certain decisions to resolve the currency risk problem are likely to be modified at a later stage depending upon ECGD's decision to provide a cover. Furthermore, the decision based on existing arrangements with ECGD is likely to be modified if such arrangements are cancelled or amended.

Toda's (*) 'fungus eater' (a research methodology became known by his game nicknamed 'fungus eater') is based on the fact that players' survival in the game is not possible without dynamically solving a variety of mutually dependent problems. Shuford (*), studied the constraints imposed upon decision maker by degrading the decision task. Psychologists believe that constraints reflect cognitive limitations such as misinterpretation of the nature of a decision task. In this context, contractors' corporate policies can be seen as constraints on Divisional managements to prevent them perceiving optimal solutions.

Fig. 6.2.6.3 illustrates how Rapaport's multi-stage decision system is a 'good fit' in Gregory's (*) analysis of task negotiations. Gregory believes that the analysis can be extended for evaluation of more than one attribute. Rapaport refers to this evaluation as a stage return measuring the pay off or utility. Corporate policies, J.V. partners, etc, can be seen as internal requirements and client's and statutory, etc, requirements as external requirements or constraints. The evaluation of these requirements in the Gregory's analysis is used for negotiating the next stage. The dynamic decision system uses this information as an input for the following stage.

6.2.7 Uncertainty and the need for structural approach to deal with risky decisions

One important omission highlighted by Kleiter (1975) in his criticism of Rapaport's approach is the uncertainty aspect.

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* Private communication.

Gregory has made provision for this in his analysis. Ebert (1972) also noticed this deficiency in Holt's (1960) 'aggregate scheduling problem'. He extended the basic work by Holt to determine more accurately the 'cost of uncertainty' in dynamic decision tasks. Salah (1977) describes the process in which judgement based on partial or imperfect information are translated in terms of probability as muddling through.

Because of unknown competition in overseas tendering, contractors face the task of translating somehow, their subjective judgements into objective assessments. The following extracts from an international contractor's risk analysis highlight the air of uncertainty surrounding the decisions regarding the levels of contingency in some items.

i) "........ In my opinion, the probability of this occuring is remote and I would not recommend any contingency".

ii) "........ Any delaying is more likely to arise from the trenching (to be dug by others) than the laying work, and the risk of liquidated damages is considered to be small".

iii) "........ some risk element does, therefore, exist .... I would recommend inclusion of a further ......% of the .... sub-contract prices for this".

Further evidence of risky decisions when pursuing construction work is given in Appendix A6.2.2 It briefly discusses the "rights and wrongs" of certain crucial decisions recently taken by such international contractors as Bath & Portland Group, George Wimpey, John Laing , Mear Group and Gleesons.

The environment surrounding the contracting business is full of risks and uncertainty basically due to the fact that jobs are priced before they are 'made', in the majority of cases, in environments outside their control. Appendix A6.2.3 lists some of the sources and causes of uncertainty during tendering.

It appears that a structured approach similar to one advocated in Decision Theory, is likely to provide, in certain cases, the framework in which all the information in a particular decision situation can be used to deduce the best alternative within the stated preferences or corporate policies. The need for explicit corporate policies is discussed later in this chapter.

If an alternative is chosen which is consistent with a certain decision maker's preferences and current knowledge, there is no guarantee that the chosen alternative will turn out to be the best. There is a great deal of chance that the available information may be imperfect or incomplete with or without the decision maker being aware of it. Hence such decisions are classified as 'decisions under risk'.

6.3 Decision making in risky situations

6.3.1 Theories of gamling

Earlier and modern theories of gamling are briefly reviewed in D.P. No. 6.5. The review highlights the cognitive aspects i.e. preferences, indifferences, etc, ignored by earlier researchers.

Lichtenstenin & Slovic (1971) suggest that to reduce cognitive strain people resort to simplified decision strategies many of which lead them to ignore or misuse relevant information.

6.3.2 Basic framework - assessment of uncertainty or critical step

The basic framework of a model of a decision process in a risky situation is shown in Fig. 6.3.2.1. The critical step in the process is the assessment of uncertainty. Some aspects of assessment such as subjective probability including psychological and normative ('best' alternative) aspects, processing of uncertain knowledge are reviewed briefly in D.P. No. 6.6 Among the studies reviewed are Pitz (1974) & Newell & Simon (1972). Referring to subjective probability, Pitz highlights the phenomenon 'hyper-precision effect' - in which people believe that the accuracy of their knowledge to be greater than is warranted by empirical reality. Fig. 6.3.2.2. & 3 show the application of a seriel method to solve a multi-stage inference task. It is concerned with uncertainty normally absent in a single stage decision task. (See Fig. 6.3.2.4).

6.3.3. Information utilisation in risky decisions

Tversky (1969) observed that the way in which sources of information are displayed affect their utilisation, i.e. the method of response. But Payne (1973) ignores display and suggests that the method of response i.e. search strategies, affect the utilisation.

6.3.4. Choice among risky alternatives

A normative model of behaviour based on expected value (EV) is briefly discussed in D.P. No. 6.7 The following general pattern observed in a contractor's method of selecting projects to bid suggests that utility of a project to the contractor and probability of achieving the desired utility seemed to influence his final decisions.

a. seeking projects with opportunity for higher cash generation,
b. seeking projects with positive cash flow,
and c. avoiding projects with negative cash flow.

The above decisions were not solely based on expected value (EV) but on the potential utility of generated cash from a project to the contractors business as a whole.

The management often used subjective judgements based on intuition and experience to finalise objective probabilities. Tversky (1967) referred to this method of decision as subjective expected utility (SEU) approach. The development of SEU models is briefly reviewed in D.P. No. 6.6.

6.4 Information searching and processing strategies

6.4.1 Information searching

Procedures of decision making 'decision models' - additive, additive difference, conjunctive and elimination-by-aspects (EBA) imply at least in their most common forms different information search processes. Chart 6.4.1.1. shows these models and the information search strategies. Chart 6.4.1.2. shows the important characteristics of search patterns.

What is to be gained by choosing one information search strategy as compared to another? Firstly, it gives an opportunity to obtain information appropriate to the objectives in hand. Secondly, the information can be assimilated without undue strain on memory or inference. Thirdly, it may be possible to control the degree of work involved. Information searching is further reviewed in D.P. No. 6.8. This includes 'abstract' (information search through many interfaces) and 'concrete' (information search through a few interfaces only) subjects. Results of Sieber & Lanzetta's (1964) experiment with abstract and concrete subjects are given in Table 6.4.1.3. The above Paper also discusses the search in formal organisations through co-operation.

Schroder, Driver, Streufert (SDS) (1967) suggest that highly abstract attitude structure i.e. very high integration index (Fig. 6.4.1.4.E) is characterised by an ability not only to compare and relate various perceptions about the object but also to integrate these alternative perceptions in alternative ways.

In tendering situations, tender project managers often have such high integration indices as a result of high interface activities. This situation, if subjected to a severe time constraint, may not provide highly desirable integration of alternative perceptions needed to submit a competitive bid. Hence the argument in Chapter 7 for tender support services.

Bruner, Goodnow, Austin (1956) suggest that a disciplined approach to information search can reduce cognitive strain and the time used in the search process.

6.4.2 Information processing

The information-processing system in a goal-directed activity differs according to the conceptual level of the person in that particular field. For example, if a contractor is seeking cash flow information from a prospective sub-contractor, the information obtained is more likely to vary according to the conceptual level of the person on contractor's staff dealing with the sub-contractor.

Some contractors, especially in the petro-chemical field, issue their staff with exact procedures in order to structure their information search and processing methods.

In this context, simply the statement to staff members of a goal - seek cash flow information - may not be sufficient. According to Lee & Bednor (1977) the group behaviour has a sequential development.

1. Initial ambiguity
2. Increase structure, i.e. through procedures, etc.

3. Increase risk-taking
4. Development of group cohesion from shared group experience
5. Increased personal responsibility

Psychologists refer to various adaptive strategies as response patterns, attitudes, needs, defence mechanisms, norms and so-on. SDS (1967) suggest that these information-processing variables often get ignored.

SDS (1967) point out that very little attention is paid to the ways people make adjustments and learn to combine or use information for adaptive purposes. They highlight that given the same amount of information different people use different conceptual rules in thinking, deciding and inter-relating.

For a further review of information processing including a heuristic approach suggested by Simon & Newell (1971), harmful environment (i.e. noxity - severity of adverse consequences and eucity - reward or promise given by an environment), Handy's (1976) E factors (effort, energy, etc) in motivation, relationship between performance and arousal by Taylor & Francis* (Pub.), hypotheses on information processing generated by SDS (1967), see D.P. No. 6.8.

6.4.3 Decision behaviour towards risky decision

Slovic and Lichtenstenin (1968) emphasised the idea of 'importance beliefs' i.e. an individual might pay more attention to a particular

* Ed. by Sigleton, Fox and Witfield 'Measurement of Man at Work'

risk dimension because he believes that one dimension to be more important than the other in a particular decision situation. This in some ways agrees with the recent views expressed by Rothschild (1978) 'There is no point in getting into panic about the risks of life until you have compared the risks that worry you with those that do not'.

The point, however, is that decisions may be affected by limitations within himself in the ability of an individual to act on the basis of those 'importance beliefs' when processing the information.

The studies such as by Slovic (1967), Slovic and Litchtenstein (1968) and Payne & Brunstein (1971) suggest that the explicitly stated stimuli (e.g. probabilities and pay-offs) are the sources of information used in the risky decision making. (See the extracts from risk analysis in Section 6.2.7.)

Maximization of expected value is discussed in D.P. 6.7.
In certain cases, the maximization of expected value or minimization of expected loss (in case of risk analysis) can be an extremely complex task requiring a decomposing exercise in order to bring it within one's information processing capabilities.

6.5 Decomposing procedure

Prior to the concept of turnkey type projects, it was not uncommon for tender documents to have Bills of Quantities from which it was possible to identify the total work required to be carried out. The element of uncertainty was small and the general practice then was to add a certain percentage to basic rates to cover any risks involved. With the turnkey type approach, contractors have the responsibility of producing an overall tender price. Because of imperfect or incomplete information, the general tendency is to carry out a risk analysis. The extent of such an analysis depends upon the quality of information and the time factor involved. A certain amount of trade off between some attributes takes place using the analyst's intuition and judgement. Risk items are broadly classified according to their severity which can be seen as a parallel step to rating of attribute contents in a theoretical approach to decomposition.

Example 6.5.1. in A6.5.1* illustrates a theoretical procedure for decomposing a problem - How health conscious mothers can select food items for their childrens meals. The Appendix also gives a step-by-step analysis of the decomposing procedure. The advantages and the disadvantages of the sequential trade off and rating scales used in the above analysis are given in Table 6.5.1.

The usefulness of the above decomposing procedure, in which the statement of the overall goals leading to a set of criteria, preferences and trade offs, etc; is an important aspect, is illustrated by practical examples in Section 6.10 of this chapter.

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* Appendix A6.5.1.

6.6 Perception of risk, risk analysis and control

6.6.1 Perception of risk

6.6.1.1 Factors of exporting

Contractors, in tendering for overseas projects, seek to export their services. Rieth (1976) in his study of the perceptions of selected manufacturers towards exporting, identifies risks as one of the factors of exporting. The hypothesis he tested was that 'exporters would differ from non-exporters in their perceptions of the factors of exporting which are:-

a. Risk
b. Profit potential
c. Cost
d. Problems

and e. Personal reward

Rieth concluded that exporters perceive the risk of exporting differently than do the non-exporters.

6.6.1.2 Severity of risks in overseas contracting

Although there is no point in getting into panic about the risks until one compares the risks which are more serious with those that are less serious, nevertheless, the fact is that more often than not, uncertain knowledge about key aspects of overseas projects makes it difficult for the above comparison to be made. This is one of the reasons why so often senior managers place a heavy discount on the seemingly solid calculations generated by their subordinates.

The Economist (Nov. 6 1971, p. 17)"Nobody can foresee which countries are going to be difficult. Chile was once thought to be a safe place to invest in. So was Libya. So in its day, was Cuba". A recent example of this pattern of extreme uncertainty is Iran.

It is this range and the acceptance of such risks as a matter of policy distinguish the risk situation in the overseas business from that in the domestic situation.

6.6.1.3 Inability to plan effectively - a risk

Contractors therefore try to turn conditions of uncertainty into risk situations. Risk analysis which utilises probability notion assist turning relatively static estimates into more dynamic ones. Although mathematical techniques such as the one developed by Von Neuman & Ulam (commonly known as 'Monte Carlo' simulation method) are used for obtaining probability distributions in certain similar situations, the success of these techniques is very much dependent upon the quality and the quantity of information available. They can also be time consuming.

In the majority of tendering situations, the lack of reliable information in sufficient quantity and also tight tendering periods make such techniques unsuitable to resolve the problem of estimating probabilities based on intuitive judgements.

The majority of large scale projects have contract periods well over three years and in some cases five or six years. The fluctuations in profits - a risk, are due mainly to inflation, currency devaluations, price fluctuations of basic construction materials and a sporadic political action. Thus, a fundamental factor influencing management against large scale contracts in overseas territories is the inability to plan with any accuracy due to high uncertainty. Under such situations, the long range planning, so vital for assessment of contractor's performance becomes a crystal ball gazing operation rather than an effective planning exercise - a risk with potentially serious repercussions.

6.6.1.4 Some of the risks attributed to overseas contracting

Table 6.6.1.4.1 lists some of the risks in overseas contracting

TABLE 6.6.1.4.1

a. Xenophobia (anti-foreign contractor feeling)
b. Political ideology (Political changes)
c. Unsatisfactory training of operatives
d. The disparity of earnings
e. Commercial risks
f. Changes in the laws of the host country
g. Financial risks
h. Political risks
- Expropriation
- Harrassment
j. Economic instability

The above risks are discussed in Appendix A6.6.1X

6.6.2 Risk Analysis

6.6.2.1 Conventional risk analysis

The purpose of a conventional risk analysis is to assist managers to look ahead of all the different outcomes as a result of an expenditure. Theoretically, one should be in a position to weigh the return one may get from such expenditure against the risks involved.

For a rough application of the technique, best guesses about how each critical variable involved is likely to behave over time, are set out. From this framework, a 'most likely' estimate of the ROI is made. And finally, after juggling the best guesses, a decision regarding the investment is reached.

A more rigorous technique of risk analysis not only requires a manager to specify the 'most likely' value each variable will assume, but also to specify all the values he thinks it might assume and then estimate the likelihood of each variable actually assuming one of these values. In other words, it involves estimating the possible range of values and then assigning a probability of occurance to each value in the range, thus creating a probability distribution for each critical variable.

6.6.2.2 Risk assessment at the tendering stage

In order to create such a distribution for a project, the tender project manager will require at the tendering stage, information about a number of critical aspects of the project.

In the majority of cases, this is extremely difficult or in some cases impossible to obtain in time for any purposeful application of the technique. Thus it makes juggling probability distributions harder than juggling one's best guesses.

Under these circumstances, the manager is likely to weigh his 'best guess' by assigning it a high probability and at the same time consider other guesses in order to estimate how likely they may occur. This assessment of risk enables him to take certain precautionary actions against undesirable events that may likely to occur. For the results to be of any practical use, Rummel & Heeman (1978) cite Brodie's suggestion to be honest about uncertainty. Furthermore, they advocate that intuition and prevailing myths, e.g. poorer the country greater the risk, must give way to more integrated approach - seeking experts' assessments before a final decision - when forecasting a risk.

After decomposing major risks items into smaller units, the Risk Manager should be in a position to draw on expertise within and/or outside his organisation. Their assessments of risks and probabilities should assist him in his final judgement. Fig. 6.6.2.2.1 shows a Risk Manager in a co-ordinating role. Fig. 6.6.2.2.2 shows decomposition of a typical risk item.

6.6.2.3 A'trade off' approach

A risk exists only if a hazard is present and something of value is exposed to the hazard.

In a political risk, hazard of political action is present when contractor's plant and materials on site, expatriates, payments due to him under the contract, etc, are exposed to the hazard. Similarly in a natural risk, earthquakes do not produce risk unless structure or persons are in the region of the earthquakes.

Lee & Collins (1977) suggest that to quantify a risk, a description of the vulnerability and damage algorithm - a relationship that gives the expected damage, as a percentage, to the exposed assets due to the occurrence of the specific event - is needed. The degree of damage depends on the hazard intensity and the vulnerability of the assets.

When the base line level of risk is determined, a comparison is made to the acceptable risk level and the final decision generally involves a trade off briefly discussed in the following paragraph.

Contractors at large, have a normally acceptable risk limit policy when bidding for construction projects. This limit gets extended if a contractor is able to secure insurance cover(s) for accepting increased responsibilities and liabilities. Every contractor however, depending upon his assets, performance, etc; has a limit set by insurance companies beyond which he may find the security through insurance a non-viability on economic grounds. Beyond this boundary, contractors therefore take decisions on 'trade off' basis i.e. trading off security for increased contribution from a project.

This trading off also has a limit depending upon individual contractor's financial resources. Fig. 6.6.2.3.1 illustrates this point with a four-part hypothesis.

Fig. 6.6.2.3.1:

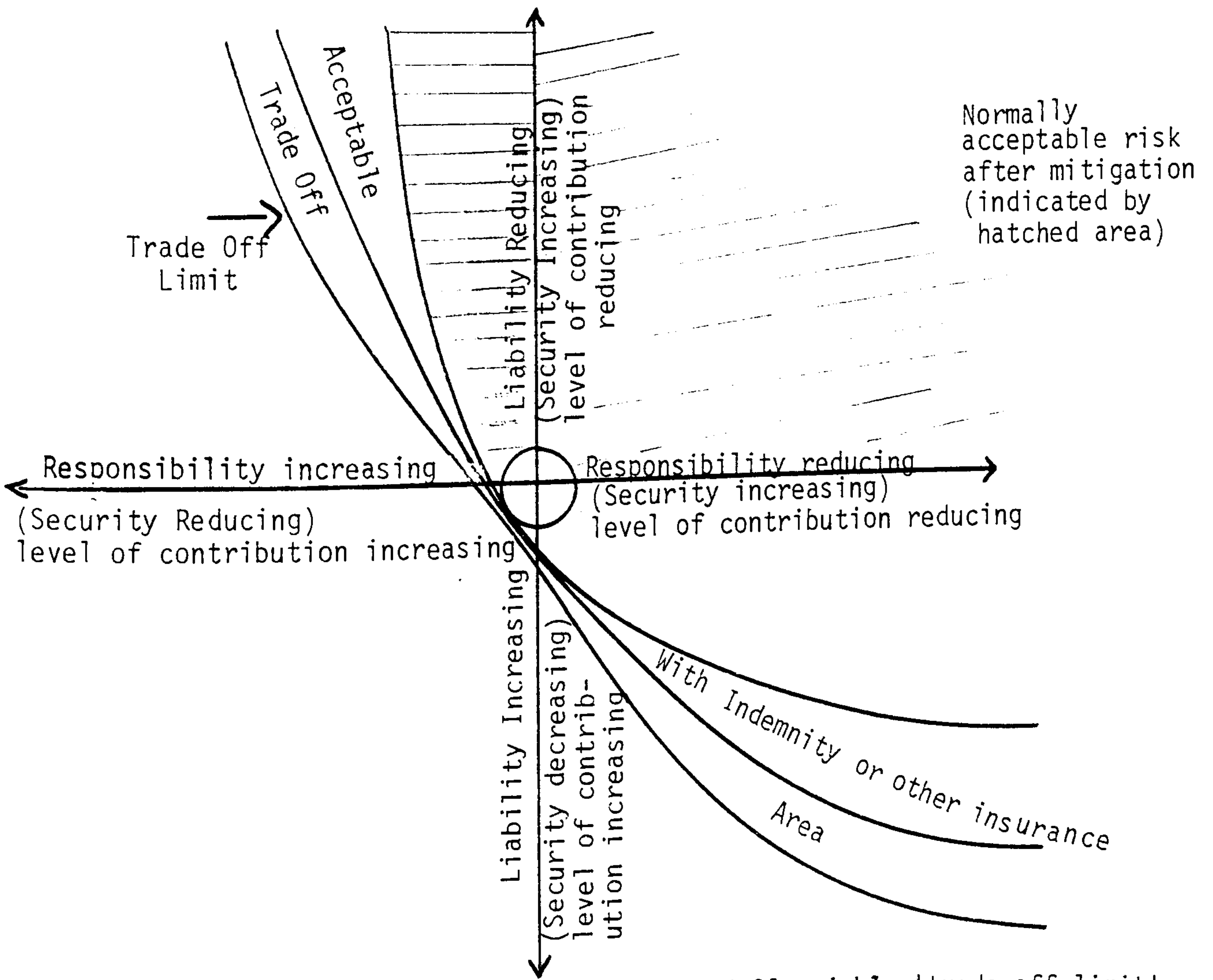
Contractors' Tendency Towards Risk When Bidding for Construction Projects - A Trade Off Approach.

Hypothesis

Part A: Contractors mitigate risks in order to arrive at individually acceptable level for risks in a construction project.

Part B: With indemnity or other insurance they are prepared to accept higher risks.

Part C: Once the limit of insurance cover is reached then they tend to 'trade-off' security for profits.



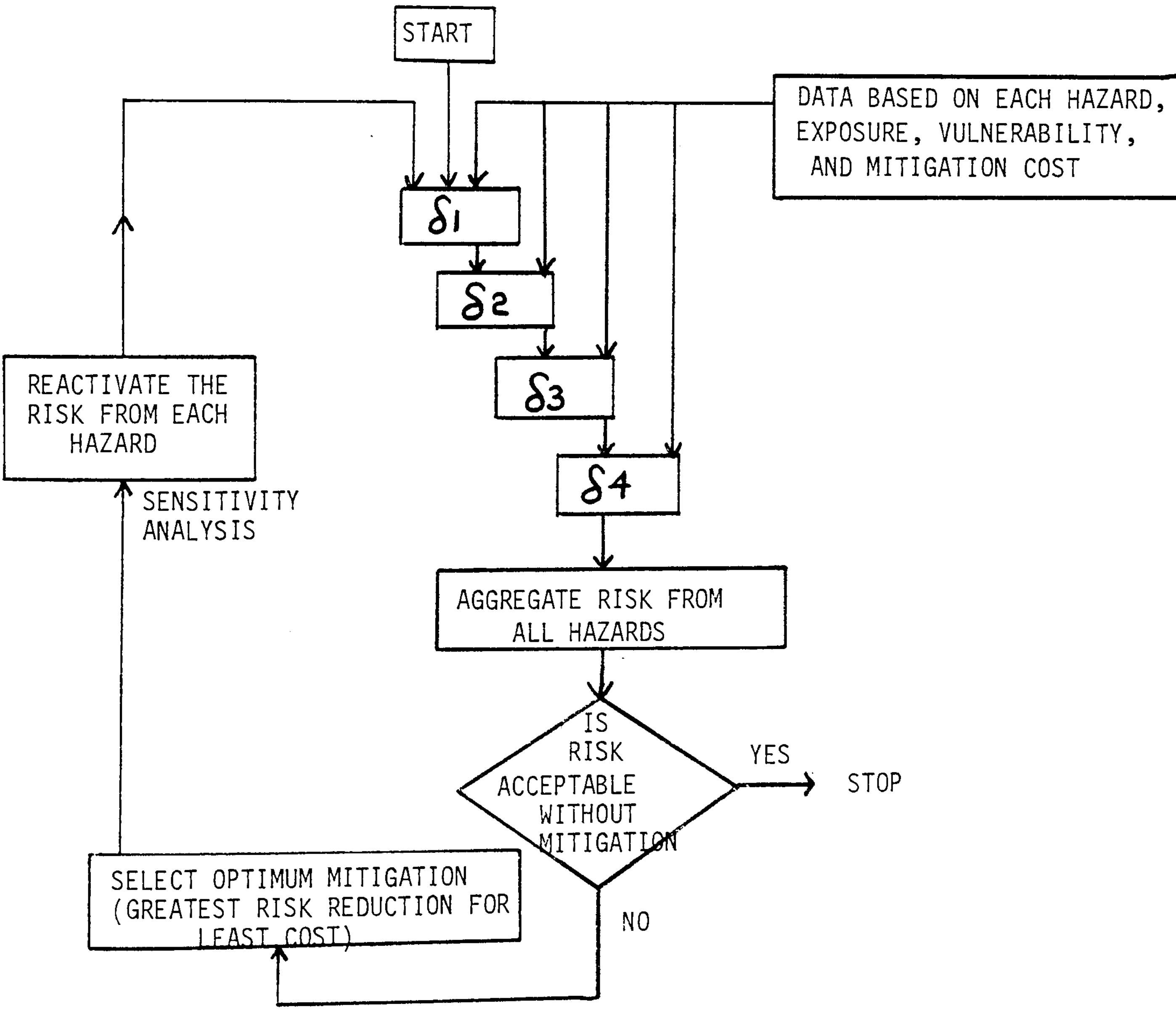
Part D: Each contractor has financially viable 'trade off limit'.

6.6.2.4 Mitigation of risk and sensitivity analysis

If the risk is unacceptable, contractors bring it under acceptable level by mitigation. The sequence of implementing the mitigations depend upon their cost and their benefit, i.e. the amount of risk reduction obtained. (Fig. 6.6.2.4.1 illustrates this point). In practice, this is carried out under sensitivity analysis.

Fig. 6.6.2.4.1: Mitigation of risk

Let $\delta 1$, $\delta 2$, $\delta 3$ and $\delta 4$ be the four basic elements of risk ($\delta 1$ = Financial, $\delta 2$ = Commercial, $\delta 3$ = Political and $\delta 4$ = Technical, natural etc) without mitigation.



6.6.2.5 Risk Analysis & Control

Risk Analysis

The five-phase approach for analysing risks in overseas projects is as follows:-

Phase I: Identification of risk items and the sources of uncertainty for each item.

Phase II: Preliminary assessment of each risk item:-

- classification
- nomination of specialist
- preliminary assessment of risks by specialists

Phase III: Detail evaluation

- Transformation of subjective judgements into objective evaluation

Phase IV: Final assessment

Phase V(a) Scheduling risks

Phase V(b) Project risk profile.

Table 6.6.2.5.1 and 2 show how Phases I to III and Phase IV respectively, incorporate various aspects of decisions under risky situations.

The above methodology is illustrated in Example 6.6.2.5.1 for a hypothetical project but with only a few (5) risk items. For a comprehensive check list of risks in overseas projects and detail analysis, see Internal Note No. 6.1. The project risk profile in Example 6.6.2.5.1 appears different to a conventional risk profile, which generally shows maximum risk at the start of a contract, because the example takes into consideration only a few selected risk items.

The above check list of risk items is based on information gathered from interviews, articles, case studies, etc and are discussed in Appendices listed in Table 6.6.2.5.3.

6.6.2.5. Risk Analysis and Risk Control (Contd)

Risk Control

Phase IV of the above risk analysis is based on five risk controlling actions - Avoid, Transfer, Eliminate, Retain and Prevent ('ATERP' actions). They are shown in Chart 6.6.2.5.2 and briefly discussed below.

Avoid : Any risk assessed as bad can be avoided.

Transfer : After assessment, certain risks can be transferred to others e.g. sub-contractors, insurance companies, J.V. partners, etc. Certain risks can be mitigated by trade off approach i.e. Transfer of high risks for less return.

Eliminate : Negotiate the Terms of Contract to eliminate unacceptable risks.

Retain : The risks which can not be avoided, transferred or eliminated may have to be retained. Provide contingency for risks retained over acceptable level. (See Internal Note 6.2 for the Budgetory Control of contingency) See Fig 6.6.2.5.1 for Contingency Profile. Consider providing for a 'Risk Pool' for the Group as a whole to enable retaining high risks thus able to submit competitive bids.

Chart 6.6.2.5.3 identifies consciously and unconsciously retained risks.

Prevent : Once a contract is awareded, try to prevent the retained risks by taking appropriate actions.

The risk profile in Phase VI, Chart 6.6.2.5.4 can be used as a standard document to show the level of risk involved at various stages of a project. This has a potential for an efficient decision aiding tool especially during contractors' internal reviews of projects to decide whether or not bids should be submitted for certain projects.

Phase VII, Chart 6.6.2.5.5 is an extension to the above Phase in the sense that on the similar bases as Phase VI, a corporate risk profile can be produced for a construction company within the Group. This can be used as a means of controlling the total risks in potential projects, i.e. projects for which bids are already submitted or being submitted.

Finally, Phase VIII, Chart 6.6.2.5.6 is one step further in this approach of risk analysis to show the total risks of the Group as a whole in potential projects. It can provide sufficient information for the top management without having to refer to individual projects to take any corrective actions if necessary. In this context, it can be an efficient decision aiding tool.

6.6.2.6 Questions to be raised before applying risk analysis

a. How mature is the risk analysis technique for use?

b. What are the origins of the decision to adopt it?

c. How will it fit in with the Company's organisation?

d. How are the managers, who are supposed to use and benefit from the technique, prepared and trained to handle it?

e. How will the data be generated and how will it be put together in model form?

f. What role would top management reserve for itself in deciding to install risk analysis?

g. Who has been assigned by the management as the Risk Manager to shepherd the project along?

6.6.2.7 Inherent Problems

a. The company must decide what exactly risk analysis can do for it. The relevance of the risk analysis and the decisions required from various experts within the company must be spelled out in detail.

b. Where individuals are required to give their assessments of risks and probabilities, it may not always be possible.

c. The trading off risk against return in a more or less structured way can present problems.

d. After risk analysis, some of the procedures for evaluating and controlling projects may need adjusting.

e. Risk analysis and corporate policies must be brought into close alignment.

6.7 Decision levels and measures for risk avoidance in risky situations - notions of risk attitude

6.7.1 Decision levels

Decisions are taken at all levels in organisations but the level at which a decision is taken depends upon the type of decision situation. Decisions dealing with risky situations appear to have a certain pattern as regards to 'ATERP' actions (avoid, transfer, eliminate, retain and prevent). In order to study tendering decisions in a contracting organisation, a risk analysis for a jumbo project was scrutinized to examine decisions associated with controlling risks and the levels at which they were taken. Table 6.7.1.1 closely identifies such decisions with 'ATERP' actions and their levels in the organisation hierarchy.

The scrutiny in the above table highlights a pattern for decisions associated with risks and the levels at which they were taken. Those decisions taken at the top were concerned with policies, broad objectives, etc, which dealt with risks in the project likely to influence the company's long range planning. On the other hand, decisions taken at lower levels were mostly to do with avoidance of risks. The majority of decisions dealing with reducing risks were taken at a medium level. Figs. 6.7.1.1 & 2 show various decision levels in the above case.

Departmental Paper D.P. No. 6.9 discusses decision type, decision levels and organisational 'fat' (An organisation's capability to survive through unfortunate decisions.)

6.7.2 Constructive and destructive measures of risk avoidance

There are two types of risk avoidance - constructive and destructive. The former can improve the overall quality of a tender while the latter can adversely affect the contractor's chances of success. Table 6.7.2.1 classifies some of the measures commonly taken to avoid risk in a project. Fig. 6.7.2.1 shows risk-averse, risk-seeking and risk neutral utility functions.

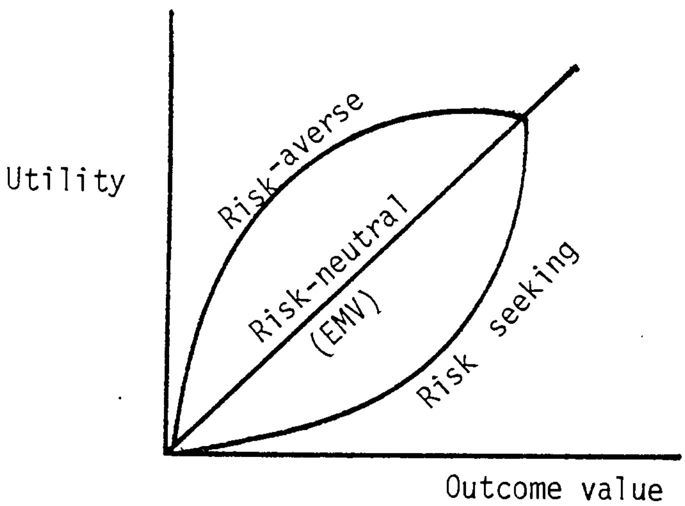


Fig. 6.7.2.1

The risk-averse function in Fig. 6.7.2.1 highlights the fact that as the outcome value increases, the decision maker's tendency towards risk aversion decreases. Schlaifer (1969) discusses this point in detail (p.147).

6.8 Need for explicit corporate objectives and treatment of multi-objective decisions

6.8.1 Definitions and purpose

Definition

An objective is a future state of affair 'approachable' within a given set of time.

The literature on the subject distinguishes goal from objectives. For example, Ackoff (1970) determines goals as obtainable within planning period while objectives must be 'approachable' within the same period.

Purpose

According to Drucker (1972), objectives serve the following main purposes:-

1. to explain the whole range of organisational phenomena in a small number of general statements.
2. to test these statements in practice
3. to predict company's behaviour
4. to appraise the soundness of decisions when they are still being made
5. to analyse one's own performance and thereby improve one's performance.

6.8.2 Characteristics of objectives

a. Aggregation of desires (attributes) for the purpose of means-ends analysis

b. Preference among the attributes.

Huber (1974) used multi-attributes with a narrow meaning than objectives. He considered multi-attributes as means to higher ends.

6.8.3 Objectives other than profit maximization

Although the profitability is rated high in measuring the success of management, nevertheless, there are increasing pressures to meet either self imposed or externally dictated standards. Table 6.8.3.1 gives some examples of self imposed and externally dictated standards.

Table 6.8.3.1

Self imposed standards	Externally dictated
a. Higher salaries	a. The standard of workmanship in a project.
b. Better working conditions	b. Completion on time.
c. Better utilisation of the Group's resources	c. Competitive pricing of a tender

This may lead to the acceptance of a different single objective or a combination of objectives (which may be conflicting with each other) than just profit maximization.

Initially, the Marshall Theory contested the belief that profit maximization is the overriding objective for the firm. Since then there are many studies which have presented several other objectives.

Ackoff (1962) identifies two objectives of a mail-order firm which did not include profit maximization.

In his earlier study (1958) in long range planning, he identified no less than seven objectives.

Baumol (1959) identified expansion as the overriding objective in one of his studies.

Cyert and March (1963) discuss how the objectives of a firm are determined and suggest that aspiration-level is used to formulate objectives.

Ansoff (1965) in discussing corporate strategies state:

> 'firms do have objectives which are different and distinct from individual objectives of the participants' (P.39).

One of the main aims of Management by Objectives (MbO) is to remove this discrepancy.

Wagner (1969) ignores altogether the problems likely to be created by multiple objectives. There are other studies such as Sharpe (1970) on finance and Fama & Miller (1972) on marketing which have similar deficiency.

6.8.4 Firm's pricing policies and its objectives

Johnsen's (1968) summary of Kaplan-Dirlam Lancilotti's (1958) study highlights the following points.

a. The concise determination of prices is usually found to include more than one decision criterion.

b. The pricing policy is not always linked to the firms general goal(s).

c. The concept of optimising* is not mentioned at all in any pricing procedure or as goal.

d. Objectives may change owing to external conditions.

* Simon's (1955) argument is based on the satisficing principle

6.8.5 The firm and its objectives

Rhenman (1964) suggests that the firm is no longer just the place for a productive activity which profits only to those who own it. Table 6.8.5.1 shows the differences between the past and today's firm. It is both a place where goods and services are created and distributed and a meeting place of interests where an equilibrium of power is established among human beings. Each of them plays a particular role and relates it to a particular socio-group.

Under these circumstances, coalition or conflict of interest or a mixture of both can occur. It depends upon such factors as firm's policies, organisational structure, interface relationship, etc. Fig.6.8.5.1 illustrates various interfaces for a contracting firm.

Churchman (1961) highlights that top managers so often fail to state explicity, the objectives of the firm.

Eilon (1972) highlights the problem of dealing with multiple objectives. He says

"What do you do when there is no one single objective function ....., but several objectives are presented and when some can be shown to be in direct conflict with others'. (P.4).

Tables 6.8.5.2 and 3 illustrate Eilon's point.

Easton's (1974) empirical observations suggest that the disparity of central and local managements is mainly due to conflicting objectives.

Researchers in the subjective decision-making field suggest that the models which deal with multiple objectives have the potential to introduce a systematic approach to the subjective-decision making process.

Often contractor's key personnel (e.g. Executive Director, Divisional Manager, etc) are away on business. In these situations, the tendency is for some of the decisions required by senior sub-ordinates, representatives visiting overseas countries, business development managers, etc. to be delayed until the return of such key personnel. In certain tendering situations these delays can have adverse effect on contractor's business.

Theorists argue that multi-objective models have a lot to offer in these situations. The systematic approach is not for replacing senior executives' intuitive decision-making approach which is likely to be based on their knowledge of the current business environment and their experience. They advocate the use of models to aid and sharpen the judgement of the decision maker who finds himself in an authoritative position. It is necessary however for him to know clearly what the objectives are. Where subjective judgement is brought into a decision making process, this can be expressed as preferences as shown in Section 6.10.

6.8.6 Multi-objective Decisions

From the discussion so far in this chapter it appears that contractors middle management requires clear guidance through explicit corporate policies on matters such as risks on which they are required to take decisions. More often than not, they have to consider more than one objective at a time when taking decisions hence such decisions fall into the category of multi-objective decisions.

6.9 Review of Multi-attribute utility theory (MAUT)

6.9.1 For the literature review on multi-objective models, see D.P. No. 6.10. (See chart 6.9.1.1 for a general review of M.A.U.T)

6.9.2 Limitations of MAUT

Rengel-Clavier (1976) summarises some of the limitations of MAUT. They are as follows:-

a. The procedures to assess utilities can be complicated and difficult to understand

   a1. They do not allow for errors.

   a2. They can be time consuming

   a3. They usually involve imaginary questions which could be very hard to think about.

b. Utility theory can be silent about errors that occur when inappropriate models are applied to a decision problem.

c. The use of probabilistic utility models in decision analysis present the difficulty of assessing the utility function. Decision makers usually do not have the time or patience to perform the assessment procedures which probabilistic models normally require, and even if time and complexity were not problems, the assumptions of independent, repeated responses in the assessment make the result rather dubious.

d. Practical models for the most complex decision situations do not exist.

e. The decision theory analysis using utilities may not take into account all the considerations which the executive would informally consider, for example, some non-monetary side effect like goodwill, though it could be included in the analysis.

f. In many cases, the analysis of decisions is carried out by a staff group which is organisationally distant from the executives being served. In such circumstances, the executive might feel threatened instead of supported by the decision analysis.

g. There are not enough trained specialist in decision theory analysis to carry out or advise managers on decision analysis.

6.10 Application of MAUT

6.10.1 Rational Decision Making

There are various ways to present information to a decision maker. The decision maker, however, has the responsibility of segregating psychological elements from rational elements in the information he receives so that a certain amount of consistency and clarity is maintained in his decisions.

In a tendering situation, it is possible for an executive to get involved in an 'undesirable' (from the company's point of view) project and influence the corporate decision in his favour to follow up the project. He may then commit the company's valuable tendering resources to his 'pet' project resulting in some cases, either abandoning the tender work halfway stage or submitting the offer with disastrous results for the company. Others, more rational decision makers, may consider the project a non-starter (as far as the company's interest is concerned).

Under such circumstances, a rational decision maker would consider the following:-

1. The criterion or criteria laid down by the company (through corporate policies) by which choice has to be made from the available alternatives.

2. Company's objectives behind the decision to follow up a particular project. The objectives could be monetary (profit, cash generation, etc.) or non-monetary (prestige, follow-up

orders from the project under consideration, i.e. likelihood of future work, present order book may be low and therefore the project could be considered as an opportunity to use the company's resources, etc.).

3. A set of available options from which an alternative project could be identified or any other course of action (e.g. continue the search for a suitable project).

4. The influence of the state of the outside world (i.e. the business environment), on the project likely to be selected for tendering.

6.10.2 Risky decision situations

It has been already pointed out that some of the large scale overseas projects can cost collaborating parties together well over £150,000 to tender. The contractors share of the tendering cost from such exercises can be extremely high. The recovery of such overheads can prove difficult in the present state of overseas markets which is highly competitive.

There are managers who believe that although tendering activities on behalf of a contracting Group does not necessarily benefit an individual division within the Group in a direct manner, nevertheless, such involvement is often essential to further the chances of the Group's tender. Hence the argument that tendering costs should be absorbed in the Group's fixed overheads and treated in some special way. (This has been discussed further in Section A7.4.2 'Competitive pricing').

Others, especially with the accountancy background, disagree with this side of the argument and insist (if they are in a position to do so) that such costs should be reflected in the build-up of tender prices.

In the recent case of a Japanese bid for a construction project in the Middle East valued at around £100M, the contractor was reported to have knocked-off £10M of the tender price to secure the contract. In such a cut-throat situation, what chance is there to recover fully the tendering cost?

One may therefore argue that choosing such a project to tender is a risky decision, i.e. likelihood of a loss from tendering cost if the tender is unsuccessful and the cost of lost opportunities. This source of uncertainty is discussed in Paragraph 6.2.4

6.10.3 Methodology of MAUT equations and application

6.10.3.1 Methodology

Many aspects of decisions in situations full of uncertainties such as discussed above, are of a subjective nature. The majority of management techniques applied in practice fall in the category of quantitative decision models (see Charts 6.10.3.1 to 4) hence unsuitable in certain tendering situations. Qualitative decision models (see Chart 6.10.3.5.) based on treatment to subjective information, appear to show some potential for use in certain practical situations.

See Departmental Paper No. 6.9 for a review of quantitative and qualitative decision models.

The methodology of developing MAUT equations in 4 phases is as follows:-

<u>Preliminary Phases</u>

<u>Define Higher Objective(s)</u>

Effective tendering for large scale overseas projects

<u>Define Lower Objective(s)</u>

Select suitable projects to bid

<u>Phase 1:</u> Generate independent attributes

- Establish criteria for selecting projects to bid
  - Opportunity to generate cash
  - Resource utilisation
  - Opportunity for future business

<u>Phase 2:</u> Specify the measure of attributes

- Derive a scale for the measurement of attributes.

<u>Phase 3:</u> Check the independence of attributes

- check preference independence
- check utility independence

<u>Phase 4:</u> Evaluate attribute utility functions

- Establish relative importance - ranking order - of attributes
- Evaluate the scaling constant, K.

MAUT Equation

The multiplicative utility function.

$$1 + KU(x) = \prod_{i=1}^{n} \left[1 + kki\ Ui\ (Xi) \right]$$

[If K = 1, the additive utility function is $U(x) = \sum_{i=1}^{n} Ki\ Ui\ (Xi)$]

6.10.3.2 Application

Multi attribute utility theory has been applied in this study to the following tendering situations:-

- selection of projects to tender (Section 6.10.3.2.1.)
- where there is a desparate need to secure a contract (Section 6.10.3.2.
- In measuring client's utility of tenders submitted (Section 6.10.3.2.3.)

In applying MAUT in selection of projects, a general utility function has been developed. With this function together with a corporate policy, it has been demonstrated that this proxy decision making approach can speed up decisions in certain situations. Furthermore, to remove some of the tedious calculations in this method, a reference table has been prepared. In order to provide some flexibility in such proxy decisions, a method of developing various options from a given situation is also discussed with worked examples. This can be a useful decision aiding tool in situations where lengthy negotiations are taking place in an overseas country.

6.11 Conclusions

When operating in overseas markets, international contractors perceive risks differently from when they operate in the home market. In these situations, a structured approach can assist managers in decision making. Prior to such a decision making process, it is necessary to define clearly, the objectives, the attributes and the criteria for testing a decision. Hence there is a need for explicit, corporate policies.

When the attributes are not concordent, a trade off approach can assist in dealing with undesirable attributes. This process can be sharpened by seeking experts' assessments where possible. Risk profiles, developed by such a structured assessment, should assist contractors in identifying and controlling project and corporate risks.

Present fierce competition in the overseas market requires contractors to consider other objectives than just profit maximization. In such circumstances the objectives are likely to conflict each other. With contractors' executives so often unavailable for crucial decisions, such conflicting objectives can cause considerable delays in the general progress of a tender. Multi-attribute utility models can provide solutions to such problems by obtaining equations for proxy decision making. Although they can consume time to produce an equation for specific corporate policies, it can be used to assist many such decisions provided the corporate policies remain unchanged.

CHAPTER 6

APPLICATIONS OF MAUT

6.10.3.2.1

APPLICATION OF MULTI-ATTRIBUTE UTILITY THEORY IN SELECTING PROJECTS FOR TENDERING

Lower objective: Tender for suitable projects

Note: At the start of the interview, the term 'indifference' was discussed thoroughly.

1.0 List of attributes

X1: Opportunity for cash generation
X2: Resource utilization
X3: Opportunity for future business

2.0 Measure of attributes

Att.	Measure							Levels	
								Worst	Best
X1	Negative Cash flow & no profit 0 A	5% Profit no down payment 20 B	5% Profit 10% down payment 30 C	10% Profit 15% down payment 50 D	10% Profit 20% down payment 70 E	15% Profit 20% down payment 80 F	20% Profit 20% down payment 100 G	-ve cash flow.	20% Profit 20% down-payment
X2	Very little opp. to use own resources 0 H	Upto 20% divisional staff can be utilized 20 J	Upto 70% divisional staff can be utilized 30 K	Input from two Divs. 50 L	Input from three Divs. 70 M	Input from four Divs. 80 N	Opp. to use the Group's Resources 100 P	Very little opp. to use	Opp. to use the Groups resources
X3	No. opp. for future work 0 Q	Opp. for Extn. of the Project 20 R	Opp. for PIE work only in the territory 30 S	Opp. for Managing Contractor type work 50 T	Opp. for Sub-contracts Work 70 U	Opp. for Main Contract Works 80 V	Opp. for all types of work 100 W	No. opp. for future work	Opp. for all types of work

(Note: It is assumed that the above measures are continuous i.e. there are intermediate values available).

3.0 Check preference independence of the attributes

Consider the pair X1 and X2. (Assume X3 fixed at its worst level).

See Fig.1

P (Question): From point (G,P) would you rather move to A(X1 at worst and X2 at best) or H(X1 at best and X2 at worst)?

Assume X3 fixed at its worst level

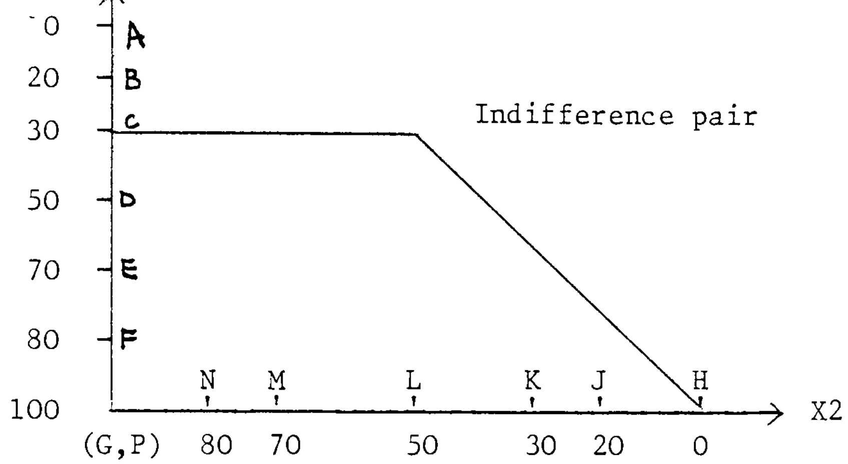


Fig.1

DM. (Answer): I am personally in favour of cash generation and would prefer to go for point H (X1 at best i.e. 20% down-payment and 20% profit and X2 at worst i.e. very little opportunity to use our own resources).

P. Would you consider point E i.e. 10% profit 20% downpayment together with opportunity to use the Group's resources?

DM. No, I would still prefer good profit level and good downpayment even if it means achieving it by using outside resources.

P. How about point D?

DM. No, I rather stay where I am.

P. At what level of cash generation would you be in dilemma i.e. it will be difficult for you to choose between X1 and X2?

DM. I think if X1 is at B (i.e. 5% profit with no downpayment and opportunity to use the Group's resources) it will be low terms as far as I am concerned and I would then rather go for the use of the Group's resources. But at point C I will be in a dilemma i.e. I will not be able to choose.

P. In other words you are indifferent at this level i.e. you have no preference for X1 or X2 at this level.

DM. That is correct.

3.0 (Contd.)

Now consider the same pair but with different assumptions. i.e. assume X3 is fixed at its best level.

P. Having considered the new assumption where would you rather go from point (GP) in Fig.1?

DM. I am sorry but the fact that there might be opportunity for all types of work in the territory does not affect my view i.e. try and execute the contract in hand on a good financial footing, otherwise we may not survive to enjoy the future opportunities.

P. That's o.k. In other words you are saying that your indifference pair (X1 at C and X2 at H) is unaffected by any variation in the levels of attribute X3.

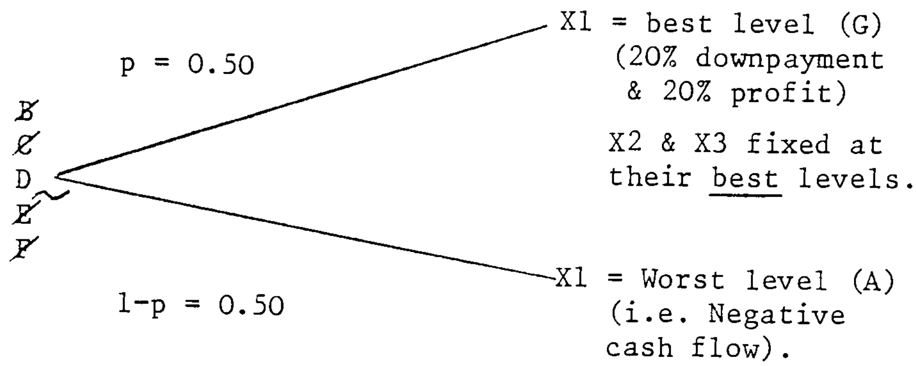
DM. That is correct.

Note: Similar discussion can establish the independence of other attributes.

4.0 Check Utility independence assumptions

This time we shall consider one attribute at a time and fix other attributes at a level, say at their best levels.

Consider attribute X1



~ indicates indifference.
(Indifference at point D).

Fig.2

P. Consider the lottery shown in Fig.2. This lottery gives you 0.50 chance that X1 would be at its best level and 0.50 chance of its being at its worst level. Remember, X2 & X3 are fixed at their best levels.

The other option you have is point B i.e. 5% profit and no downpayment. But this is a certainty.

What would you prefer?

DM. With a 50% chance of the best level, I would rather go for the lottery.

P. How about point C?

DM. No, the lottery still attracts me.

P. What would you think of point D i.e. 10% profit and 15% downpayment for certain?

DM. In this case I think I would be indifferent.

Note: On similar basis, the utility independence of the other attributes can be checked.

5. Evaluation of Individual Utility Functions

We now need to assess the single attribute utility functions.

Starting with attribute X1. Assign arbitrarily the values of 1 and 0 to U (20% profit, 20% downpayment) and U (-ve cash flow) respectively, the two extreme levels.

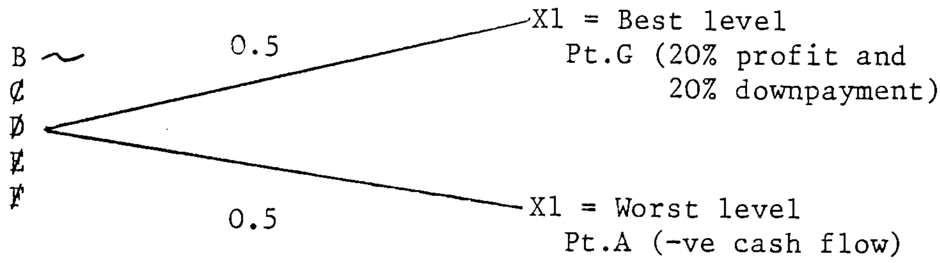


Fig.3

P. Please refer to Fig.3 and the scale. What point on the scale would you consider as a certainty equivalent to the lottery? (We can ignore X2 and X3 because they are preference and utility independent).

DM. 5% Profit and no downpayment i.e. Pt.B.

P. Even though you have a 50-50 chance to achieve best level i.e. 20% profit and 20% downpayment?

DM. Yes, because I wouldn't like the 50% chance of the worst level and therefore even at point B, I would be indifferent.

P. O.K. Your utility of point B is then

$$U(B) = 0.5(1) + 0.5(0) = 0.5$$

Now please refer to Fig.4. Can you tell me at what point would you have certainty equivalent to the lottery?

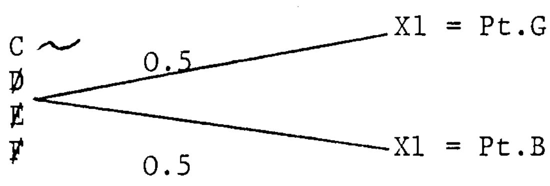


Fig.4

DM. 5% profit and 10% downpayment i.e. point C, I would be indifferent between point C and the lottery.

P. Let us work out your utility of point C i.e. 5% profit and 10% downpayment.

$$U(C) = 0.5(1) + 0.5(0.5) = 0.75$$

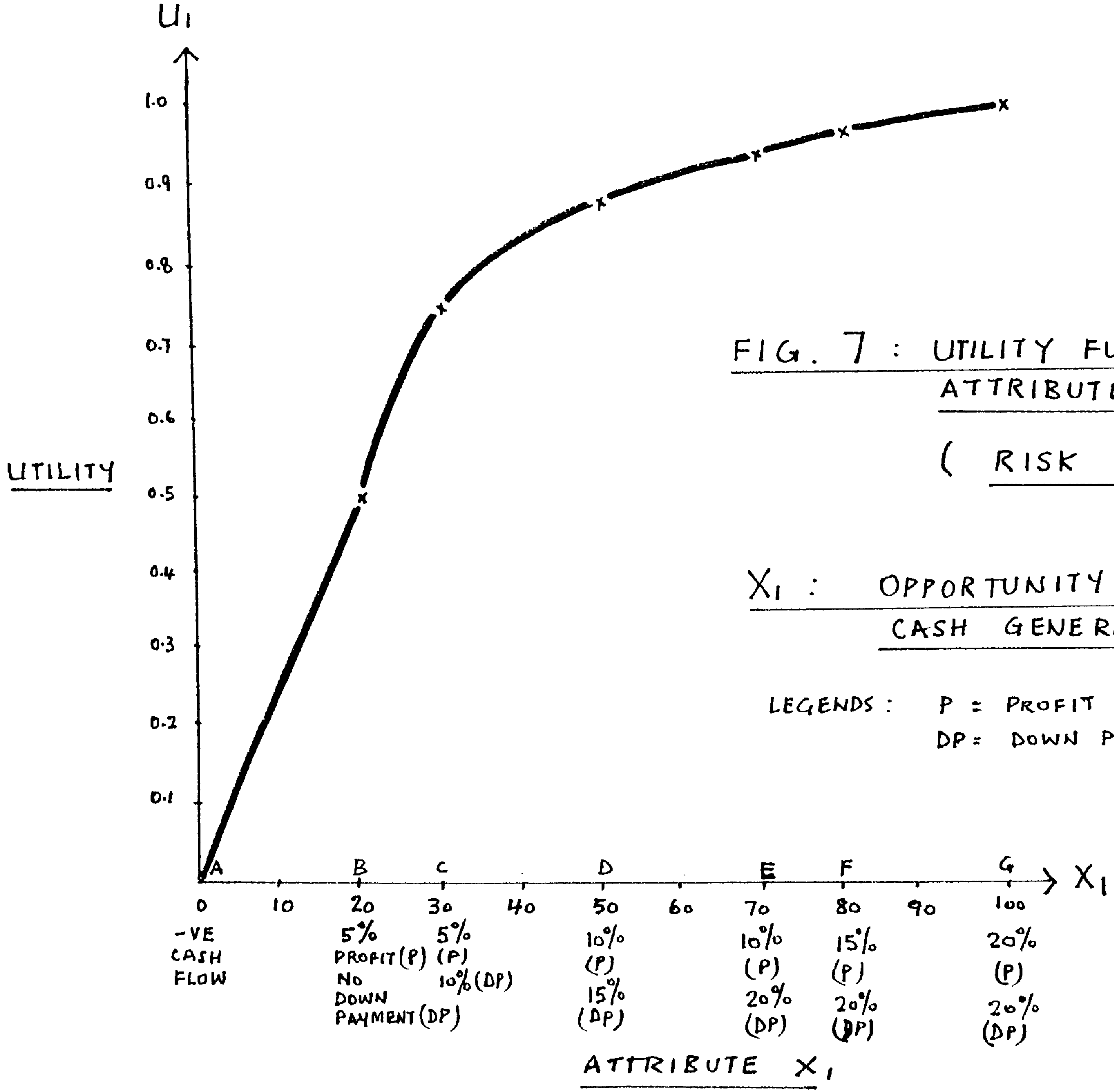


FIG. 7 : UTILITY FUNCTION FOR ATTRIBUTE X_1

(RISK AVERSE)

X_1 : OPPORTUNITY FOR CASH GENERATION

LEGENDS : P = PROFIT
DP = DOWN PAYMENT

FIG. 8
SECTION 6.10.3.2.1.

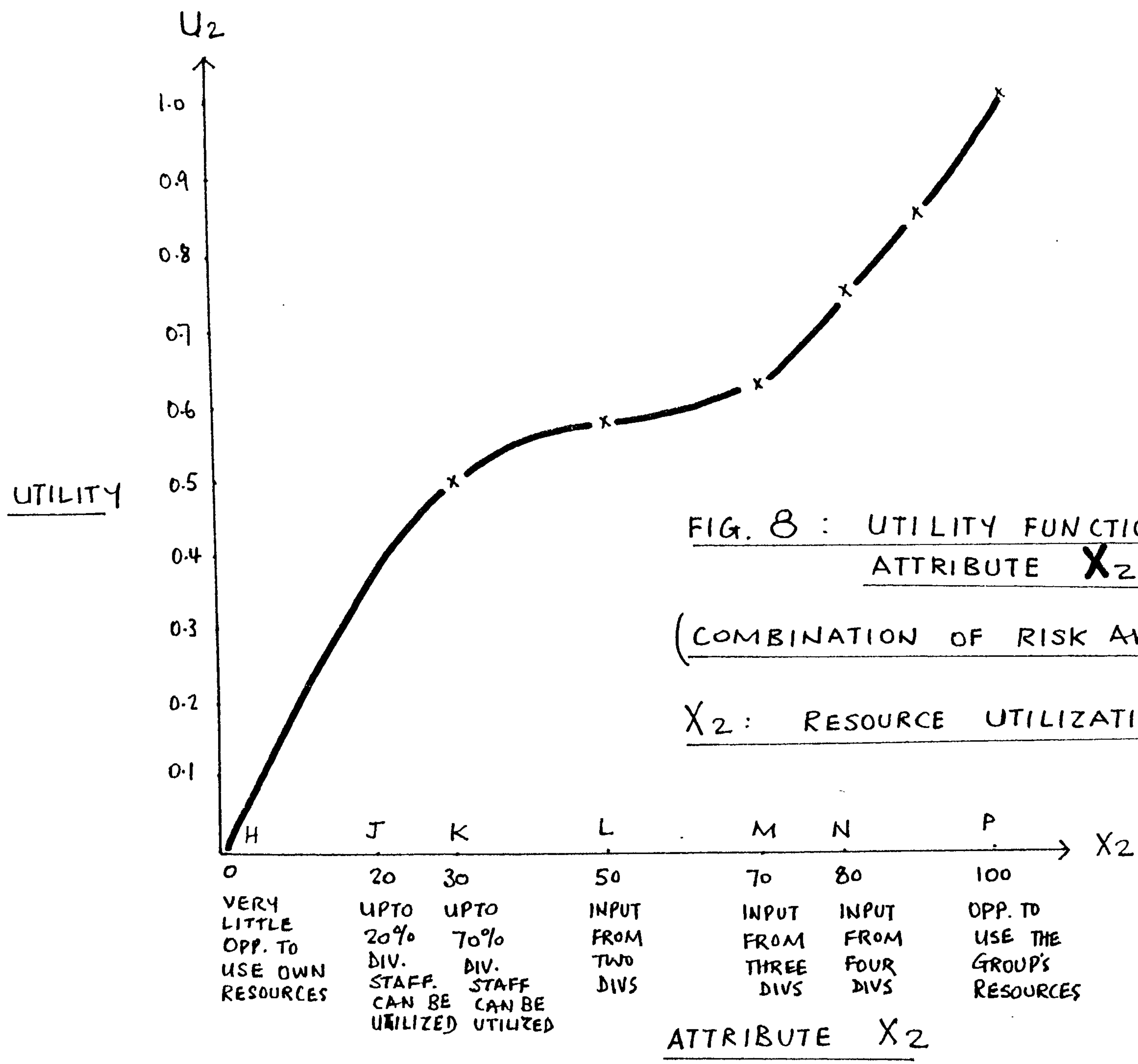


FIG. 8 : UTILITY FUNCTION FOR ATTRIBUTE X_2

(COMBINATION OF RISK AVERSE AND RISK TAKER)

X_2: RESOURCE UTILIZATION.

FIG. 9.
SECTION 6.10.3.2.1.

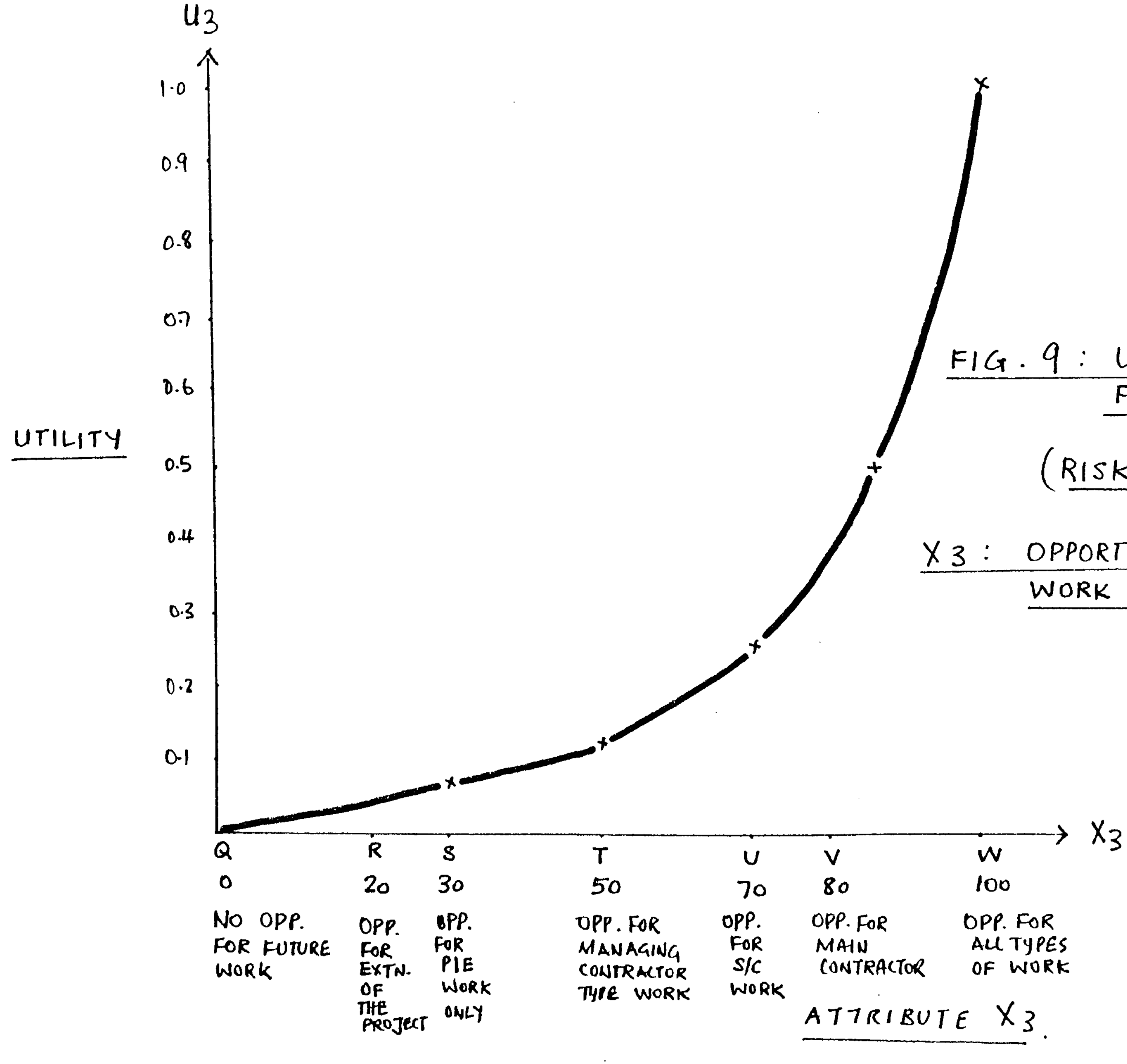


FIG. 9 : UTILITY FUNCTION FOR ATTRIBUTE X_3

(RISK TAKER)

X 3 : OPPORTUNITY FOR FUTURE WORK IN THE TERRITORY.

5.0 (Contd.)

Now please refer to Fig.5. At what point would you be indifferent between a certainty and the lottery?

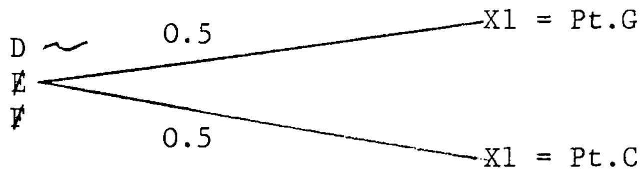


Fig.5

DM. At point D.

P. Let us see what it means from utility of D(10% profit, 15% downpayment) point of view.

$$U\ (D) = 0.5\ (1) + 0.5\ (0.75)$$
$$= 0.5 + 0.375$$
$$= 0.875$$

Now at what point in Fig.6 would you be indifferent?

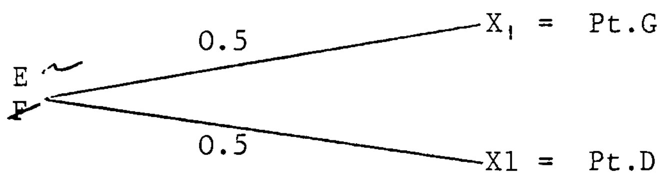


Fig.6

DM. At point E i.e. (10% profit and 20% downpayment).

P. O.K. This means your utility of E is

$$U\ (E) = 0.5\ (1) + 0.5\ (.875)$$
$$= 0.5 + 0.437$$
$$= 0.937$$

$$\text{and } U\ (F) = 0.5\ (1) + 0.5\ (0.937)$$
$$= 0.5 + 0.468$$
$$= 0.968$$

We are now in a position to draw your utility function for attribute X1 i.e. opportunity for cash generation. See Fig.7.

Other utility functions can be evaluated on similar basis.

Figs. 7, 8 and 9 show the utility functions of attributes X1, X2 and X3. See worked examples for establishing the relative importance of the attributes and assessing the scaling constants.

6.0 Application of Multi-attribute Utility Theory in selecting Projects for tendering

6.1 DATA:

ATTRIBUTES	PROJECT A	PROJECT B
X1	Point C 5% Profit Margin 10% downpayment	Point E 10% Profit 20% downpayment
X2	Point N Input from four Divisions	Point K Upto 70% divisional staff can be utilized on the project.
X3	Point R Opportunity for extension of the Project.	Points Opportunity for PIE work only.

6.2 Assessing Utility of Project A

From Figs. 11,15 & 20:

$U1$ (Pt.C) = 0.75 $K1 = 0.8$
$U2$ (Pt.N) = 0.75 $K2 = 0.7$
$U3$ (Pt.R) = 0.04 $K3 = 0.74$
$\Sigma U_i = 1.54$ $K = 0.74$

$$[1 + (-0.74)\ U_x]$$

$$= [1-(0.74)\ (0.75)\ (0.8)]\ [1-(0.74)\ (0.75)\ (0.7)] \times [1-(0.74)\ (0.04)\ (0.74)]$$

$$= (1-0.444)\ (1-0.389)\ (1-0.022)$$

$$= (0.556)\ (0.611)\ (0.978)$$

$$= 0.332$$

$$0.74\ U_x = 1 - 0.332 = 0.668$$

$$\therefore U_x = \frac{0.668}{0.74} = 0.9$$

$$\boxed{U(x)_A = 0.9}$$

6.3 Assessing Utility of Project B

From Figs. 11,15 & 20:

$U1$ (Pt.F) = 0.95 $K1 = 0.8$
$U2$ (Pt.K) = 0.5 $K2 = 0.7$
$U3$ (Pt.S) = 0.0625 $K3 = 0.74$
$\Sigma U_i = 1.51$ $K = -0.74$

6.0 (Contd.)

6.3 (Contd.)

$$[1 + (-0.74)\ U(X)]$$
$$= [1-(0.74)\ (0.95)\ (0.8)]\ [1-(0.74)\ (0.5)\ (0.7)]$$
$$= [1-(0.0625)(0.74)(0.74)]$$
$$= (1-0.562)\ (1-0.259)\ (1-0.034)$$
$$= (0.438)\ (0.741)\ (0.966)$$
$$= 0.312$$
$$Ux = \frac{1 - 0.312}{0.74}$$
$$= \frac{0.688}{0.74}$$
$$= 0.93$$

$$\boxed{Ux_B = 0.93}$$

6.4 Consider Project C

X1 = Point B
X2 = Point L
X3 = Point Q

From Figs. 11, 15 & 20:

$U1 = 0.5$ $K1 = 0.8$
$U2 = 0.55$ $K2 = 0.7$
$U3 = 0$ $K3 = 0.74$
$\Sigma Ui = 1.05$ $K = -0.74$

$$[1 + (-0.74)\ Ux]$$
$$= [1-(0.74)\ (0.5)\ (0.8)]\ [1-(0.74)\ (0.55)(0.7)]\ (1-0)$$
$$= (1 - 0.296)\ (1 - 0.285)\ (1)$$
$$= (0.704)\ (0.715)$$
$$= 0.503$$
$$U(x) = \frac{0.497}{0.74}$$
$$= 0.67$$

$$\boxed{U(x)_C = 0.67}$$

6.5 Consider Project D

X1 = Point B
X2 = Point J
X3 = Point S

$K1 = 0.8$
$K2 = 0.7$
$K3 = 0.74$
$K = -0.74$

From Figs. 11, 15 & 20:

$U1 = 0.5$
$U2 = 0.35$
$U3 = 0.06$
$\Sigma Ui = 0.91$

6.0 (Contd.)

6.5 (Contd.)

[1 + (-0.74) Ux]
= [1- (0.74) (0.5) (0.8)] [1- (0.74) (0.74) (0.35) (0.7)]
[1- (0.74) (0.06) (0.74)]
= (1- 0.296) (1-0.18) (1-0.033)
= (0.704) (0.82) (0.967)
= 0.558

$$Ux = \frac{0.442}{0.74}$$

= 0.6

$U(x)_D = 0.6$

6.6 Consider Project E

X1 = Point D
X2 = Point H
X3 = Point Q

From Figs. 11,15 & 20: U1 = 0.875, U2 = 0, U3 = 0, $\Sigma U_i = 0.875$

K1 = 0.8
K2 = 0.7
K3 = 0.74
K = -0.74

[1 + (-0.74) Ux]
= [1- (0.74) (0.875) (0.8)] (1-0) (1-0)
= (1 - 0.518)
= 0.482

$$Ux = \frac{0.518}{0.74}$$

= .65

$U(x)_E = 0.7$

6.7 Consider Project F

X1 = Point A
X2 = Point M
X3 = Point Q

From Figs. 11,15 & 20: U1 = 0, U2 = 0.625, U3 = 0, $\Sigma U_i = 0.625$

K1 = 0.8
K2 = 0.7
K3 = 0.74
K = -0.74

[1 + (-0.74) (U(x)]
= (1-0) [1- (0.74) (0.625) (0.7)] (1-0)
= (1 - 0.32)
= 0.68

$$U(x) = \frac{0.32}{0.74}$$

= 0.43

$U(x)_F = 0.43$

6.0 (Contd.)

6.8 Consider Project G

X1 = Point A
X2 = Point K
X3 = Point T

$U_1 = 0$
$U_2 = 0.5$
$U_3 = 0.125$
$\Sigma U_i = 0.625$

$K_1 = 0.8$
$K_2 = 0.7$
$K_3 = 0.74$
$K = -0.74$

$$[1 + (-0.74)\ U_x]$$
$$= [1 - (0.74)\ (0)\ (0.8)]\ [1 - (0.74)\ (0.5)\ (0.7)]\ [1 - (0.74)\ (0.125)\ (0.74)]$$
$$= (1-0.259)\ (1-0.07)$$
$$= (0.741)\ (0.93)$$
$$= 0.69$$
$$U_x = \frac{1-0.69}{0.74}$$
$$= \frac{0.31}{0.74}$$
$$= 0.41$$

$$\boxed{U(x)_G = 0.41}$$

6.0 (Contd.)

6.9 <u>Consider Project H</u>

X1 = Point F
X2 = Point N
X3 = Point V

From Figs. 11,15 & 20

U1 (Pt.F)	= 0.968	K1	= 0.8
U2 (Pt.N)	= 0.75	K2	= 0.7
U3 (Pt.V)	= 0.05	K3	= 0.74
		K	= -0.74
$\sum$ Ui	= 2.218		

[1+ (-0.74) Ux]

= [1- (0.74)(0.958)(0.8)] [1- (0.74)(0.75)(0.7)] [1- (0.74)(0.5)(0.74)]

= (1-0.573) (1-0.388) (1-0.273)

= (0.427) (0.612) (0.727)

= (0.189)

$$Ux = \frac{1-0.189}{0.74}$$

$$= \frac{0.811}{0.74}$$

= 1.09

Ux_H = 1.09

6.10 <u>Consider Project J</u>

X1 = Point G
X2 = Point P
X3 = Point W

From Figs. 11,15 & 20

U1 (Pt.G)	= 1	K1	= 0.8
U2 (Pt.P)	= 1	K2	= 0.7
U3 (Pt.W)	= 1	K3	= 0.74
		K	= -0.74
$\sum$ Ui	= 3		

[1 + (-0.74) Ux]

= [1- (0.74) (0.8)] [1- (0.74) (0.7)] [1- (0.74) (0.74)]

= (1- 0.592) (1-0.518) (1-0.547)

= (0.408) (0.482) (0.453)

= (0.089)

$$Ux = \frac{1 - 0.089}{0.74}$$

$$= \frac{0.911}{0.74}$$

= 1.23

Ux_J = 1.23

7.0 GENERAL UTILITY FUNCTION

From the information about individual attribute utilities and project utilities, it is possible to obtain scaled project utilities as shown in Table 1. From this data a general utility function can be drawn as shown in Fig.10.

Assumption

Contractor's corporate policy states that unless a special case could be made, tenders should not be submitted for projects showing utilities less than 0.7.

With the above directive it is possible to define the boundaries for suitable and unsuitable projects as shown in Fig.10.

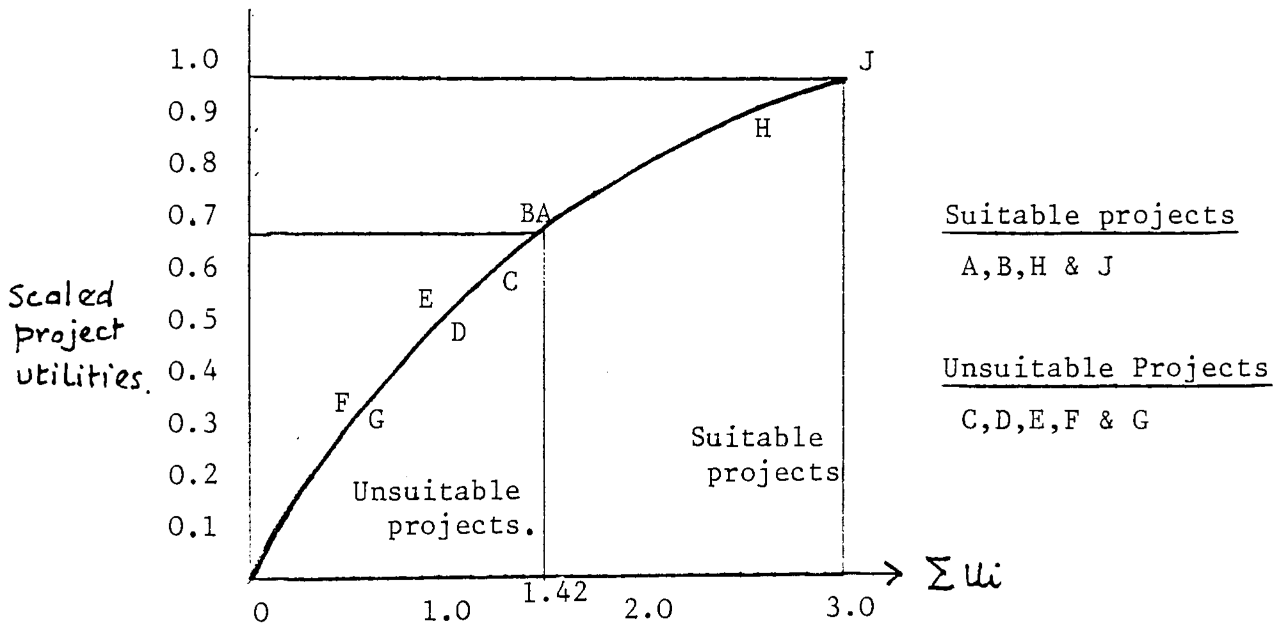


Fig.10: General Utility Function

TABLE 1 : SCALED PROJECT UTILITIES

Project	Individual attribute utilities				Project Utility	Scaled Project Utilities
	U1	U2	U3	$\sum$Ui		
A	0.75	0.75	0.04	1.54	0.9	0.75
B	0.95	0.5	0.06	1.51	0.9	0.75
C	0.5	0.55	0	1.05	0.67	0.54
D	0.5	0.35	0.06	0.91	0.6	0.49
E	0.88	0	0	0.88	0.65	0.52
F	0	0.63	0	0.63	0.43	0.35
G	0	0.5	0.14	0.64	0.41	0.33
H	0.97	0.75	0.5	2.23	1.09	0.89
J At the best level	1.0	1.0	1.0	3	1.23	1.0

8.0 PRACTICAL USEFULNESS

The above general utility function can identify efficiency, the suitable projects in order to pursue them further. On the other hand, contractors can avoid committing their resources to the projects which are unsuitable from their point of view. This proxy decision approach can be useful to representatives especially on overseas tours, in cases where a number of potential enquiries have been generated and need relatively quick decisions as to whether these should be pursued further.

9.0 REFERENCE TABLES

In order to avoid tedious mathematical calculations to find the project utility every time a project is identified and a decision is required, a ready reference table can be prepared as shown in Table 2. It gives at a glance, the value of Ux for different values of one attribute while the remaining attributes are held constant. The table also includes two worked example using the reference table. The approach to the table is similar to a great many reference tables.

There is a scope for further work in this area if tedious calculations are to be eliminated from this approach of decision making. An extensive use of computer can provide the required flexibility i.e. change in corporate policies to suit the current needs of the contractor.

TABLE 2

X1	U1	U2+U3	∑Ui	Ux	U2+U3	∑Ui	Ux	U2+U3	∑Ui	Ux
A	0.00	0	0.0		0.50	0.50		1.00	1.00	
B	0.50	0	0.50		0.50	1.00		1.00	1.50	
C	0.75	0	0.75		0.50	1.25		1.00	1.75	0.80
D	0.88	0	0.88		0.50	1.38		1.00	1.88	0.83
E	0.94	0	0.94		0.50	1.44		1.00	1.94	0.84
F	0.97	0	0.97		0.50	1.47		1.00	1.97	0.85
G	1.00	0	1.00		0.50	1.50		1.00	2.00	0.86

X1	U2+U3	∑Ui	Ux	U2+U3	∑Ui	Ux	U2+U3	∑Ui	Ux	U2+U3	∑Ui	U
A	1.25	1.25		1.50	1.50		1.75	1.75	0.80	2.00	2.00	0.8
B	1.25	1.75	0.80	1.50	2.00	0.86	1.75	2.25	0.90	2.00	2.50	0.9
C	1.25	2.00	0.86	1.50	2.25	0.90	1.75	2.50	0.93	2.00	2.75	0.9
D	1.25	2.13	0.87	1.50	2.38	0.91	1.75	2.63	0.94	2.00	2.88	0.9
E	1.25	2.19	0.88	1.50	2.44	0.92	1.75	2.69	0.94	2.00	2.94	0.9
F	1.25	2.22	0.89	1.50	2.47	0.93	1.75	2.72	0.95	2.00	2.97	0.9
G	1.25	2.25	0.90	1.50	2.50	0.93	1.75	2.75	0.95	2.00	3.00	1.0

$\sum U_i = U_1 + U_2 + U_3$.
Where U_1 = 0.0, 0.5, 0.75, 0.88, 0.94, 0.97 and 1.0
U_x is calculated from the equation for the multiplicative utility function.

$$1 + KU(x) = \prod_{i=1}^{n} \left[1 + K k_i U_i (X_i)\right]$$

PROJECT UTILITIES FOR DIFFERENT VALUES OF ATTRIBUTE X1 (ATTRIBUTES X2 & X3 HELD CONSTANT).

(Similar Table for X2 & X3)

Assumption:

Contractor's corporate policy states that no project should be tendered if the project utility is less than 0.8.

Worked Examples

Example 1: Data

X1 = Point E
= 10% Profit 20% downpayment

X2 & X3 are such that
U2 + U3 = 1.0
X2 = Point K
= Upto 70% staff can be utilized.

X3 = Point V
= Future opportunity for main contracts.

$\sum$Ui = U1 + (U2 + U3)
= 0.94 + (0.5 + 0.5)
= 1.94

From Table 2, Ux = 0.84

∴ The Project is unsuitable for tendering

Example 2

X1 = Point C
= 5% Profit, 10% downpayment

X2 & X3 are such that
U2+U3 = 0.5
X2 = Point K
= Upto 70% utilization of divisional staff.
X3 = Point Q
= No opp. for future work

$\sum$ Ui = 1.25, Ux < 0.8

∴ The Project is unsuitable for tendering

TABLE 2

U1	U2+U3	$\sum$Ui	Ux	U2+U3	$\sum$Ui	Ux	U2+U3	$\sum$Ui	Ux	U2+U3	$\sum$Ui	Ux	U2+U3	$\sum$Ui	Ux	U2+U3	$\sum$Ui	Ux	U2+U3	$\sum$Ui	Ux
0.00	0	0.0		0.50	0.50		1.00	1.00		1.25	1.25		1.50	1.50		1.75	1.75	0.80	2.00	2.00	0.86
0.50	0	0.50		0.50	1.00		1.00	1.50		1.25	1.75	0.80	1.50	2.00	0.86	1.75	2.25	0.90	2.00	2.50	0.93
0.75	0	0.75		0.50	1.25		1.00	1.75	0.80	1.25	2.00	0.86	1.50	2.25	0.90	1.75	2.50	0.93	2.00	2.75	0.95
0.88	0	0.88		0.50	1.38		1.00	1.88	0.83	1.25	2.13	0.87	1.50	2.38	0.91	1.75	2.63	0.94	2.00	2.88	0.97
0.94	0	0.94		0.50	1.44		1.00	1.94	0.84	1.25	2.19	0.88	1.50	2.44	0.92	1.75	2.69	0.94	2.00	2.94	0.98
0.97	0	0.97		0.50	1.47		1.00	1.97	0.85	1.25	2.22	0.89	1.50	2.47	0.93	1.75	2.72	0.95	2.00	2.97	0.99
1.00	0	1.00		0.50	1.50		1.00	2.00	0.86	1.25	2.25	0.90	1.50	2.50	0.93	1.75	2.75	0.95	2.00	3.00	1.00

$\sum U_i = U_1 + U_2 + U_3$.
Where U_1 = 0.0, 0.5, 0.75, 0.88, 0.94, 0.97 and 1.0
U_x is calculated from the equation for the multiplicative utility function.

$$+ KU(x) = \prod_{i=1}^{n} \left[1 + K K_i U_i (X_i)\right]$$

TABLE 2:

PROJECT UTILITIES FOR DIFFERENT VALUES OF ATTRIBUTE X1 (ATTRIBUTES X2 & X3 HELD CONSTANT).

(Similar Table for X2 & X3)

Assumption:

Contractor's corporate policy states that no project should be tendered if the project utility is less than 0.8.

Worked Examples

Example 1: Data

X1 = Point E
 = 10% Profit 20% downpayment

X2 & X3 are such that
U2 + U3 = 1.0
X2 = Point K
 = Upto 70% staff can be utilized.

X3 = Point V
 = Future opportunity for main contracts.

$\sum$Ui = U1 + (U2 + U3)
 = 0.94 + (0.5 + 0.5)
 = 1.94

From Table 2, Ux = 0.84

∴ The Project is unsuitable for tendering

Example 2

X1 = Point C
 = 5% Profit, 10% downpayment

X2 & X3 are such that
U2+U3 = 0.5
X2 = Point K
 = Upto 70% utilization of divisional staff.
X3 = Point Q
 = No opp. for future work

$\sum$Ui = 1.25, Ux $<$ 0.8

∴ The Project is unsuitable for tendering

10.0 SOME OF THE OPTIONS FOR X2 and X3 WITH A GIVEN LEVEL OF X1 TO PROVIDE FLEXIBILITY FOR SELECTION OF PROJECTS

Assume a corporate policy

Projects with utility values less than 0.8 should not be tendered.

A given level of X1

10% downpayment
5% Profit Margin } X1 = Point C

Some of the Options for X2 and X3

OPTION 1:

	X1	X2	X3	ΣUi	Ux
Points	C	K	V		
Ui	0.75	0.5	0.5	1.75	0.8

X2 = Opportunity to use up to 70% divisional staff

and X3 = Future opportunity for main Contractor's role in the territory.

OPTION 2:

	X1	X2	X3	ΣUi	Ux
Points	C	H	W		
Ui	0.75	0.00	1.0	1.75	0.8

X2 = Very little opportunity to use own resources

and X3 = Future opportunity for all types of work.

OPTION 3:

	X1	X2	X3	ΣUi	Ux
Points	C	P	Q		
Ui	0.75	1.0	0	1.75	0.8

X2 = Opportunity to use the Group's resources

and X3 = No opportunity for future work.

10.3 (Contd.)

OPTION 4

	X1	X2	X3	$\sum$Ui	Ux
Points	C	J	Mid value V-W	.	
Ui	0.75	0.35	0.65	1.75	0.8

X2 = Opportunity to use upto 20% divisional staff

and X3 = Opportunity for main Contractor's role and some other roles.

OPTION 5

	X1	X2	X3	$\sum$Ui	Ux
Points	C	M	Mid-Value U-V		
Ui	0.75	0.625	0.375	1.75	0.8

X2 = Opportunity for input from three divisions

and X3 = Opportunity for s/c works and similar other roles.

The above discussion suggestions that even for the limiting utility value, (i.e. 0.8 in the above cases), it is possible to generate a number of options thus providing the much needed flexibility in decision making. Once again, the options developed above are only a few among many possible.

6.10.3.2.2

APPLICATION OF MAUT (MULTI-ATTRIBUTE UTILITY THEORY) IN DECISION SITUATIONS WHERE THERE IS A DESPERATE NEED TO SECURE A CONTRACT BY A DIVISION

1.0 REASONS FOR DESPERATION

P: What are the reasons for desperation?

DM: 1. Need to utilize spare resource capacity.
2. Need to prove the present capabilities in executing projects.
3. Need to contribute to the Division's overheads.

2.0 LIST OF ATTRIBUTES

P: Let us establish the attributes.

X1: OPPORTUNITY TO USE OWN ENGINEERING AND MANAGERIAL RESOURCES

X2: OPPORTUNITY TO CONTRIBUTE

Let me provide you with measures of the above attributes. See whether they are reasonable as far as you are concerned.

Before we check these two attributes for their independency, can you provide some approximate figures for resource utilization?

DM: I will have a go but it will be a guess work because the resources will depend upon the actual size and our involvement in a contract.

P: That is o.k. The figures now give some idea of the relationship between a particular type of contract and the resources required to execute the work involved in the contract.

See Table 3 for the measure of the above attributes.

3.0 MEASURE OF THE ATTRIBUTES X1 AND X2

TABLE 3

ATTRIBUTE	MEASURE	LEVELS: Worst	LEVELS: Best
X1	Opportunity to prove engineering and Managerial Capabilities (see below)	A	H
X2	Opportunity to make a contribution (see below)	K	V

X1 — Opportunity to prove engineering and Managerial Capabilities

Type of Contract	S/C	S/C	M	M	T/K	T/K	T/K
Size	S	L	S	L	JV	S	L

	A	B	C	D	E	F	G	H
Scale	0	7	13	19	50	63	75	100
Resource	0	5%	10%	15%	40%	50%	60%	80%

Legends:
- S/C Sub-Contract
- S Small
- L Large
- M Management
- T/K Turnkey

For further details see Table 4.

X2 — Opportunity to make a contribution

	K	L	M	N	P	Q	R	S	T	U	V
Scale	0	10	20	30	40	50	60 Break Even	70	80	90	100
Loss on											
Own Cost	10%	5%	0	0	0	0	0				
S/C Cost	0	0	0	0	0	0	0				
Contractual O/H	100%	100%	100%	50%	0	0	0				
Fixed O/H	100%	100%	100%	100%	100%	50%	0				
Profit	0	0	0	0	0	0	0	5%	10%	15%	20%

For further details see Table 5

A MEASURE OF ATTRIBUTE 'OPPORTUNITY TO PROVE ENGINEERING & MANAGERIAL CAPABILITIES' (X1)

	A	B	C	D	E	F	G	H
OPPORTUNITY FOR: TYPE OF CONTRACT	No. Opp.	S/C	S/C	MANAGE-MENT	MANAGE-MENT	TURNKEY CONTRACT (JV OR CONSORTIUM SITUATION)	TURNKEY CONTRACT	TURNKEY CONTRACT
SIZE OF CONTRACT		SMALL	LARGE	SMALL	LARGE	SMALL/ MEDIUM	SMALL	LARGE
VALUE OF PROJECT		BELOW £30M	OVER £30M	UPTO £5M	OVER £5M	UPTO £50M	UPTO £30M	OVER £50M
VALUE OF CONTRACT		BELOW £1M	OVER £1M	ON FEE BASIS	ON FEE BASIS	UPTO £20M	UPTO £30M	OVER £50M
TYPE OF RESPONSIBILITY M: MANAGERIAL E: ENGINEERING M/E: MANAGERIAL & ENGINEERING		E	M/E	M	M/E	M/E	M/E	M/E
RESPONSIBILITY (AS A TOTAL CONTRACT) W: WHOLE					W		W	W
S: SHARED		S	S	S		S		
OWN RESOURCE UTILIZATION	0	5%	10%	15%	40%	50%	60%	80%
SCALE VALUES	0	7	13	19	50	63	75	100

TABLE 5:

A MEASURE OF ATTRIBUTE 'OPPORTUNITY TO MAKE A CONTRIBUTION' (X2)

		K	L	M	N	P	Q	R	S	T	U	V
OPPORTUNITY TO RECOVER												
	OWN COST	90%	95%	100%	100%	100%	100%	100%	100%	100%	100%	100%
	S/C COST	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
	CONTRACTUAL O/H	0%	0%	0%	50%	100%	100%	100%	100%	100%	100%	100%
	CONTRIBUTION											
	FIXED O/Hs (10% COMPANY's TOTAL O/Hs)	0%	0%	0%	0%	0%	50%	100%	100%	100%	100%	100%
	NET PROFIT (% OF TOTAL OF OWN COST AND S/C COST)	0%	0%	0%	0%	0%	0%	0%	5%	10%	15%	20%
LOSS ON												
	OWN COST	10%	5%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	S/C COST	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	CONTRACTUAL O/H	100%	100%	100%	50%	0%	0%	0%	0%	0%	0%	0%
	FIXED O/H	100%	100%	100%	100%	100%	50%	0%	0%	0%	0%	0%
PROFIT (% OF TOTAL OF OWN & S/C COST)		0%	0%	0%	0%	0%	0%	0%	5%	10%	15%	20%
								BREAK EVEN				
SCALED VALUES		0	10	20	30	40	50	60	70	80	90	100
POINTS ON THE SCALE		K	L	M	N	P	Q	R	S	T	U	V

4.0 CHECK UTILITY INDEPENDENCE ASSUMPTION

P: Consider attribute X1.

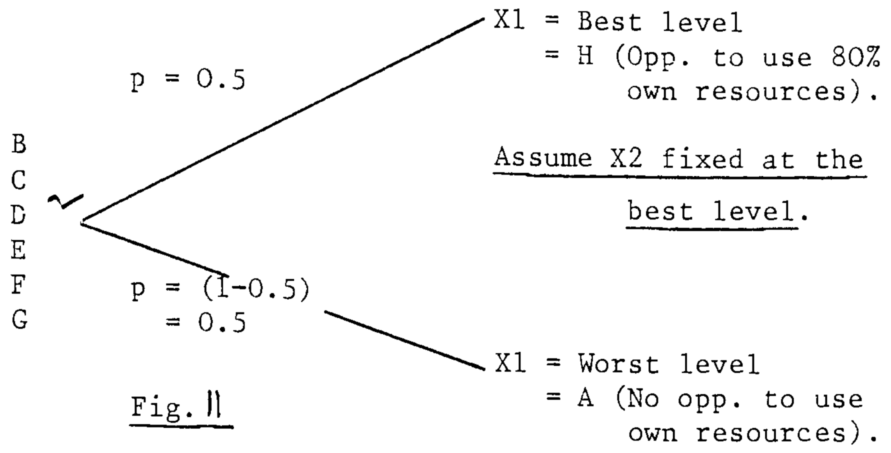


Fig. 11

Consider the lottery shown in Fig. 11. This lottery gives you 0.5 chance that X1 would be at its best level.

Remember, X2 is fixed at the best level.(i.e.20% profit).

The other option you have is point B. i.e. opportunity to use only 5% of own resources on a contract.

What would you prefer?

DM: With a 50% chance of the best level, I would rather go for the lottery.

P: How about point C?

DM: No, I still rather go for the lottery.

P: Would point D tempt you to reject lottery?

DM: Well, if the situation is desperate, I think I should not take any chance to lose the opportunity to use even 15% of the resources on a contract.

But at the same time 50%chance to get an opportunity to utilize 80% of the resources is also tempting.

Perhaps I am indifferent.

CALCULATE CONTRACTOR'S UTILITIES OF PROJECTS A, B, C & D UNDER 'DESPERATE' SITUATIONS

Attributes	Project A	Project B	Project C	Project D
X1	Pt.D (Opp. to utilise 15% resources).	Pt.A (No opp. to use resources).	Pt.G (Opp.to utilise 60% resources.	Pt.B (opp. to utilise 5% resources).
X2	Pt.S (Opp. to make 5% profit).	Pt.T Opp. to make 10% profit.	Pt.L (Likelihood of a loss situation).	Pt.V (Opp. to make 20% profit).

UTILITY OF PROJECT A

From Figs. 33 & 40 { U1 (P+D) = 0.25, U2 (P+S) = 0.99

K1 = 0.6
K2 = 0.3
K = 0.55

$1 + 0.55\,Ux$
$= [1 + (0.55)(0.25)(0.6)]\,[1 + (0.55)(0.99)(0.3)]$
$= (1 + 0.0825)(1 + 0.163)$
$= (1.0825)(1.163))$
$= 1.26$

$0.55\,Ux = 0.26$
$Ux = \frac{0.26}{0.55} = 0.47$

UA = 0.47

UTILITY OF PROJECT B

From Figs. 33 & 40 { U1 (Pt.A) = 0, U2 (Pt.T) = 0.992

K1 = 0.6
K2 = 0.3
K = 0.55

$1 + 0.55\,Ux$
$= [1 + (0.55)(0)(0.6)]\,[1 + (0.55)(0.992)(0.3)]$
$= (1)(1 + 0.164)$
$= 1.164$

$\therefore 0.55\,Ux = 0.164$
$\therefore Ux = \frac{0.164}{0.55}$
$= 0.3$

UB = 0.3

UTILITY OF PROJECT C

From Figs. 33 & 40
$$\begin{cases} U1 = (\text{Pt. G}) = 0.875 \\ U2 = (\text{Pt. L}) = 0.5 \end{cases}$$

K1 = 0.6
K2 = 0.3
K = 0.55

1 + 0.55 Ux

$$= [1 + (0.55)\ (0.875)\ (0.6)]\ [1 + (0.55)\ (0.5)\ (0.3)]$$

$$= (1 + 0.288)\ (1 + 0.08)$$

$$= (1.39)$$

$$\therefore\ Ux = \frac{0.39}{0.55} = 0.71$$

UC = 0.71

UTILITY OF PROJECT D

From Figs. 33 & 40
$$\begin{cases} U1\ (\text{Pt.B}) = 0.0625 \\ U2\ (\text{Pt.V}) = 1.0 \end{cases}$$

K1 = 0.6
K2 = 0.3
K = 0.55

1 + 0.55 Ux

$$= [1 + (0.55)\ (0.0625)\ (0.6)]\ [1 + (0.55)\ (1.0)\ (0.3)]$$

$$= (1 + 0.020)\ (1 + 0.165)$$

$$= (1.02)\ (1.165)$$

$$= 1.19$$

$$Ux = \frac{0.19}{0.55} = 0.35$$

UD = 0.35

CONSIDER PROJECT E

X1 Pt.H (Opp. to use 80% resources).

X2 Pt.R (Opp. to break even).

From Figs. 33 & 40
$$\begin{cases} U1 = (\text{Pt.H}) = 1 \\ U2 = (\text{Pt.R}) = 0.984 \end{cases}$$

K1 = 0.6
K2 = 0.3
K = 0.55

1 + 0.55 Ux

$$= [1 + (0.55)\ (1.0)\ (0.6)]\ [1 + (0.55)\ (0.984)\ (0.3)]$$

$$= (1.33)\ (1.16)$$

$$= 1.54$$

$$Ux = \frac{0.54}{0.55} = 0.98$$

UE = 0.98

6.10.3.2.3

APPLICATION OF MAUT IN MEASURING CLIENT'S UTILITY OF TENDERS SUBMITTED FOR LARGE SCALE PROJECTS

Client's Objective: To optimise the services offered by the potential contractor.

Assumptions:

1. Tenders for turnkey contract.
2. Contract to be awarded to a contractor who submitted a tender which has the highest utility value (not necessarily the lowest price) from client's point of view.
3. Tenderers have to qualify before invited to tender.

Attributes (Two)

X1 = Opportunity to pay out a minimum.

X2 = Opportunity to appoint a contractor on a longterm advantages basis.

1.0 UTILITY FUNCTIONS

OPPORTUNITY TO PAYOUT A MINIMUM* = X1

Measure of attribute X1

A	B	C	D	E	F	G	H	J	K	L
0	10	20	30	40	50	60	70	80	90	100
Tender price 50% higher than expected	40% higher	30% higher	20% higher	10% higher	5% higher	Tender price as expected	5% Lower	10% Lower	15% Lower	20% Lower

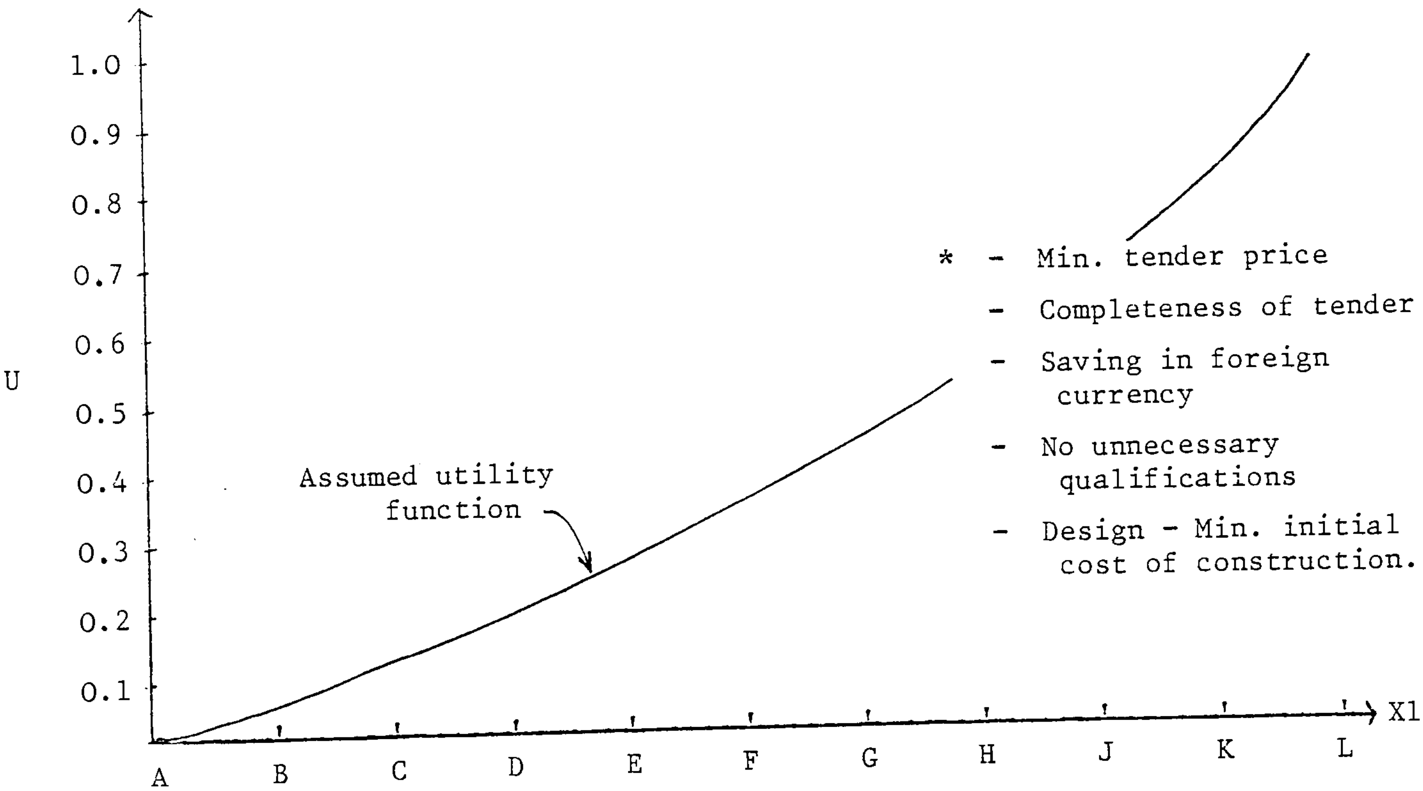


Fig.1

OPPORTUNITY TO APPOINT A CONTRACTOR
ON A LONGTERM * ADVANTAGES BASIS $= X_2$

* a) Client Training - a1) Technical
a2) Managerial.

b) Known for good workmanship.

c) Design C1) Min. operational cost.
C2) Min. maintenance cost.
C3) Min. spares cost.

d) Contractor from a country likely to have good relations with the host country.

e) Extra work at a competitive rate.

f) Finance arranged (if required) at an attractive rate.

g) Bid contains a workmanlike solution to the problem.

g.1) Planning - g.1.1) Material
g.1.2) Resource

g.2) Technical

g.3) Managerial.

h) Max. saving in foreign currency.

j) Prepared to buy back (or sell on behalf of the client) goods produced on a national basis.

k) Provides long term national agreements in other fields.

MEASURE OF ATTRIBUTE X2

M	N	P	Q	R	S	T	U	V	W	X
0	10	20	30	40	50	60	70	80	90	100
None of the long term advantages	d	d b	d b c	d b c e	d b c e g	d b c e g a	d b c e g a h	d b c e g a h f	d b c e g a h f j	d b c e g a h f j k

UTILITY FUNCTION OF ATTRIBUTE X2

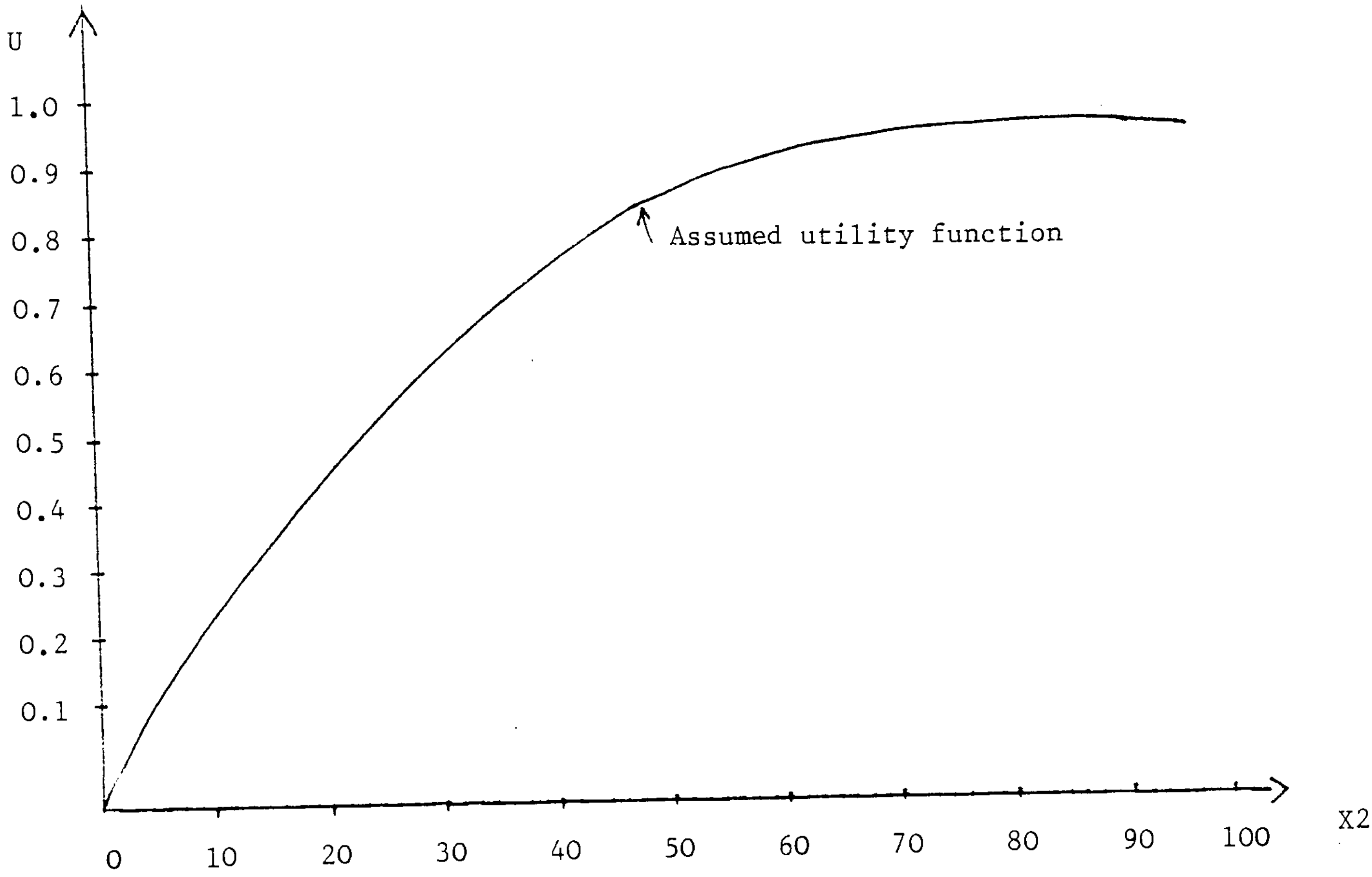


Fig.2

Calculate client's utilities of tenders received for a project

Attribute	Tender T_1	Tender T_2	Tender T_3	Tender T_4	Tender T_5
X_1	Point D 20% higher	Point H 5% lower	Point C 30% higher	Point K 15% lower	Point G At the expected price
X_2	Point P b & d	Point S d,b,c,e & g	Point Q d, b & c	Point M None	Point V d,b,c, e,g,a, h & f

Tender T1

From Figs.1 & 2

$$\begin{cases} U1\ (D) = 0.1 & K1 = 0.8 \\ U2\ (P) = 0.45 & K2 = 0.12 \end{cases} \qquad K = 0.83$$

$$1 + 0.83\ Ux = \left[1 + (0.83)(0.1)(0.8)\right]\left[1 + (0.83)\ (0.45)\ (0.12)\right]$$

$$= (1 + 0.067)\ (1 + 0.045)$$

$$= (1.067)\ (1.045)$$

$$= 1.11$$

$$Ux = \frac{0.11}{0.83} = 0.13$$

$$\boxed{U_{T1} = 0.13}$$

Tender T2

From Figs.) U1 (H) = 0.43 K1 = 0.8 K = 0.83
1 & 2) U2 (S) = 0.08 K2 = 0.12

$$1 + 0.83\ Ux = \left[1 + (0.83)\ (0.43)\ (0.8)\right] \left[1 + (0.83)\ (0.8)(0.12)\right]$$

$$= (1 + 0.29)\ (1 + 0.08)$$

$$= (1.29)\ (1.08)$$

$$= 1.39$$

$$\therefore\ Ux = \frac{0.39}{0.83} = 0.47$$

$$\boxed{UT_2 = 0.47}$$

Tender T3

From Figs.) U1 (C) = 0.06 K1 = 0.8 K = 0.83
1 & 2) U2 (Q) = 0.6 K2 = 0.12

$$1 + 0.83\ Ux = \left[1 + (0.83)\ (0.06)\ (0.8)\right] \left[1 + (0.83)\ (0.6)\ (0.12)\right]$$

$$= (1.04)\ (1.06)$$

$$= 1.1$$

$$Ux = \frac{0.1}{0.83} = 0.12$$

$$\boxed{UT_3 = 0.12}$$

Tender 4

From Figs.) U1 (K) = 0.8 K1 = 0.8 K = 0.83
1 & 2) U2 (M) = 0 K2 = 0.12

$$1 + 0.83\ Ux = \left[1 + (0.83)\ (0.8)\ (0.8)\right] \left[1 + (0.83)\ (0)\ (0.12)\right]$$

$$= (1 + 0.53)\ (1.0)$$

$$= 1.53$$

$$Ux = \frac{0.53}{0.83}$$

$$= 0.64$$

$$\boxed{UT_4 = 0.64}$$

Tender 5

From Figs.) U1 (G) = 0.3 K1 = 0.8 K = 0.83
1 & 2) U2 (V) = 0.96 K2 = 0.12

$$1 + 0.83\ Ux = \left[1 + (0.83)\ (0.3)\ (0.8)\right] \left[1 + (0.83)\ (0.96)\ (0.12)\right]$$

$$= (1.2)\ (1.1)$$

$$= 1.32$$

$$\therefore\ Ux = \frac{0.32}{0.83}$$

$$= 0.39$$

$$\boxed{UT_5 = 0.39}$$

Tender 6

X_1 = Pt. J

10% Lower max.

X_2 = Pt. Y

From Figs.) U1 (J) = 0.6 K1 = 0.8 K = 0.83
1 & 2) U2 (Y) = 1.0 K2 = 0.12

$$1 + 0.83\ Ux = \left[1 + (0.83)\ (0.6)\ (0.8)\right] \left[1 + 0.83)\ (1.0)\ (0.12)\right]$$

$$= (1.4)\ (1.1)$$

$$= 1.54$$

$$Ux = \frac{0.54}{0.83} = 0.65$$

$$\boxed{UT_6 = 0.65}$$

Tenders 4 & 6 provide better long term advantages to the client than the rest of the tenders hence he is likely to consider these two for further negotiations.

CHAPTER 6

CHARTS, TABLES, ETC

Table 6.2.1.1: Conscious Decision Making

According to Lucas (1978) conscious decision-making may be regarded as a formal process in which six stages are frequently distinguished, as given in the following table.

Table 6.2.1.1: Conscious Decision Making

1.	Definition of objectives and of criteria for testing the decision.
2.	Collection of information.
3.	Determination of the scope of the problem.
4.	Development of possible solutions.
5.	Following these through to their logical consequences.
6.	Selection of the best solution or the one that is least bad.
7.	Implementation
8.	Monitoring the results of the implementation to enable the solutions to be modified and information to be fed back to help with future problem.

Table 6.2.1.2: Dill's classifications of decisions (Cited by Ansoff (1976))

Also see Fig. 6.2.1.2.

Table 6.2.1.2: Classification of decisions

Group	Classification	Brief Description
1.	'Agenda' Decisions	Identification of the problem and assignment of priorities.
2.	'Search' Decisions	Selecting procedures for searching and processing information for solving the problem and deciding how much resources (time & money) can be spent on procedures.
3.	'Allocation' Decisions	Committing resources to selective lines of actions.
4.	'Implementation' Decisions	Details of Who? What? How? When? and Where?
5.	'Evaluation' Decisions	Methods of assessment against foredetermined goals,* development of modifications and perhaps leading into 'Agenda' decisions.

* Need for explicit corporate objectives. (See 6.8).

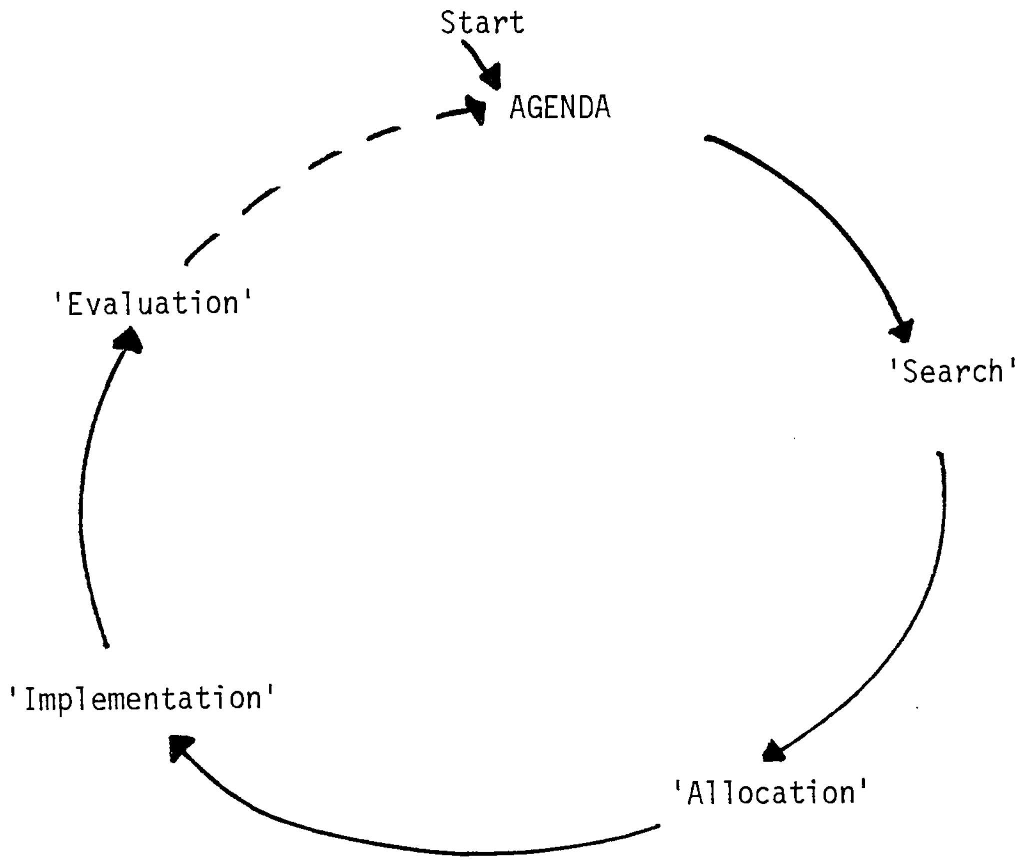


Fig. 6.2.1.2: Classification of decisions

Table 6.2.5.1:

Arguments for and against systematic approach in decision making

FOR	AGAINST
1. The systematic approach forces the decision maker to come to quantitative grips with the interactions between various facets of his problems.	1. A poor analysis can be far worse than no analysis at all.
2. The systematic approach helps communication.	2. When a problem is decomposed it is often extremely difficult to answer basic questions often of hypothetical nature.
3. It can help to suggest gathering, compilation and organisation of the data from various sources. It can assist the evaluation of the data.	3. "The human brain can be a magnificent synthesizer of disparate pieces of nebulous information and often formal techniques and procedures thwart and inhibit this mysterious mechanism from operating efficiently". Raiffa & Keeney (1976).
4. It distinguishses the decision makers preferences from his judgements.	4. By numbers on everything it is possible to bias a study in a direction that leaves out many human and artistic qualities and that analysis therefore inhibits creativity.
5. It can be a stimulus to think hard at the time when it counts	5. Often feature those aspects of the problem that are readily amenable to analysis and to ignore those intangibles e.g. human and artistic qualities, etc. that really count in the long run.
6. A thorough analysis helps the decision maker to argue his case on 'firm' grounds. A decision based on consideration to all the relevant factors helps to overcome an argument which is based on single or a couple factors because consideration to many factors can outweigh the effect of a couple of factors.	6. They are 'armchair' methods with unrealistic assumptions.

Table 6.2.5.1 (Contd.)

FOR	AGAINST
7. Decomposition of a problem helps to focus on those issues which are important.	7. Procedures sound more or less similar to clinical procedures used by psychologists.
8. It can provide a framework for contingency planning.	8. Majority of theorems are based on laboratory environment and often distinctly remote from the realities of the problems faced by decision makers (e.g. international contractors).
9. It can suggest alternative actions .	9. The decision makers intuition sharpened by his practical experience is far better than the academic approach.
10. It can provide a framework for continuous re-evaluation.	10. When faced with fierce competition (as in overseas construction) the techniques such as maximisation of profit can be of little use.
11. The systematic approach can help to appreciate some of the intricacies of dynamic decisions. (See Paragraph 6.2.10).	11. This may be said to reduce 'creativity' and the generation of new ideas as mentioned in 3 above.

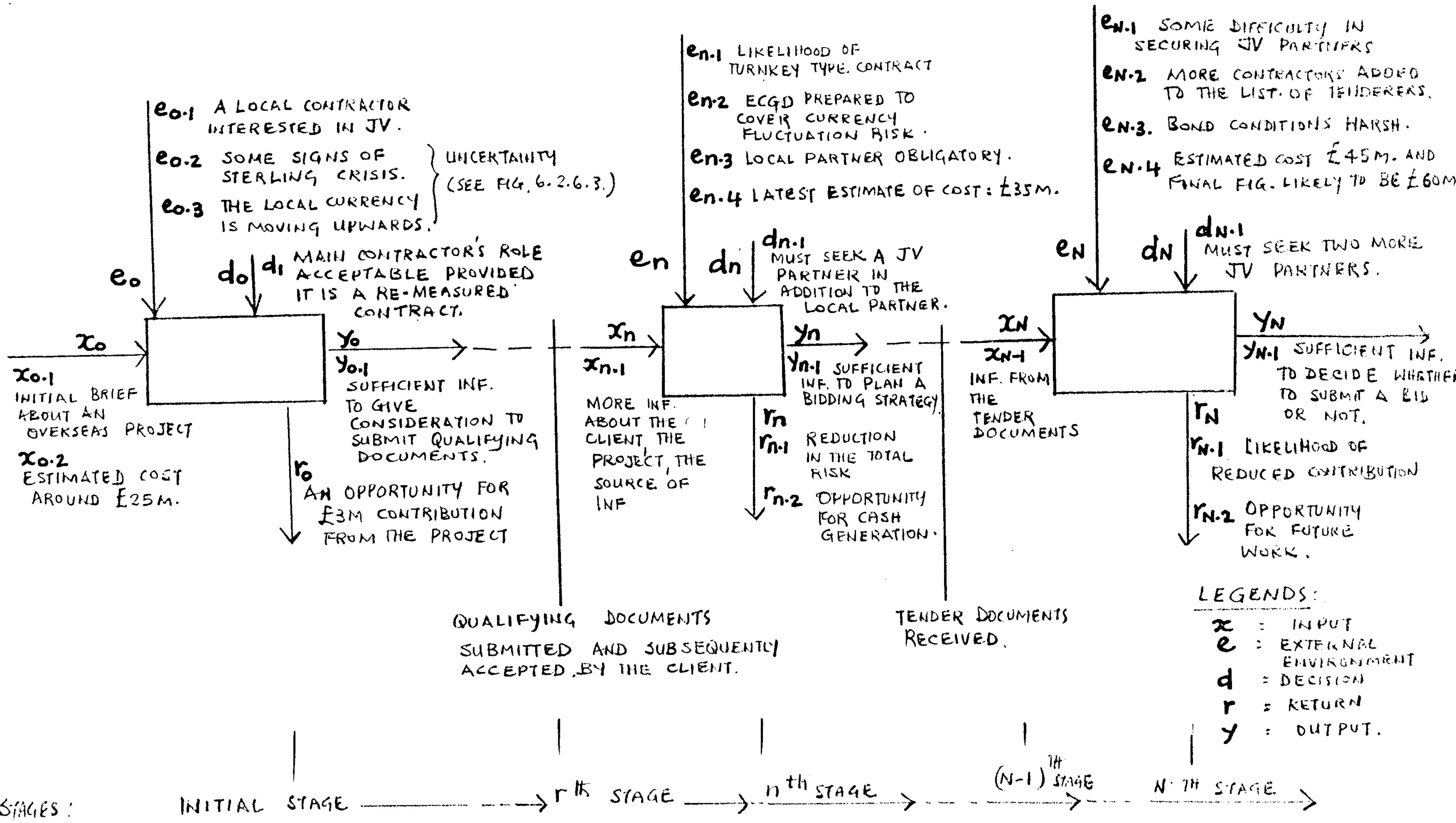
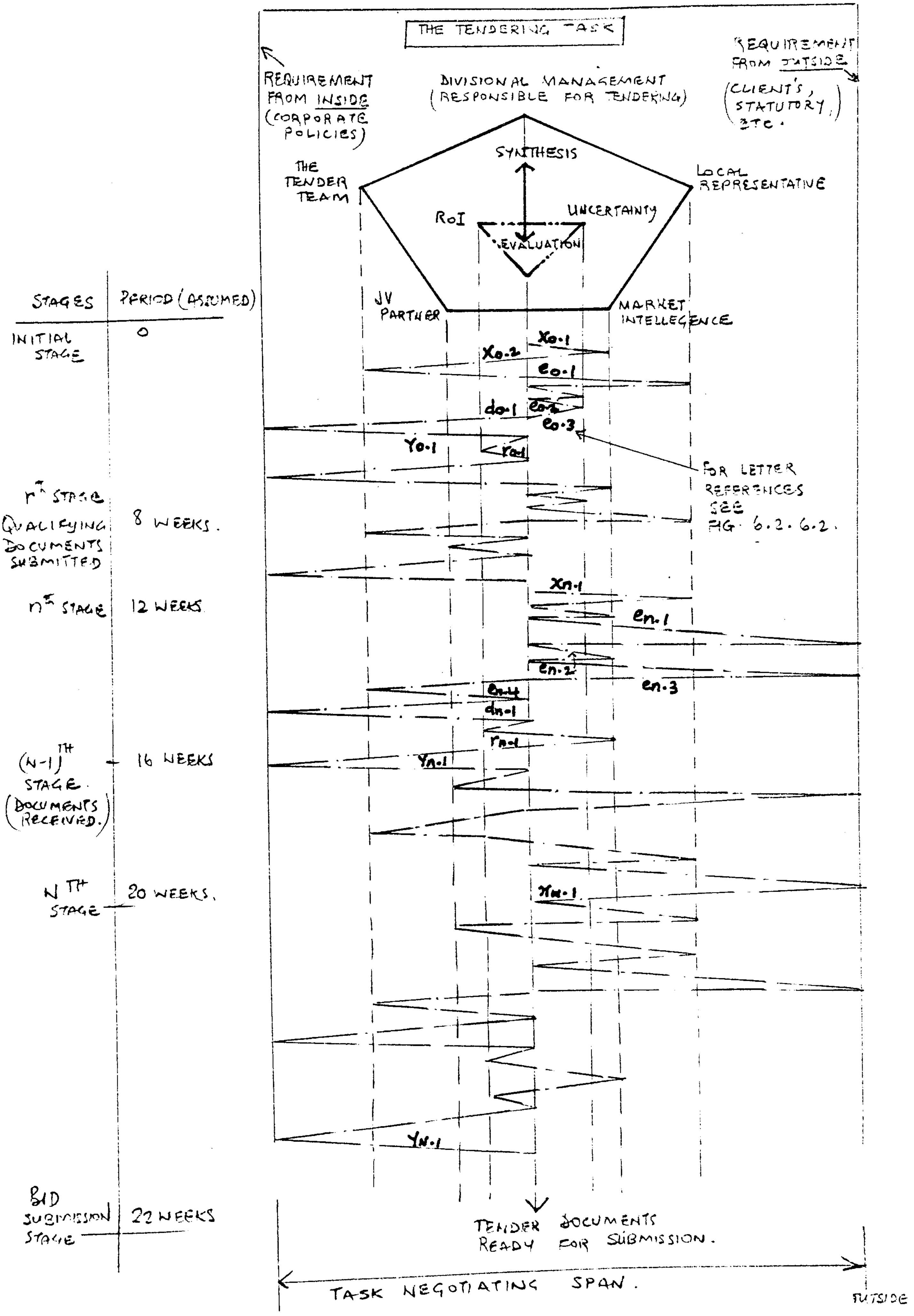


FIG. 6.2.6.2: TENDERING DECISIONS – A DYNAMIC DECISION SYSTEM.

FIG. 6.2.6.3: INCORPORATION OF RAPOPORTS DYNAMIC DECISION SYSTEM INTO GREGORYS ANALYSIS OF TASK NEGOTIATIONS



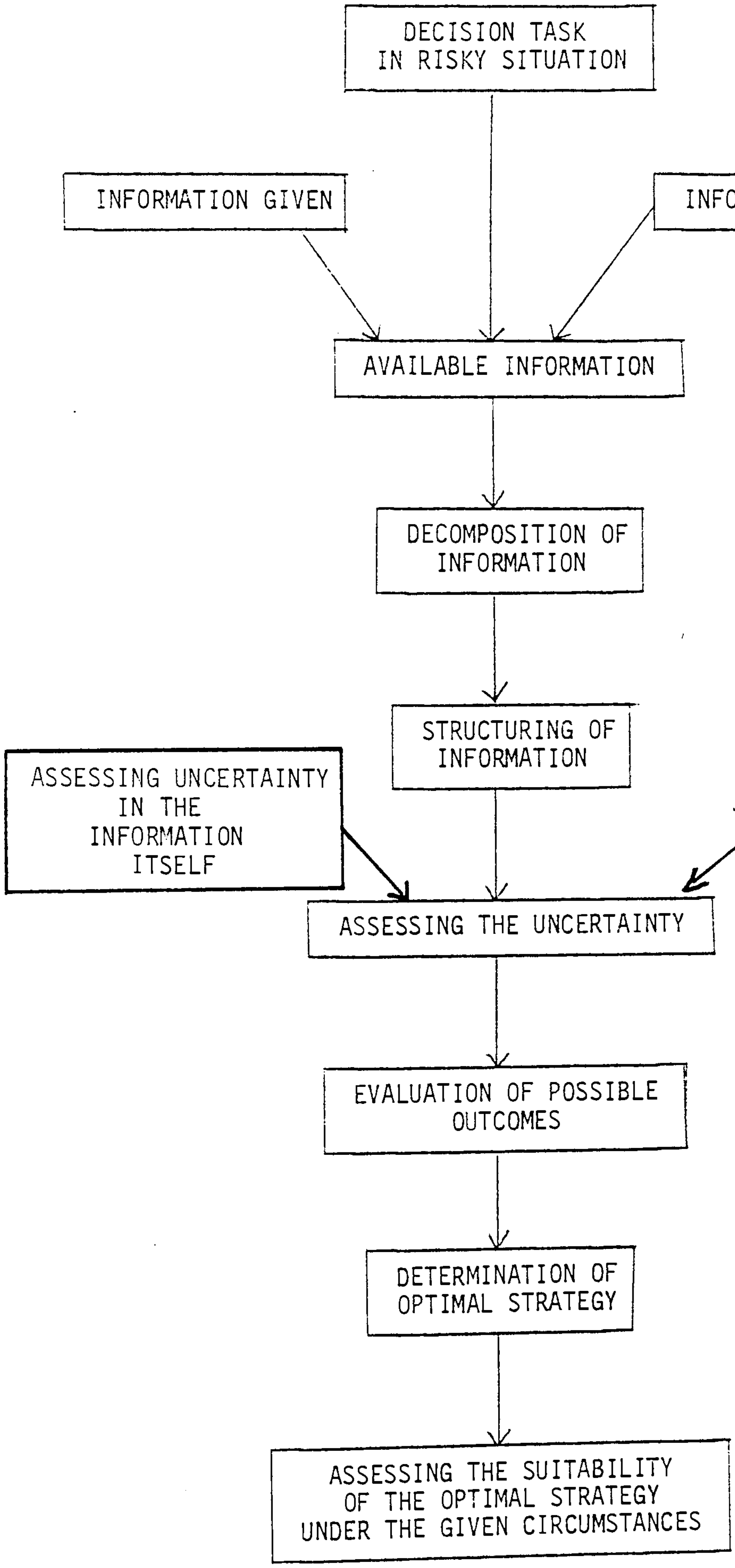
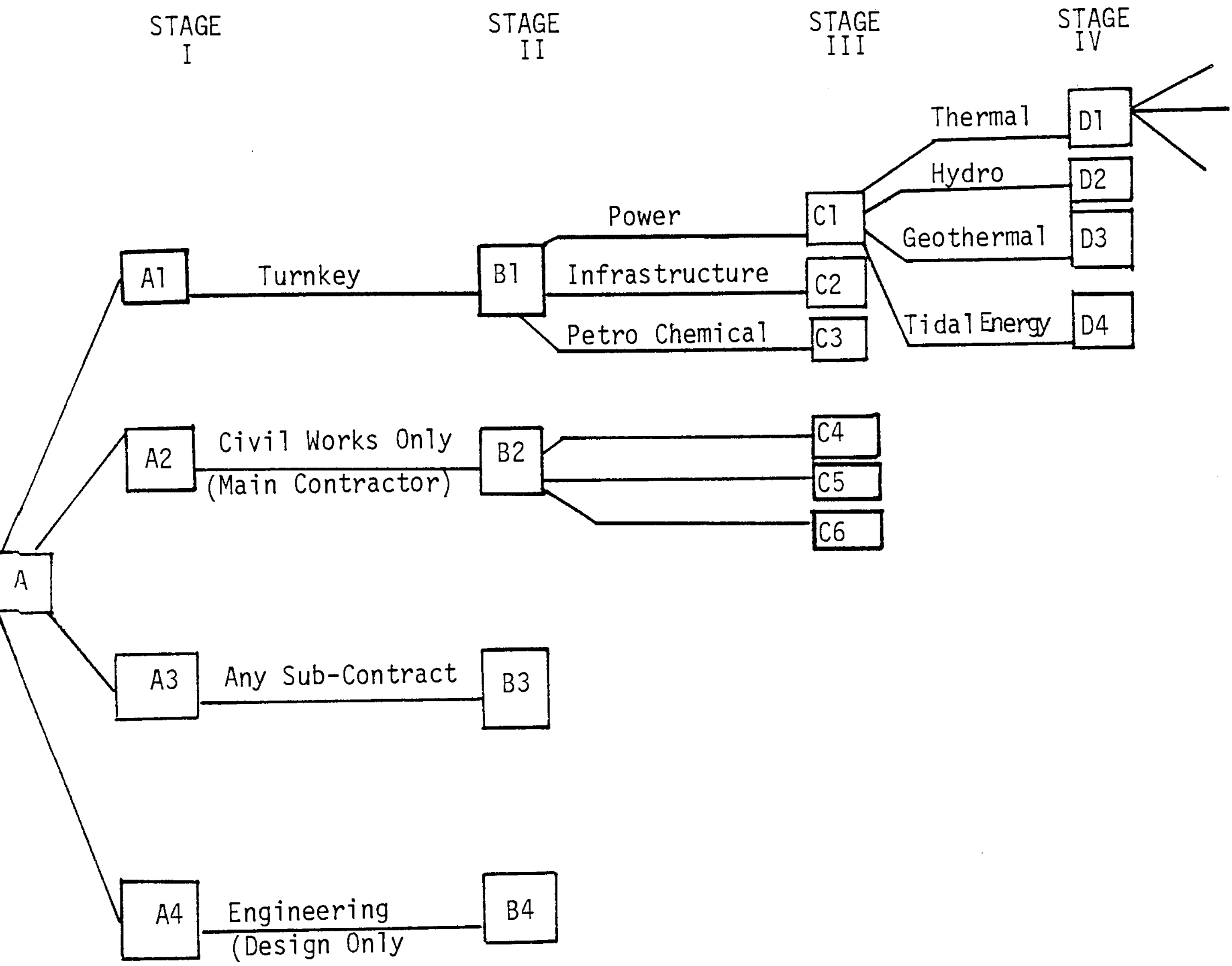


FIG. 6.3.2.1

PROCESS OF DECISION MAKING IN RISKY SITUATION



If $P(D1)$ = Probability of a contractor tendering for thermal power station on a turnkey basis

Then $$P(D1) = \sum_{j} \Big[P(C_1) \,|B_1|\, \sum_{i} \big[P(B_1) \,|A_1|\, P(A_1) \big] \Big] \quad (1)$$

where $P(C_1)$ = prob of C_1 being selected out of C_1, C_2--C_j, and $P\big[(C_1)\,|B_1|\big]$ = prior probability of C_1 based on B_1 taking place.

Fig. 6.3.2.2: An example of a multi-stage probabilistic inference structure. The equation gives the approximate way to compute the probability of any one terminal outcome. (Ref: Conditional probabilities: Bayes's Theorem).

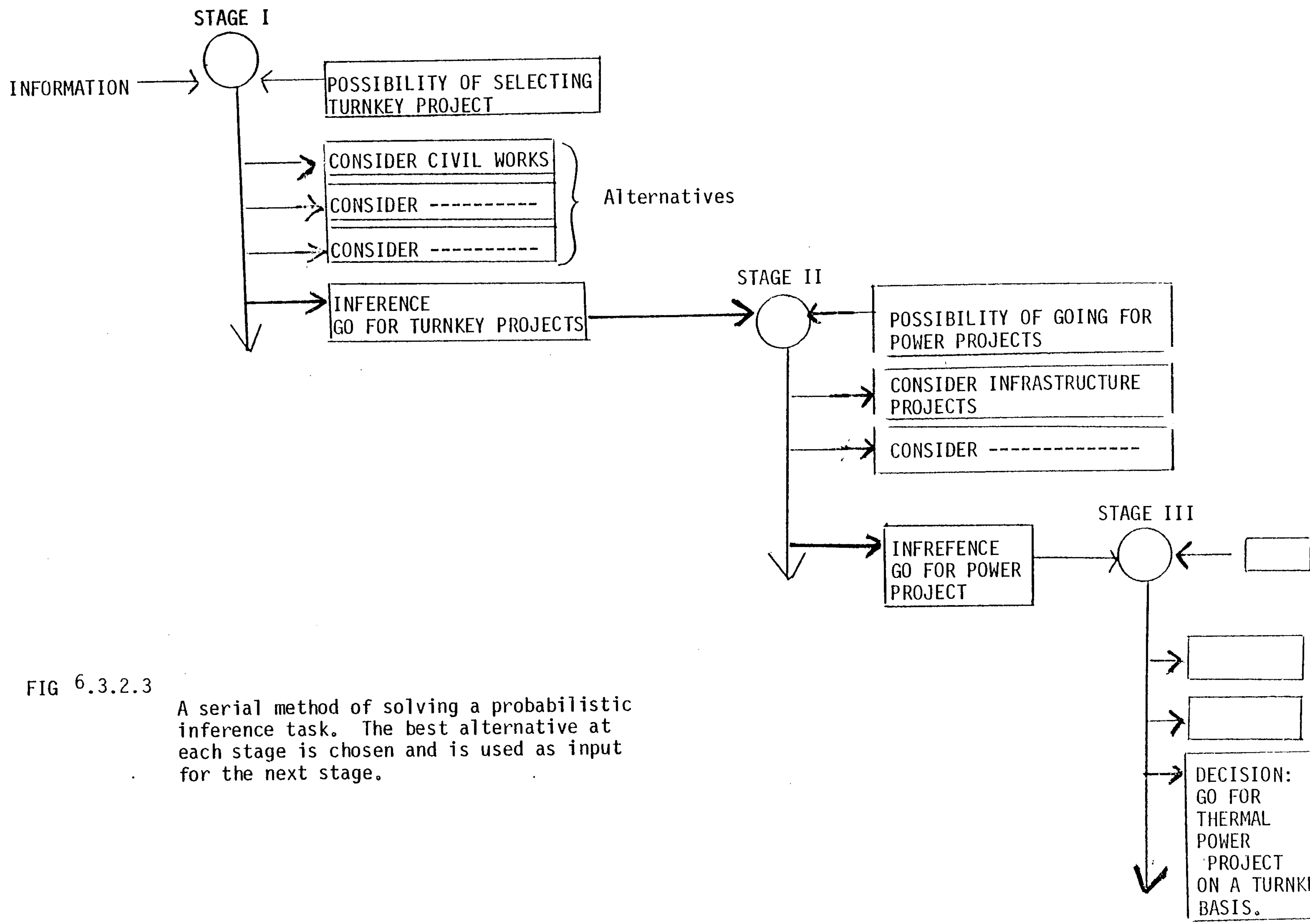


FIG 6.3.2.3

A serial method of solving a probabilistic inference task. The best alternative at each stage is chosen and is used as input for the next stage.

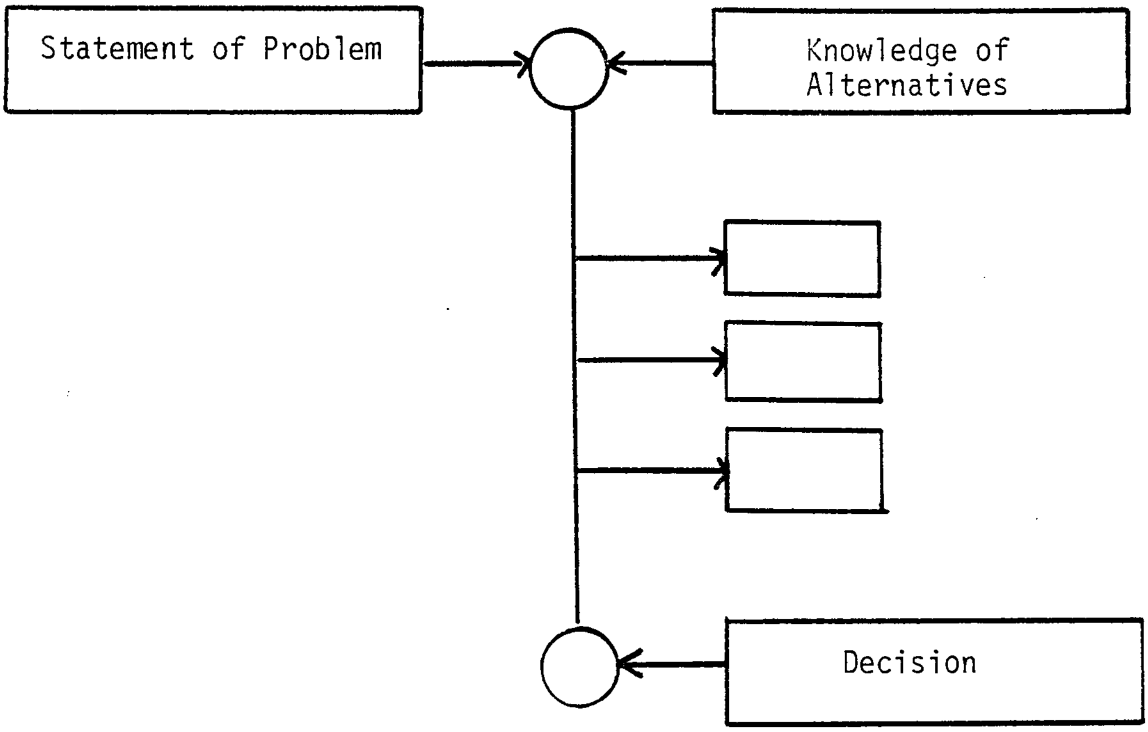


Fig. 6.3.2.4: A Single stage decision task with serial generation of alternatives

CHART 6.4.1.1

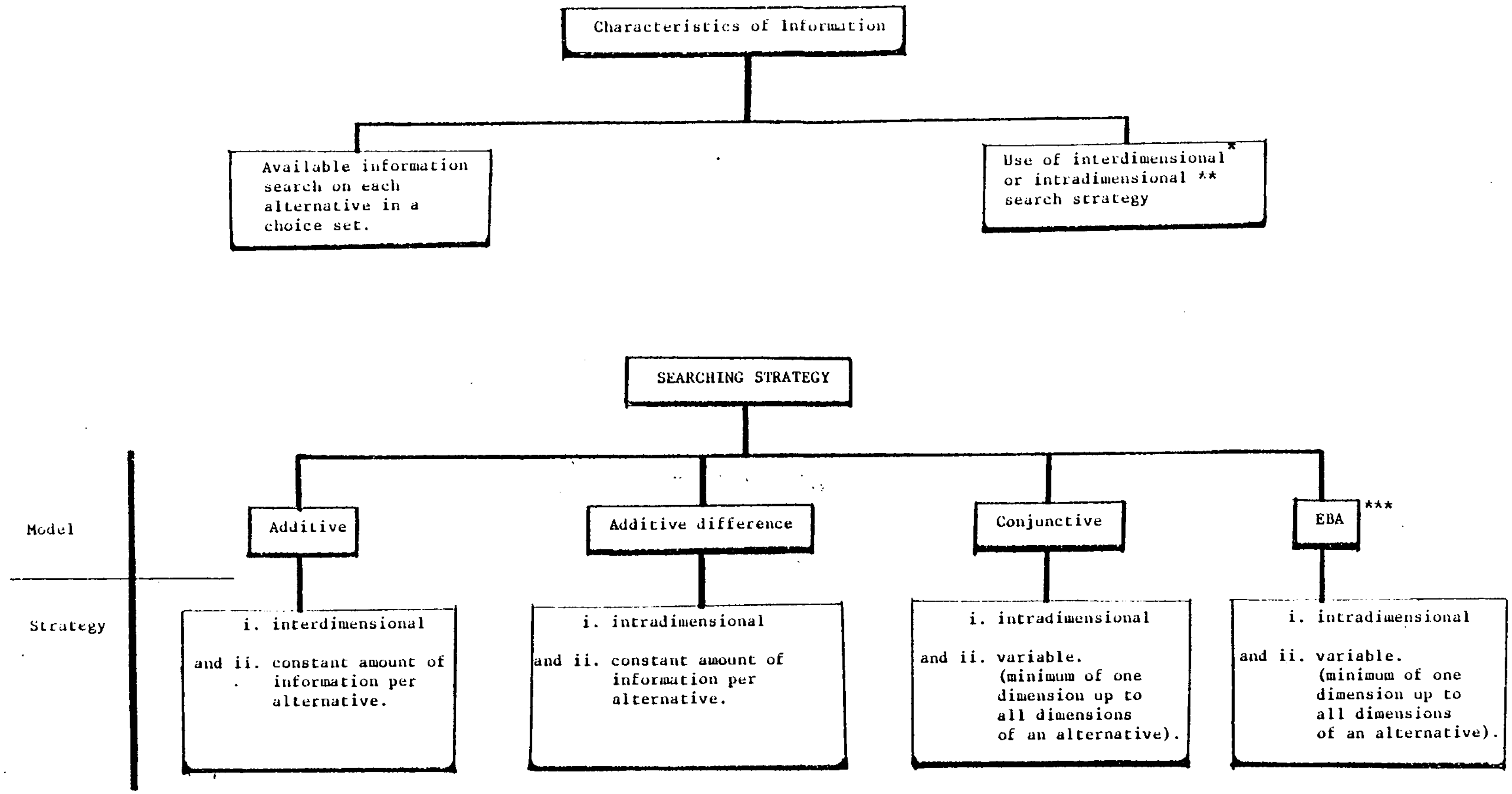
Decision Models

DECISION MODELS (Different Information Search Processes)

	(1) (1.1)	(1) (1.2)	(2)	(3)	(4)
Model:	Additive Model	Linear Model (Based on principle) (of satisficing.)	Non-linear Non-compensatory Conjunctive Model	Additive-difference Model	Elimination-by-aspects (EBA) Model
Process:	Process of choosing among multi-dimensional alternatives.			Using an intradimensional* evaluation strategy: (Direct comparison between alternatives)	Using an intradimensional evaluation strategy.
Model By	Slovic & Lichtenin(1968) Anderson & Shanteau (1970)	Simon (1957)	Coombs (1964) Dawes (1964) Einhorn (1970)	Tversky (1969)	Tversky (1972)
Information Processing Procedure:	1. Each alternative in a choice set is evaluated separately. 2. A value either objective or subjective is arrived at for each dimension of an alternative. 3. Dimensions are then combined in an additive fashion resulting in an overall value for that alternative. 4. Comparisons are then made among the overall values of the alternatives and 5. One with the greatest value is chosen.	Alternatives are searched only until an alternative is found which exceeds some minimum requirement level.	Search for an alternative which has a certain minimum value on all the relevant dimensions in order to be chosen. For instance Multi-dimensional alternative $x = (x_1, x_2, x_3, \ldots x_4)$ surpasses some required standard y where $y = (y_1, y_2, y_3 \ldots y_4)$ only if xi is greater than yi for all values of i.	<u>For two alternatives</u> 1. Alternatives are compared directly on each dimension. 2. Difference is determined. 3. Results summed together to reach a decision. <u>For more than two alternatives</u> 1. Compare a given alternative to only the best of the preceeding alternatives. 2. If the given alternative is preferred it can become the new standard against which remaining alternatives can be compared.	1. A dimension or an aspect of a dimension is selected. 2. All the alternatives that do not possess that dimension or aspect are eliminated. 3. The procedure is repeated until all but one of the alternatives are eliminated.
Important aspects:	It is compensatory i.e. it implies that the decision maker will trade-off between high value on one dimension of an alternative and a low value on another dimension.	Reduce the information processing demands being made on the individual.		* Intradimensional = different alternative but same dimension.	

CHART 6.4.1.2.

Characteristics of Informatio
and Searching Strategies



* Interdimensional;
Same alternative but different dimension.

** Intradimensional:
Different alternative but same dimension.

*** EBA:
Elimination-by-aspects.

Table: 6.4.1.3

Results of Sieber and Lanzetta's (1964) experiment with 'Abstract' and 'Concrete' subjects

	CONCRETE SUBJECT	ABSTRACT SUBJECT
1.	'Concrete' persons search less information and spend less time in processing the information.	'Abstract' persons search more information and spend more time in processing the information.
2.	As the uncertainty increases the information search and processing does not increase proportionately.	As the uncertainty increases, the information search and processing increases proportionately.
3.	'Concrete' persons give less information in their decisions than do 'Abstract' persons.	'Abstract' persons give more information in their decisions than do 'Concrete' persons.
4.	'Concrete' persons are less likely to qualify their decision.	'Abstract' persons are more likely to qualify their decisions with remarks indicating doubt, uncertainty and tentativeness than 'Concrete' persons.

DIMENSIONS

RELATIVELY FIXED OR HIERACHICAL ORGANISATION.

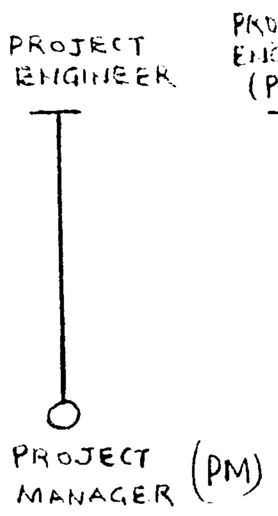


FIG A: VERY LOW INTEGRATION INDEX

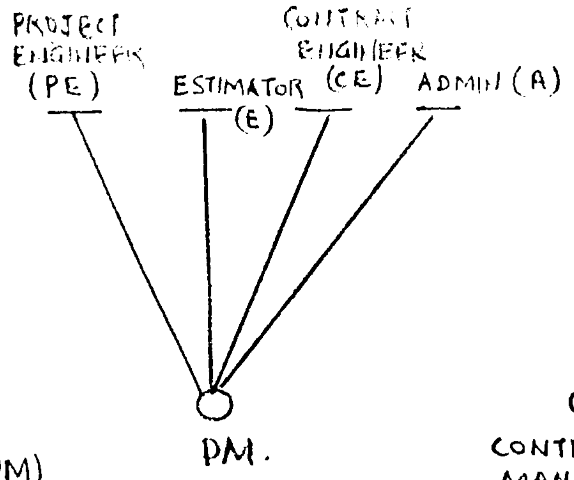


FIG B: LOW INTEGRATION INDEX

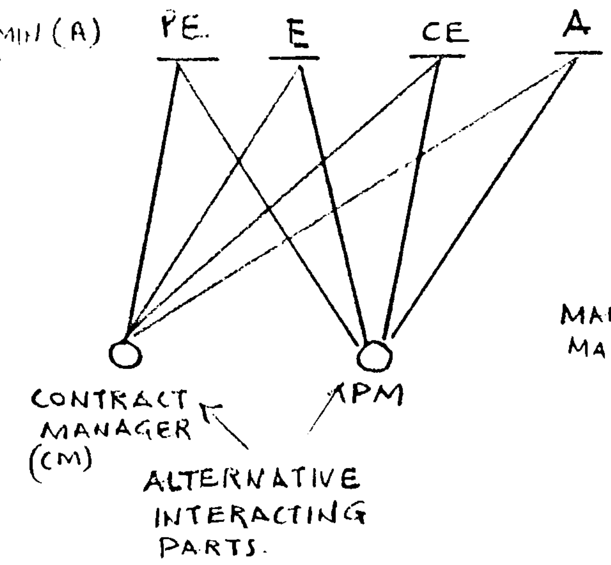


FIG C: MEDIUM INTEGRATION INDEX

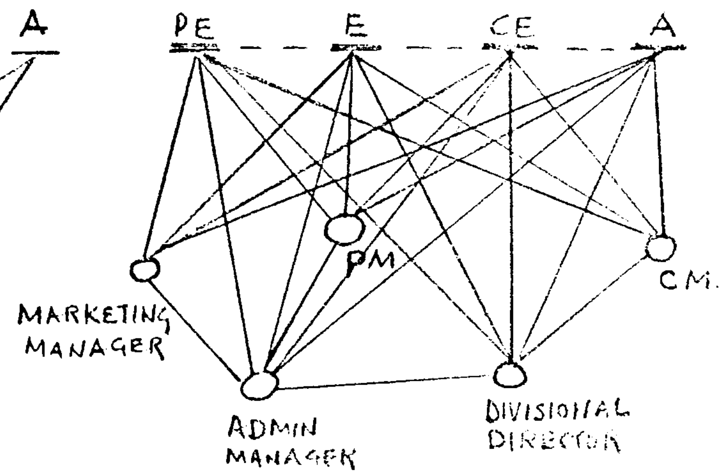


FIG D: HIGH INTEGRATION INDEX

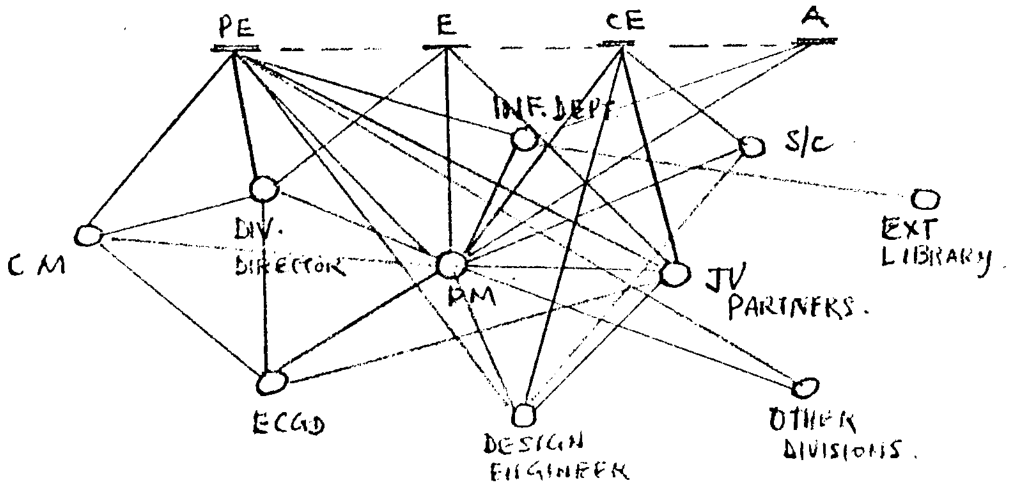


FIG E: VERY HIGH INTEGRATION INDEX

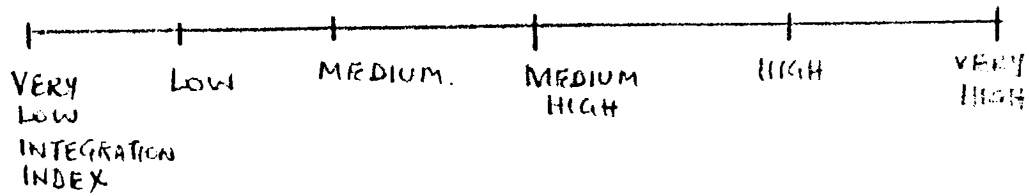


FIG F: GRADUATION POINTS ON INTEGRATION INDICES SCALE.

FIG. 6.4.1.4. (A, B, C, D, E, & F): INTEGRATION INDICES AND SCALING OF THE INDICIES.

TABLE 6.5.1

A. Advantages and disadvantages of sequential trade off and direct rating scale *

Advantages and disadvantages of the sequential trade-off.

- Advantages
  1) Reduces burden on the decision maker because only two attributes are considered at a time.
  2) Can be applied to a large number of attributes.
- Disadvantages
  1) Trade-off rates between any two attributes may vary.
  2) There is a need for the entire trade off process to be carried out separately for each outcome under consideration. Thus the number of outcomes to be evaluated must be small.
  3) Likelihood of unrealiability entering in each stage of the process.
  4) Indifference relations are difficult to assess.
  5) Time consuming.

B. Advantages and disadvantages of direct rating scale.

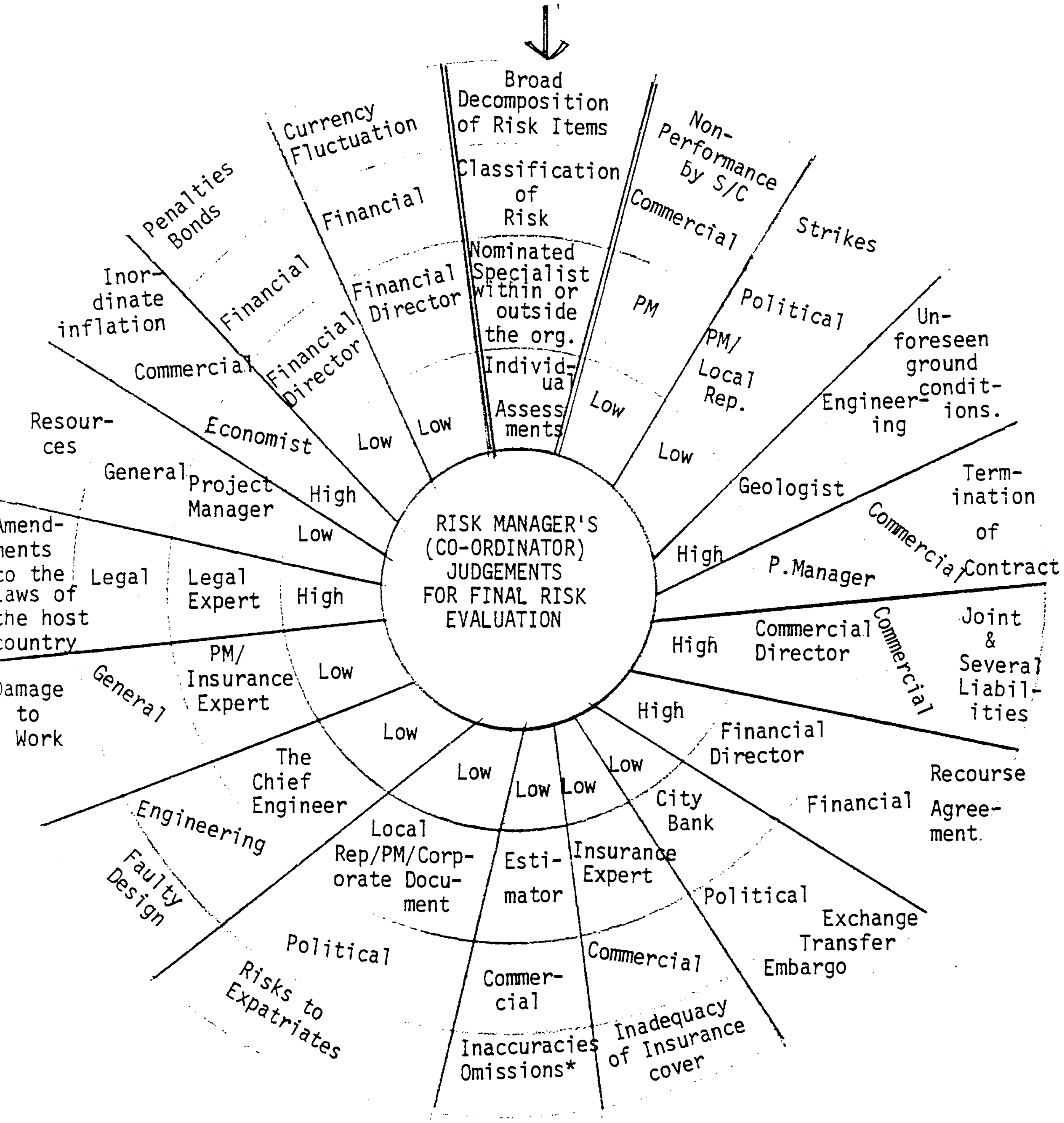
- Advantages.
  1) Can be applied to a large number of outcomes.
  2) Possibility of using bootstrapping technique once the basis of preferences and decisions of the decision maker are known.
  3) Applicable to a large number of attributes.
  4) To obtain the scaling factors, need to consider only two attributes at a time.
  5) Applicable to situations in which collective decisions are taken. (Organisational objectives by corporate policies).
- Disadvantages
  1) The decision makers preferences may not be consistent with the additivity assumptions.
  2) Scaling prcedures can be ad-hoc.

---

* See the following page.

* Referring to scaling techniques, Fischer (1973) states:

' These more teoretically attractive scaling techniques, suffer, however, from being much more difficult to implement. In practice, direct rating procedures have been and probably will continue to be much more widely used.'



* See Chart 6.6.2.2.3: 'Project Cost'

Fig. 6.6.2.2.1: Evaluation of Risk By Decomposition

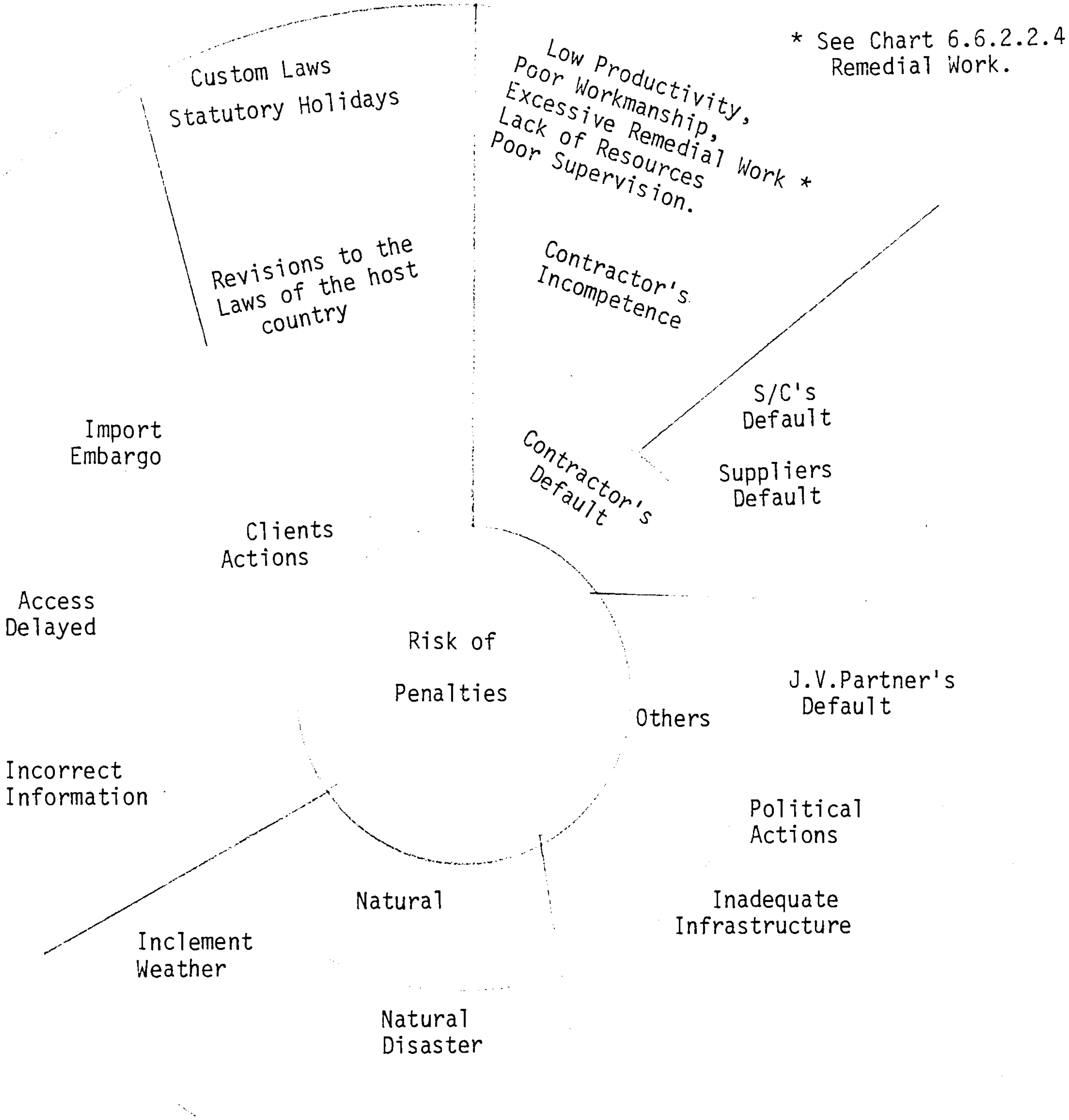


Fig. 6.6.2.2.2: Detail Decomposition of a Risk Item

CHART 6.6.2.2.3

Project Cost

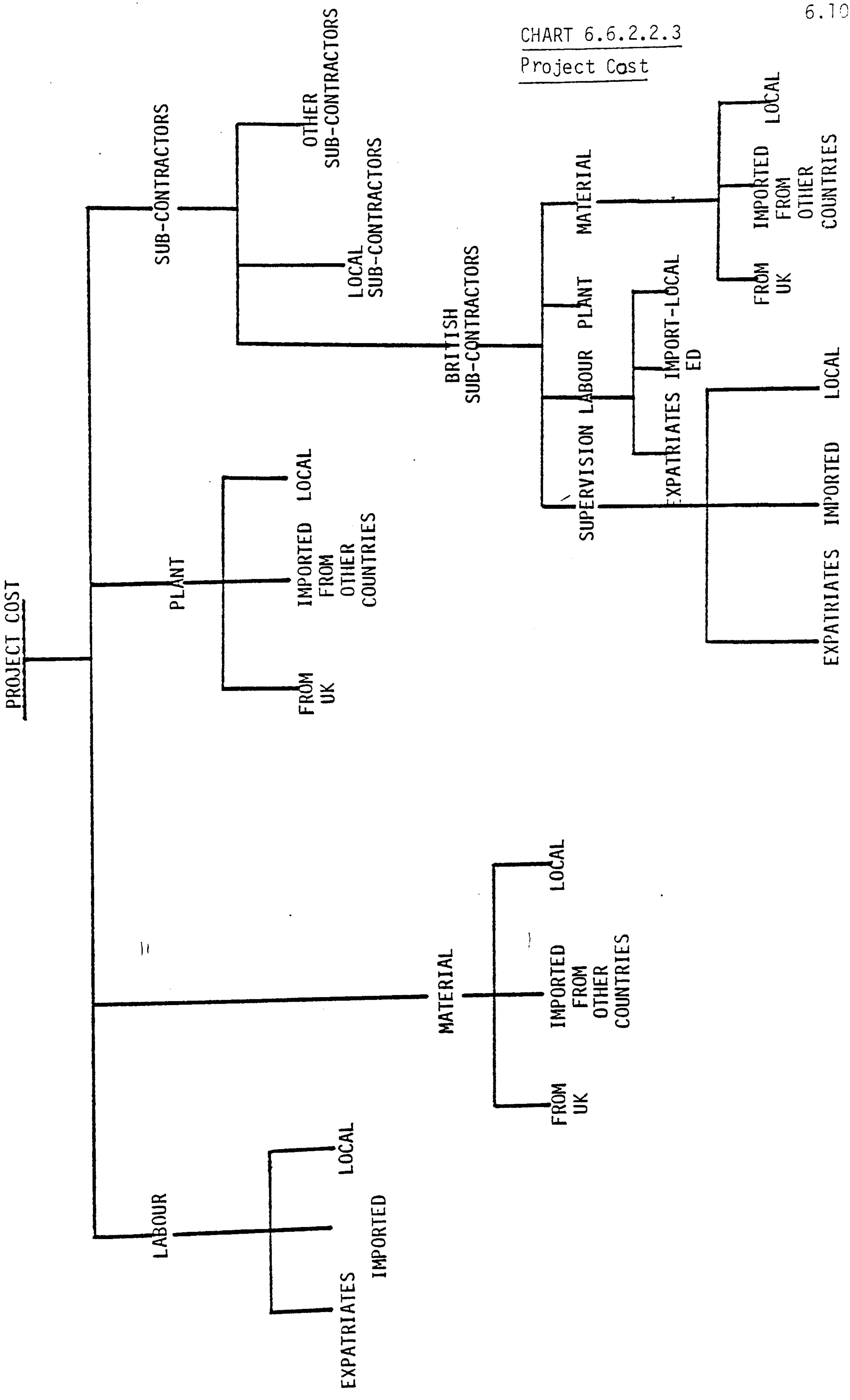


CHART 6.6.2.2.4

Remidial Work

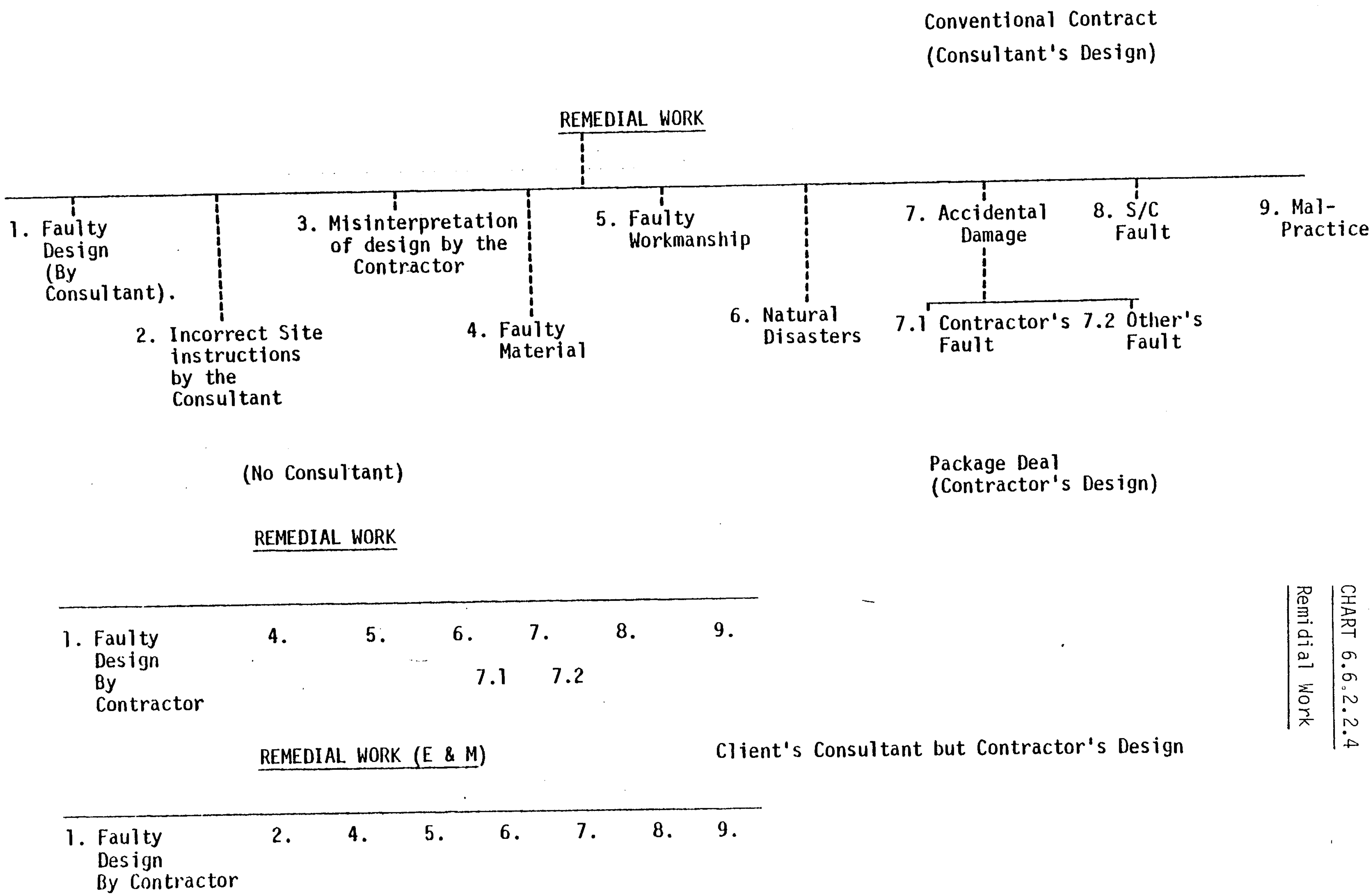


Table: 6.6.2.5.1:

Aspects of 'Decisions under risky situations' in Risk Analysis: Phases I to III including the Check List of risk items

Aspects of Decision Theory: Discussion reference in previous paragraphs in this chapter	Brief Description of the phase.
1. Decision behaviour in risky decisions - 'Importance beliefs'(views) 2. Hogarth's notion of complexity of task. 3. SDS's Hypotheses - Interaction of environmental complexity and the level of information processing. 4. Heuristic - 'Prepare a check list'. 5. Decisions in risky situations - structured approach 6. Information search and processing.	Check List of Risk Items: A comprehensive check list of risk items has been prepared from collection of views from different professions associated with the construction industry. They are listed in Internal Note No. 6.1 . Note For detailed views see the Appendices listed in Table 6.6.2.5. 3.
1. 'E' factors (Effort, energy etc) in motivation to carry out a comprehensive risk analysis. 2. Source of uncertainty. 3. Source of information. 4. Influence of uncertainty 5. Information search strategies 6. Information utilisation	Risk Analysis - Phase I The first phase identifies the risk items in overseas projects and the likely sources of uncertainty for each item, as shown in Example 6.6.2.5.1.

Contd...

Table 6.6.2.5.1: Contd...

1. Trying to turn conditions of uncertainty into risk situation. ('Assessment') 2. Assessment of uncertainty. 3. Categorisation. 4. Source of assessment. 5. Preliminary assessment. 6. Decomposition of risk items. 7. Processing uncertain knowledge. 8. 'Response from nominated experts' - Performance/ Arousal Concreteness/Abstractness.	Risk Analysis - Phase II Phase II assesses the risk in a broad sense. Each risk is classified and a nominated specialist (within or outside the organisation) is identified and nominated for his assessment of the risk. In some cases corporate documents are also referred to assist decision making. See example 6.6.2.5.1
1. Choice among risky alternatives. 2. Utility aspects. 3. Normative aspects. - 'Best' alternative. 4. Harmful environment for information processing - Noxity i.e. severity of adverse consequences of failure. 5. Maximisation of expected value.	Risk Analysis - Phase III Each risk item is evaluated in this phase. Some risk item may need detail and lengthly calculations. See Example 6.6.2.5.1

Table 6.6.2.5.2: Risk Control: Phase IV

Discussion reference in previous paragraphs in this chapter.	Brief description of the Phase.
1. Mitigation of risk. - Avoid & Transfer.	Phase IV: Risk Control This phase as illustrated in Example 6.6.2.5.1
2. Trade off - Eliminate.	following risk controlling factors.
3. Acceptable level of risk after mitigation. - Retain. (See Chart 6.6.2.5.3 for conscious & unconscious retention of risks).	Avoid, Transfer, Eliminate, Retain and Prevent. (In short 'ATERP'). See Chart 6.6.2.5.1 for an overview of risk control factors.
4. Experts' assessments - Prevent.	Also see Chart 6.6.2.5.2 for some likely actions under 'ATERP' factors.

CHART 6.6.2.5.1

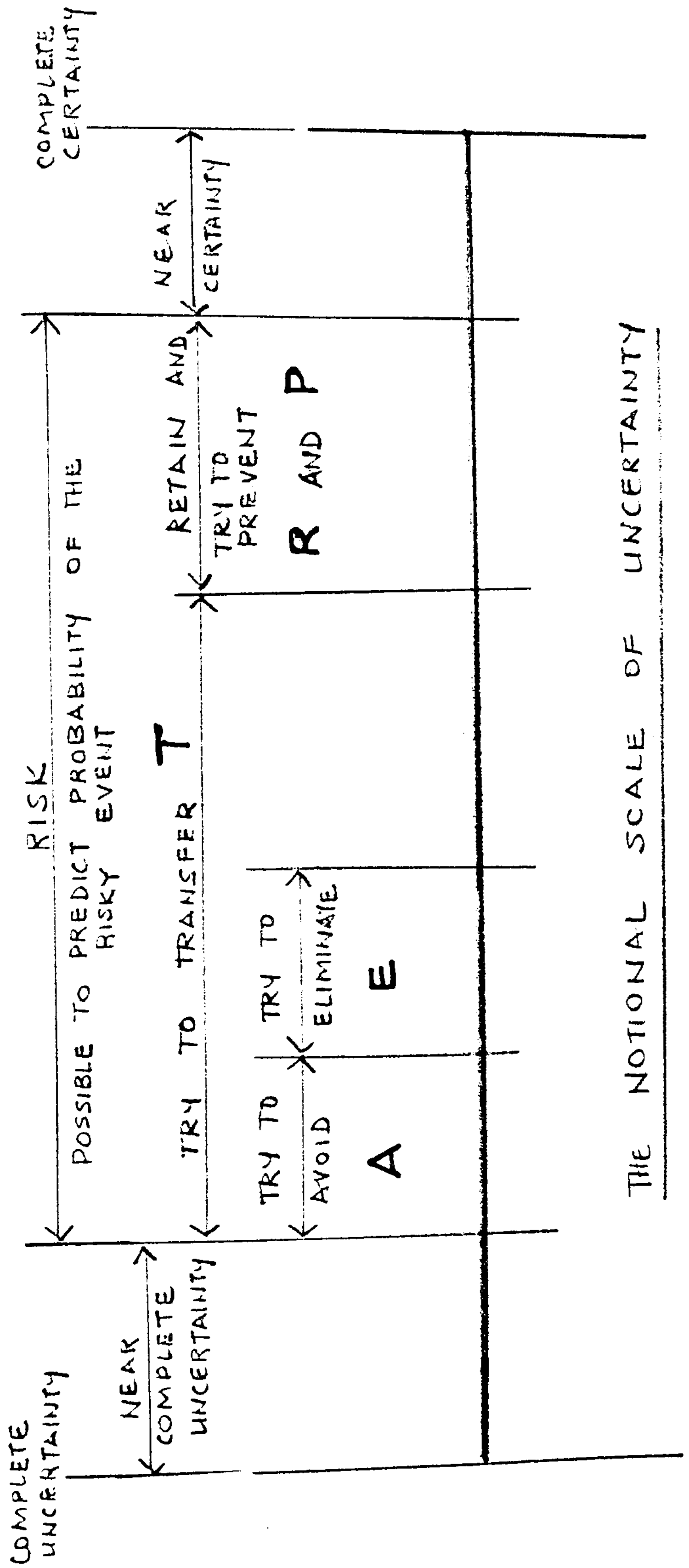
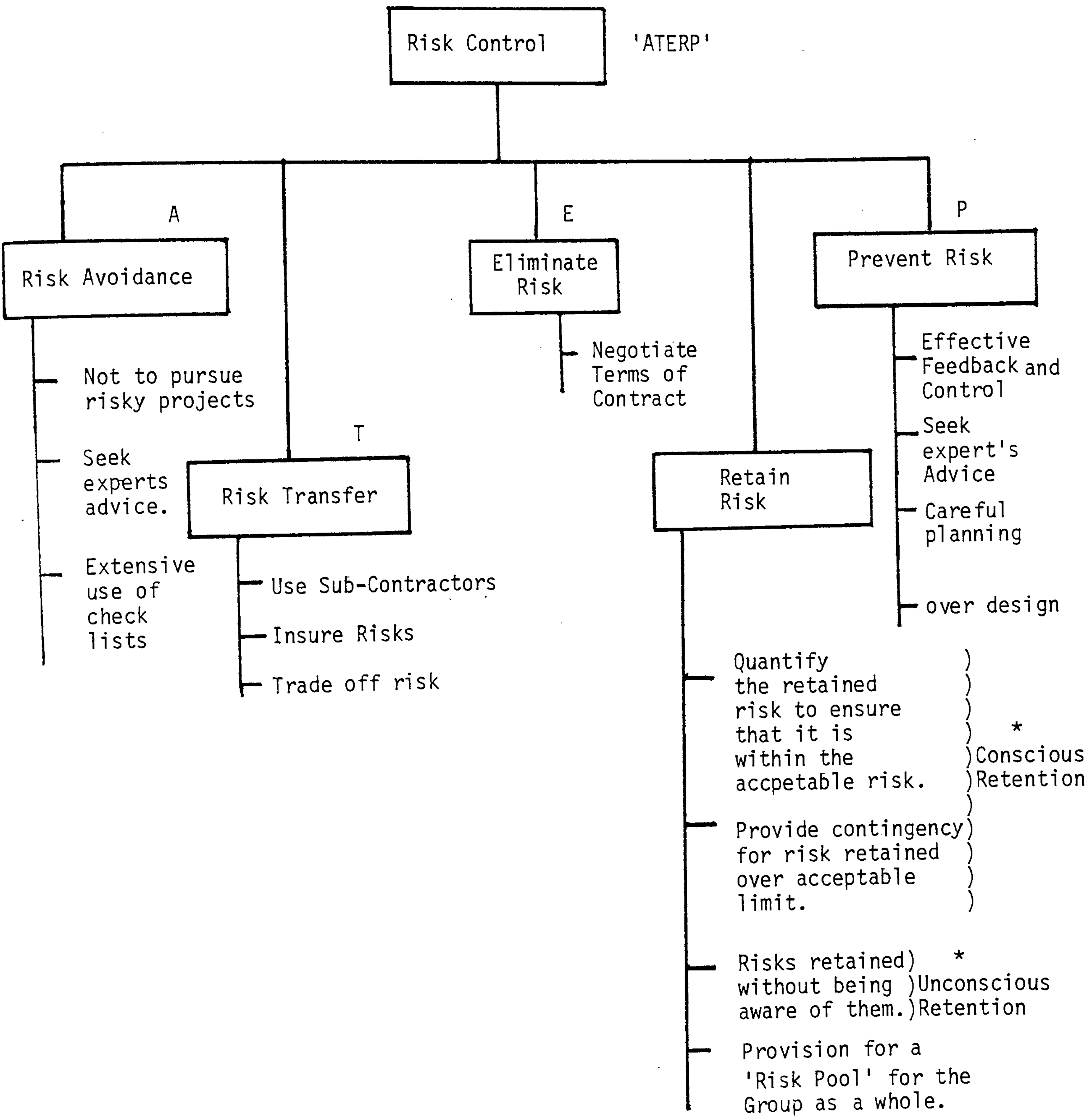


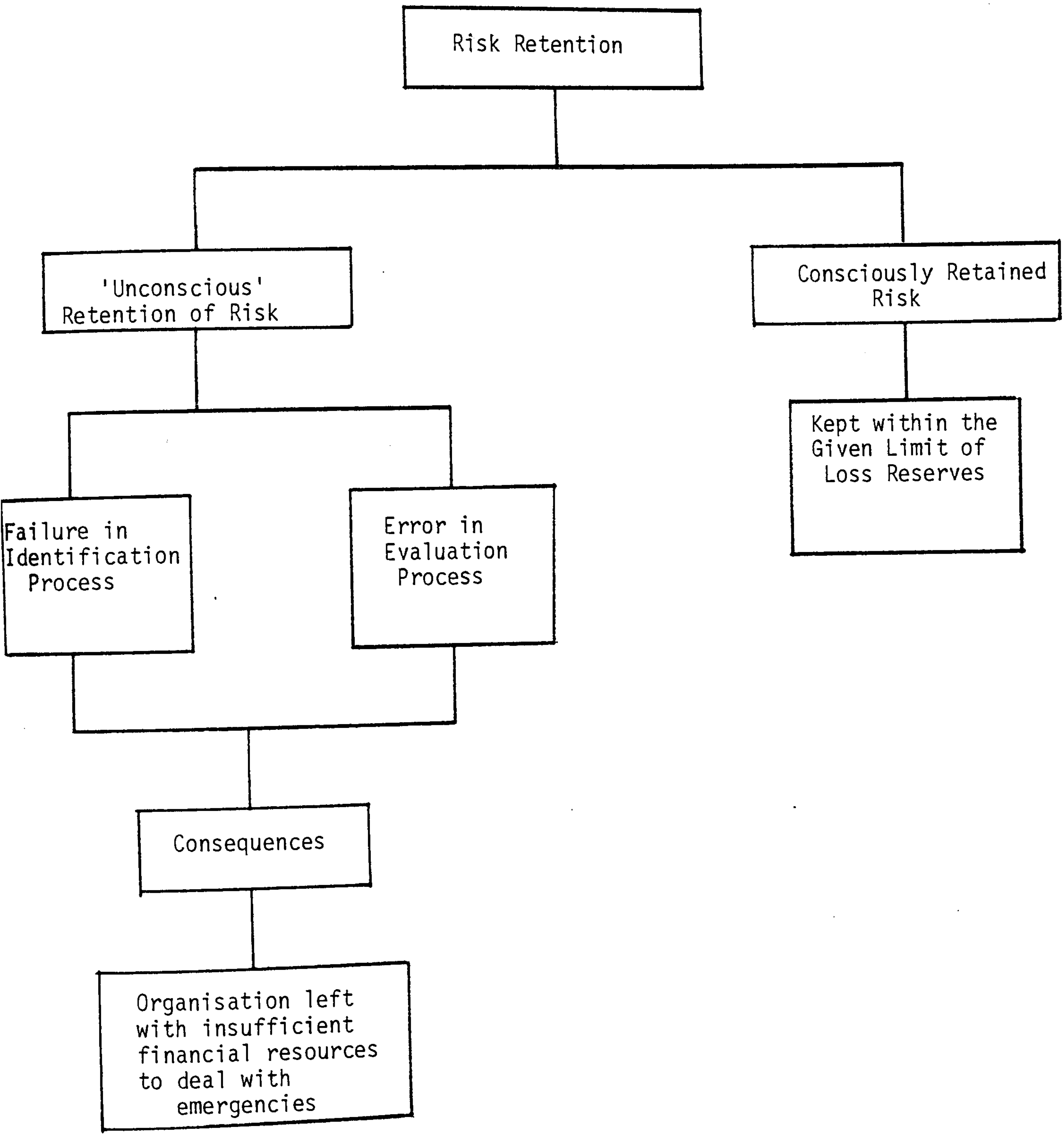
CHART 6.6.2.5.1 : RISK CONTROL ACTIONS. ('ATERP' ACTIONS)

Chart 6.6.2.5.2 Likely Actions under 'ATERP'



* See Chart 6.6.2.5.3 for conscious and unconscious retention of risks.

Chart 6.6.2.5.3: Risk Retention



Example: 6.6.2.5.1: Risk Analysis - Phase I (Hypothetical Project)

Identification of Risk Items and Sources of Uncertainty

Risk Ref No.	Source of Uncertainty	Risk Item
1.	Source of uncertainty:→	Interest on overdue payments may not be approved by the Client even though it is written in the contract. Uncertainty about the client's commercial attitude.
3.	Source of uncertainty:→	If penalties are imposed for delays in completion. Uncertainty about the meaning of the law. No track record.
7	Source of uncertainty:→	Risk of bankruptcy as a result of accepting the contract. Liquidity position.
14e	Source of uncertainty:→	Remedial work. Cost of remedial work.
33	Source of uncertainty:→	Termination of contract. i) The political relations between the two countries. ii) The Client/Contractor relationship. iii) The Client's financial position. iv) The political situation in the host country. v) Contractor's incompetance.

Risk Analysis - Phase II: Preliminary Assessment of Risk

Decomposition of Risk		Classification of Risk	Nominated Specialist	Individual Assessment	Comments
Item Ref	Brief Description				
1.	Loss of interest on overdue payments	Financial	PJK: (Com/Financial) Director	Evaluate the risk	
3.	If penalties are imposed for delays on completion	Commercial	CRT/SLP (Planning Engineer/ Commercial Engineer)	Key Dates 1.-Doubtful 2.- " 3.-Reasonable 4.- " 5.-Extremely doubtful.	For key dates 3 & 4 it is a justifiable risk but for key dates 1, 2 & 5 need to provide contingency.
14e.	Cost of damage to the work by	General	WJP (Tender Project Mgr & Insurance Department)	Evaluate the max. cost in each year of the contract for insurance purposes.	The Insurance Company to advise on the appropriate policy.
33.	Termination of contract.				Evaluate the risk at various stages of the contract.
	- Political relations	Political	WJP (T.P.Manager)	Isolated incidencies)	
	- Client/ Contractor relationship.	General	"	Experienced site manager - low risk	
	- Client's financial position.	Financial	PJS (Company Economist)	- sound - low risk	
	- Political situation in the host country.	Political	WJP	- stable - low risk	
	- Contractor's incompetence	General	WJP	Experienced team - low risk.	

Risk Analysis - Phase III: Risk Evaluation

Risk Item No.	Risk Evaluation	Amount At Risk
1.	**Data:** i) Contract period: 3 years ii) Contract value: £80M. Contractor's share: £40M. iii) Advance payment: £4M iv) Average delay in payment: 3 months v) Annual value of Contractor's progress = £12m (Ave). vi) Payment period - Quarterly vii) Value of quarterly certificate = £3M. viii) Cost of interest 10% p.a. **Calculations** Interest cost on 3 months delay in receiving quarterly progress payments: $\frac{£3M \times 10\%}{4} = £75,000$ Total number of quarterly certificates during the contract = 12 No. Total interest cost: 75,000 x 12 = £900,000	£900,000

Phase III

Risk Item No	Risk Evaluation	Amount At Risk
3.	Data Information from the Local Representative (See Note to file dated ....) suggests that there were some recent cases in the territory of fines imposed on contractors for delays in completion. Also there were isolated cases in the host country of penalties imposed on contractors. But there is no information about the Client's irrational behaviour during his three previous projects stretching back to 7 years. Nevertheless, he is likely to impose fines in 'fair' cases. The memo from ....(Project Manager, Project, in the host country) dated ...... suggests that there could be some problem of port congestion in a couple of years time. No other problems envisaged in completion of the project on time. From tender documents Ref...... pp........ Key Dates / Qtr / Penalties (£) 1 / 4 / 25,000 2 / 5 / 150,000 3 / 8 / 1,250,000 4 / 10 / 750,000 5 / 12 / 2,000,000 Total: 4,175,000 Comments To meet key dates 1, 2 and 5, capital goods have to be imported. There is only one port in the host country. Key Date 3: most likely to be achieved. Key Date 4: a reasonable chance of achieving. Contd...	4,175,000

Phase III (contd...)

Key Dates	Probabilities (after discussing with the above individuals) of achieving the key dates	Amount at Risk (£)
1	Low	25,000
2	Low	150,000
3	Very High	-
4	High	-
5	Very Low	2,000,000
	Total amount at risk through penalties	2,175,000

Phase III : Continued

Risk Item No	Risk Evaluation	Amount At Risk
7	<u>Data</u>: The host country is classified under Category C. Project Value = £80M Contractors assets £250 Ratio = $\frac{\text{Project value}}{\text{Contractor's assets}} = \frac{80}{250} = 0.32$ Corporate policy document for Category C, Ref .... dated .... states that the above ratio should not exceed 0.2 (preferably around 0.15) 250 x 0.15 = £37.5M 250 x 0.2 = £50M Need to reduce the share of the work. Say £40M. Ratio $\frac{40}{250}$ = 0.16 o.k. Meeting .... Notes dated ...... states that it is possible to secure a J.V. partner to carry out £40M. work. Because of the reduced share of work, risk of bankruptcy has been eliminated.	NIL

Phase III (contd..) [See Internal Note No. 6.1 for sources of uncertainty a) to e)]

14 Damage to Works NIL

a), b) and d) Transfer the risk by insuring for value of insurance see (e) below.

c) Sub-contractors have to provide the cover indemnifying the contractor. NIL

e) Likely cost of remedial work

Although the total share of the work is £40M, a damage from any of the sources a), b) and/or d) is not expected to reach this figure. (The site is not susceptible to any natural disaster).

Although it is a turnkey contract, completed work for which a progress payment is made, will be covered by the Employer's constructional works insurance policy.

The specification however requires the contractor to provide a cover against damage to work in progress (or to work completed but for which progress payment is not yet made).

Minutes of the meeting between the Project Manager, the Planning Engineer, The Accountant, The Estimator and the Company insurance officer held on .... states that the expected maximum value of work in progress at any given period will be around 20% of the expenditure except the first few quarters.

Phase III (Contd..)

Table 14 (e) shows the value of insurance required at various stages of contract. Fig.14 (e) shows the risk covered by the Employer & the Contractor's liability.

Liability between £0.2M to £8.0M. Increase the value of insurance as the work progresses. Minimum insurance £2M. (For Plant and Machinery and material in storage.)

Negotiate the amount of insurance required with the Insurance Company.

Phase III (contd..)

Table 14 (e)

Figs in £(M)

Qtr.	Rate of Expenditure				20% of Expenditure	Max. Liability In a Year	Value of Insurance Req'd Min. £2M
	Per Qtr.			Cum. (Value of Installed Work)			
	In the host country From 8(a)	Value of imported Items Installed	Total				
1	1		1	1	0.2)		
2	2		2	3	0.6)	1.6	2
3	2		2	5	1.0)		
4	1	2	3	8	1.6)		
5	2	5	7	15	3.0)		
6	1	5	6	21	4.2)	5.4	6
7	1	2	3	24	4.8)		
8	2		2	27	5.4)		
9	1		1	28	5.6)		
10	2		2	30	6.0)	6.6	7
11	2		2	32	6.4)		
12	1		1	33	6.6)		
13	2		2	35	7.0)		
14	2		2	37	7.4)	8.0	8
15	2		2	39	7.8)		
16	1		1	40	8.0)		

Phase III (contd..)

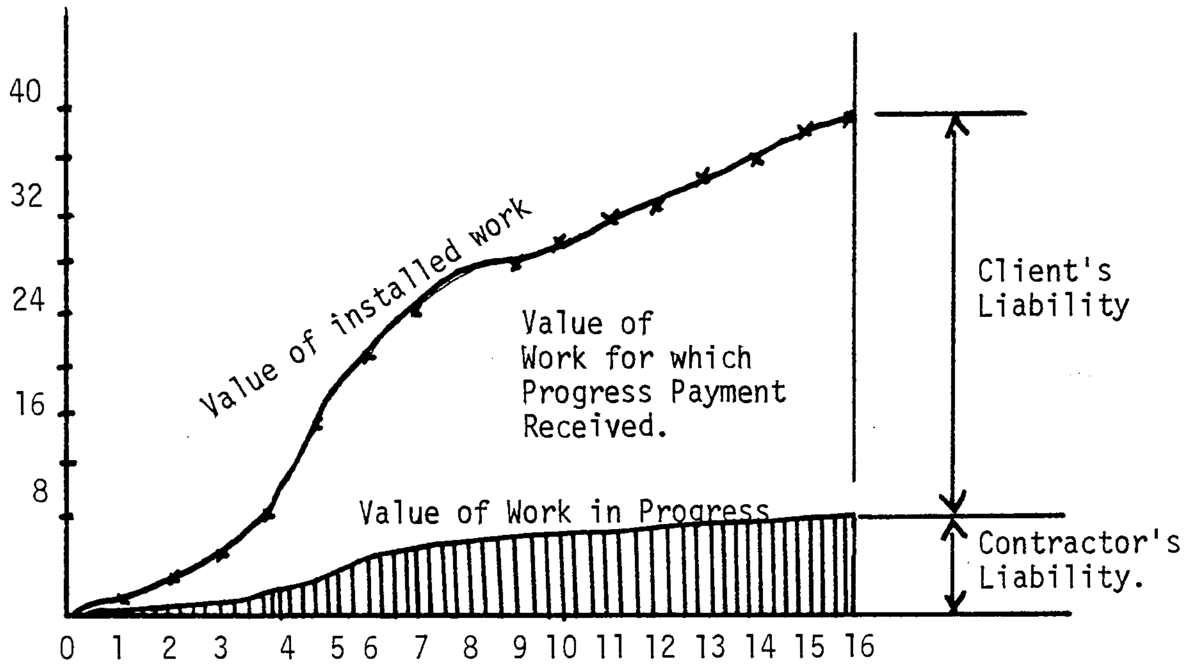


Fig. 14 (e)

Risk Item Ref: 33

Table 33: Termination of Contract - Losses at Various Stages

...r.	Rate of Expenditure			Payment Received			Contract Expenditure				Net Loss if contract is terminated but progress payment settled. 11 - 6	Net loss if contract is terminated a... progress pay... not settled. 11 - 5
	On Site	Impor-ted Goods	Cum. Total	Advance Payment	Progress Payment	Total	Own Exp.	Own Commit-ments	Payments to S/C	Total		
1	2	3	4	5	6	7	8	9	10	11	12	13
1	1.0		1.0	5.0	-	5.0	1.0	2.0	2.0	5.0	NIL	NIL
2	2.0		3.0		1.5	1.5	2.0	1.0		3.0	1.5	3.0
3	2.0		5.0		1.8	1.8	2.0	2.0		4.0	2.2	4.0
4	1.0	2.0	8.0		2.5	2.5	1.0	-	2.0	3.0	0.5	3.0
5	2.0	5.0	15.0		6.5	6.5	2.0	3.0	5.0	10.0	3.5	10.0
6	1.0	5.0	21.0		3.5	3.5	1.0	4.0	3.0	8.0	4.5	8.0
7	1.0	2.0	24.0		2.5	2.5	1.0	3.0	2.0	6.0	3.5	6.0
8	2.0	1.0	27.0		2.8	2.8	2.0	2.0	1.0	5.0	2.2	5.0
9	1.0		28.0		0.8	0.8	1.0	2.0		3.0	2.2	3.0
10.	2.0		30.0		1.8	1.8	2.0	2.0		4.0	2.2	4.0
11	2.0		32.0		1.8	1.8	2.0	2.0		4.0	2.2	4.0
12	1.0		33.0		0.9	0.9	1.0			1.0	0.1	1.0
13	2.0)		35.0		1.8	1.8	2.0			2.0	0.2	2.0
14	2.0)		37.0		1.8	1.8	2.0			2.0	0.2	2.0
15	2.0) *		39.0		1.8	1.8	2.0			2.0	0.2	2.0
16	1.0)		40.0		-	-	1.0			1.0	1.0	1.0

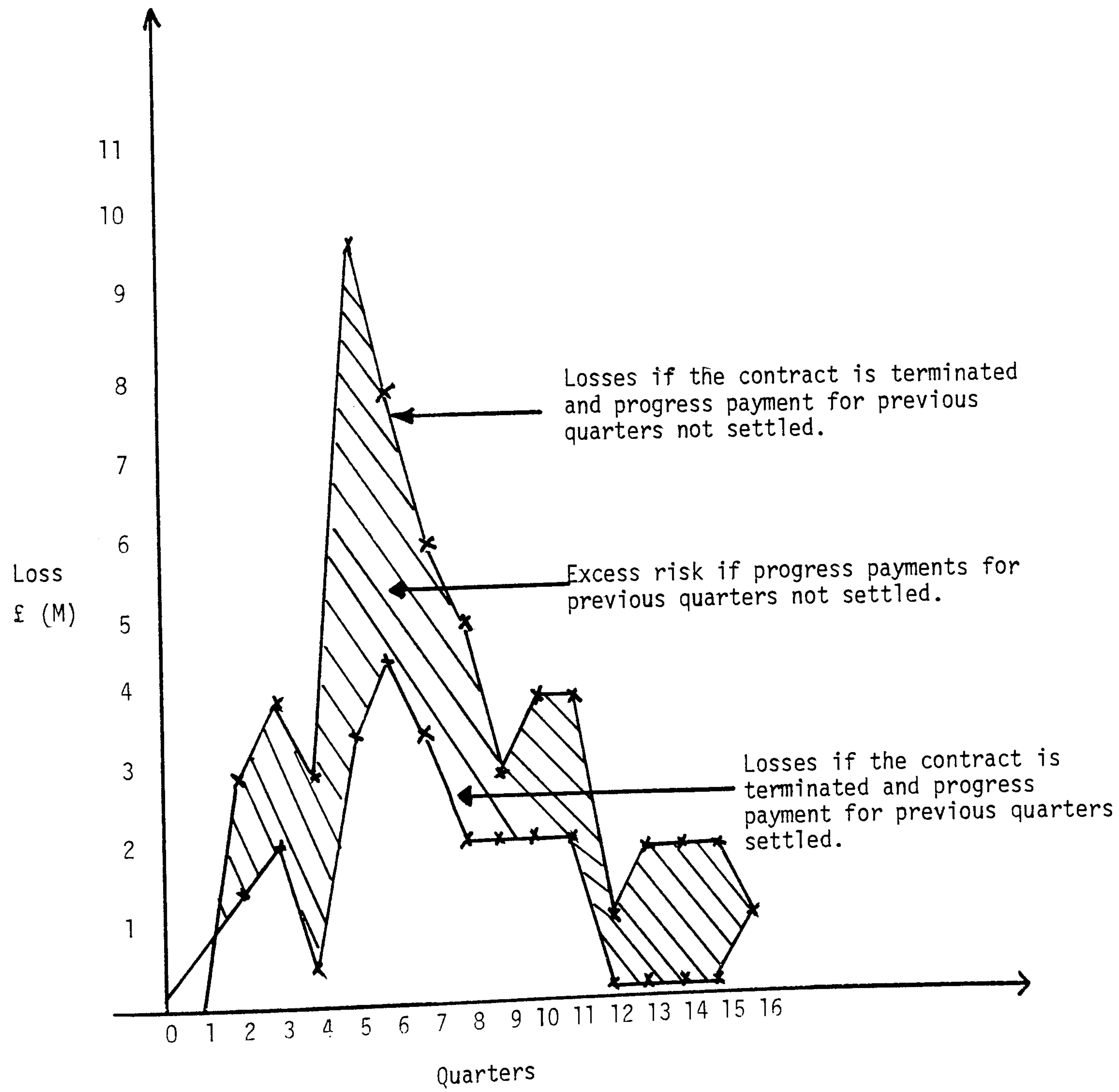
* Work requiring no maintenance e.g. Training, Delivery of Spares, etc.

See Fig. 33

Risk Item Ref: 33

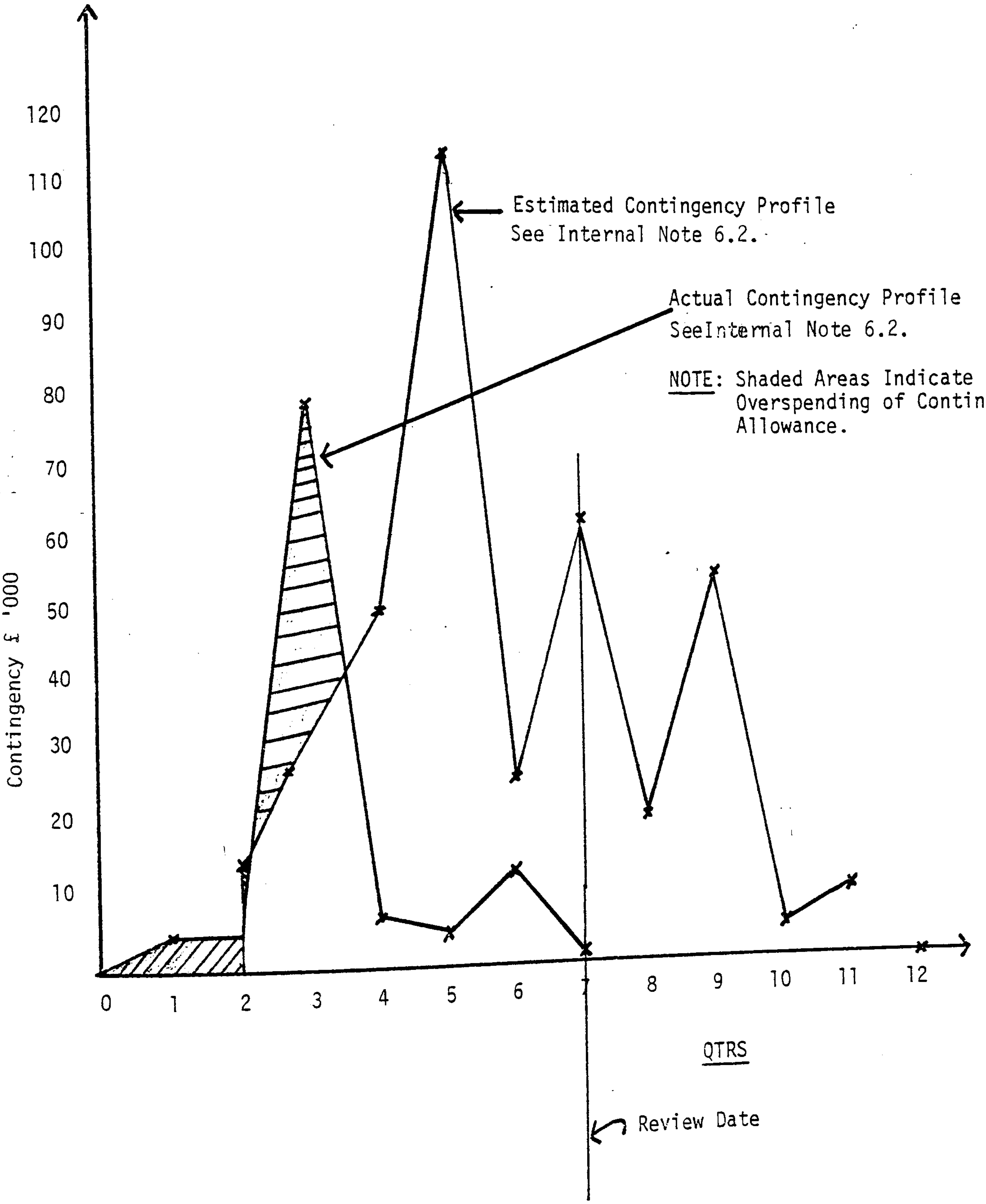
Fig. 33: Termination of Contract

-Losses at various stages



1	2	3	4	5	6 A	7 T	8 E	9 R	10 P	11	12	13	14	15
7	Risk of bankruptcy	£80M	Value of the share of the work reduced from £80 to £40M by J.V.	Low	✓					The risk level within the limit specified by the corporate document ..... No risk of bankruptcy.				
14e	Cost of remedial work.	£8M (Max)	Insurance Policy	NIL	✓					No risk				
33	Termination of Contract	£10M (Max) See Fig.33	Progress payment for previous quarter not settled.	If the present political inciden-cies take a bad turn then HIGH RISK				✓		Prevention Provide for intelligence service to keep up to date with the political situation.		See Fig. 33.		

FIG 6.6.2.5.1. CONTINGENCY PROFILES - ESTIMATED & ACTUALLY USED



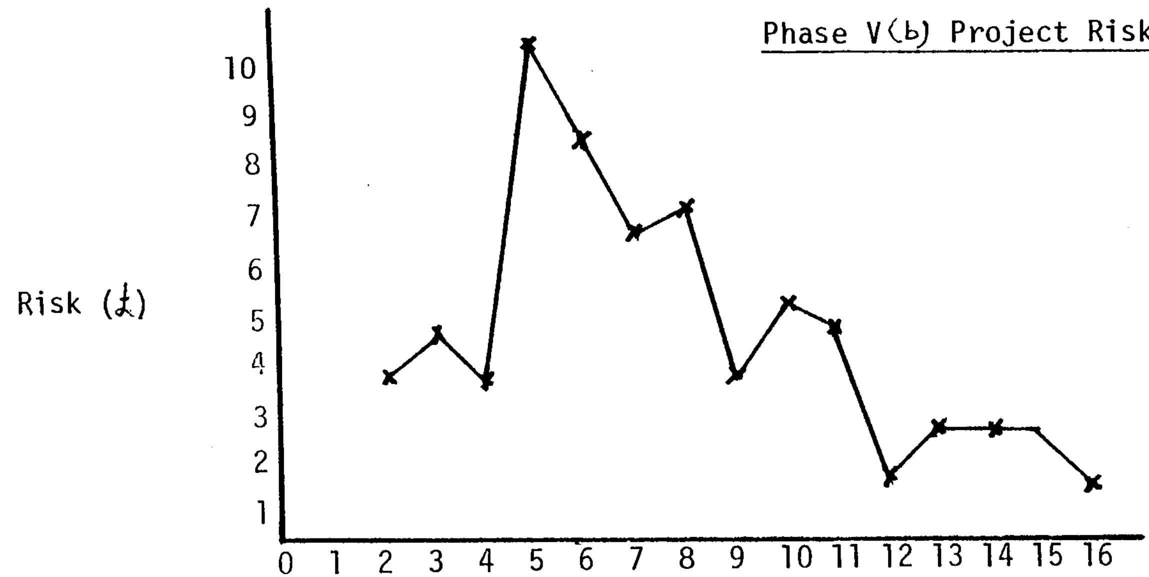
For Reference Tables see Internal Note No. 6.2.

Risk Analysis: Phases V (a and b)

Phase V(a) Risk Schedule

Risk Item	Estimated Timing of Risk (in Quarters) in £M – Contract Period: 1	2	3	4	5	6	7	8	9	10	11	12	Maintenance: 13	14	15	16	Maximum Risk Accepted For Each Item £M
1		0.0375	0.0375	0.0375	0.0375	0.0375	0.0375	0.0375	0.0375	0.0375	0.0375	0.0375	0.0375				0.45
3								1.25		0.75							2.0
7																	NIL
14e																	NIL
33		3.0	4.0	3.0	10.0	8.0	6.0	5.0	3.0	4.0	4.0	1.0	2.0	2.0	2.0	1.0	10 (Max)
Total		3.075	4.0375	3.0375	10.0375	8.0375	6.0375	6.2875	3.0375	4.7875	4.0375	1.0375	2.0375	2.0375	2.0	1.0	

Phase V(b) Project Risk Profile



Example 6.6.2.5.1 (Continued)

PHASE VI CHART 6.6.2.5.4. RISK PROFILE

PROJECT TITLE ....PROJECT

CLASSIFICATION OF TERRITORY: Category A (Ref - See the table at the bottom)
(Ref: Corporate Document
Dated..............)

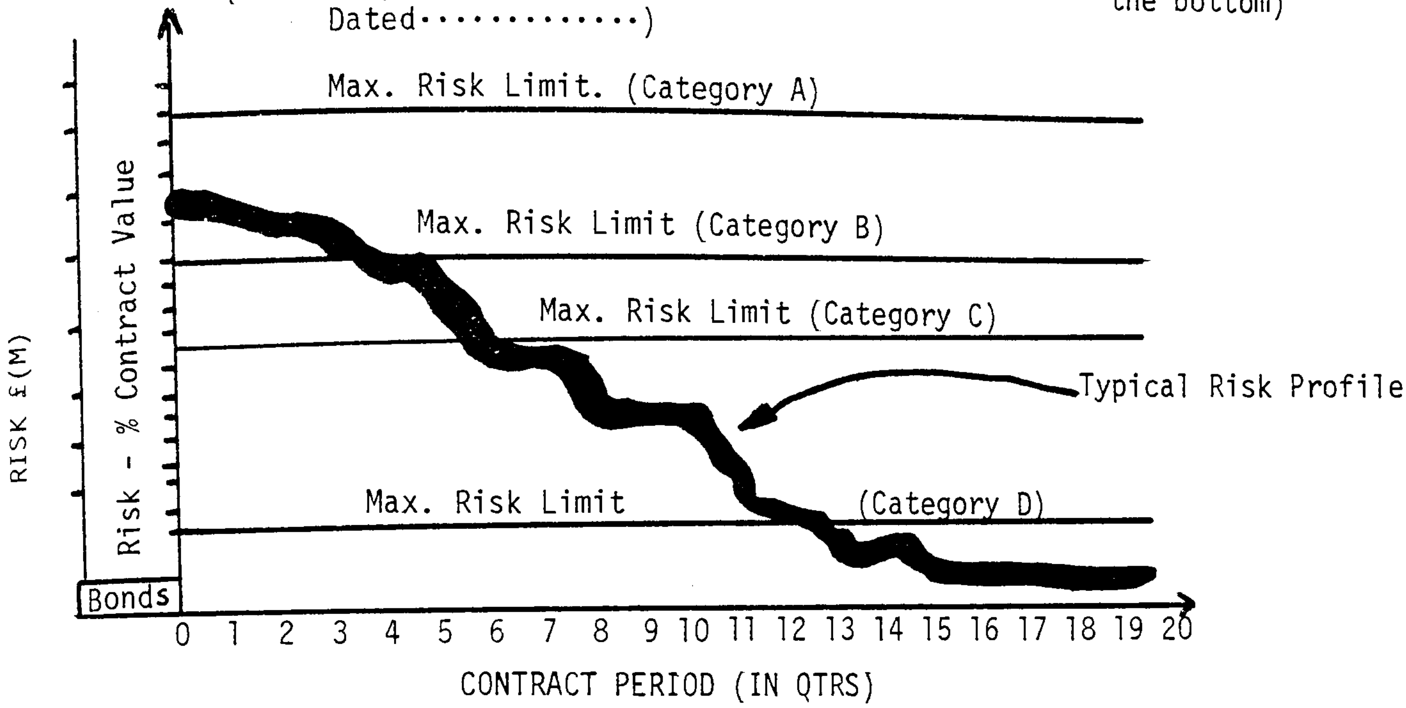


TABLE SHOWING CLASSIFICATION OF TERRITORIES

CATEGORY A	CATEGORY B	CATEGORY C	CATEGORY D
Saudi Arabia Philippines Kuwait Kenya	Jordan Bahrain Venezuela Equador India Nepal	Oman Qatar Brazil Mexico U A E Yemen Argentine Gambia	Iraq Egypt Algeria Sudan Syria Nigeria Zambia
Ratio = Project Value / Contractors Assets. not to exceed 0.3	Not to exceed 0.25	Not to exceed 0.2	Not to exceed 0.1

TABLE SHOWING CORPORATE RISK PROFILE (CONSTRUCTION PROJECTS) FIGS IN £(M)

PROJECT	ESTIMATED TIMING OF RISK (IN QTRS)												TOTAL
	1	2	3	4	5	6	7	8	9	10	11	12	
A	1.0	1.5	4.0	4.0	5.0	3.0	2.0						
B		0.5		6.0	9.0	12.0	12.0	7.0	8.0	6.0	4.0	4.0	
C	0.5	1.0	8.0	12.0	9.0	8.0	8.0	6.0	2.0	2.0			
D	0.1	0.1	0.5	0.8	0.9	1.3	1.5	0.8	0.6				
E						0.5	3.0	4.0	8.0	12.0	15.0	15.0	
TOTAL													

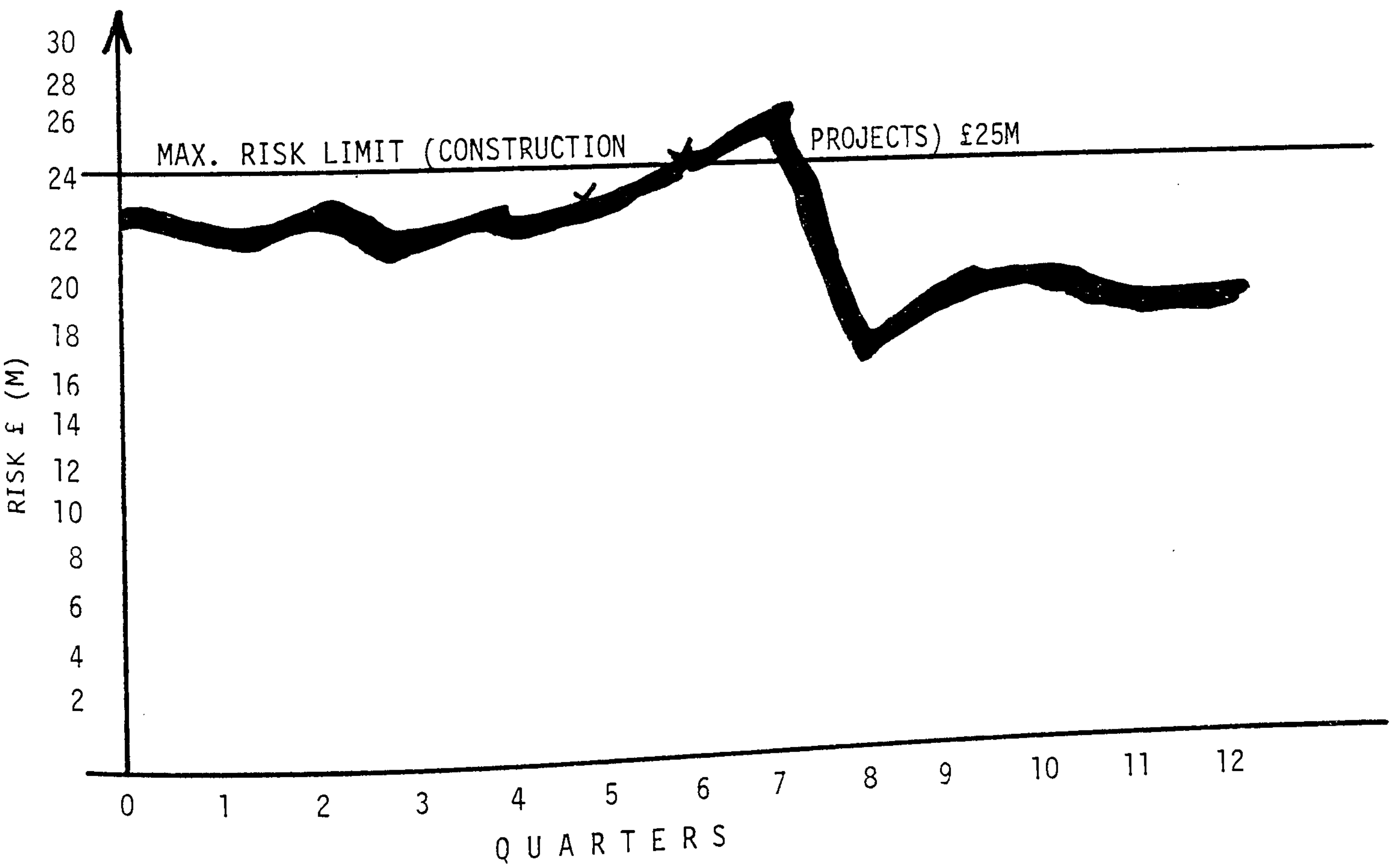


CHART: 6.6.2.5.5: Corporate Risk Profile (Construction projects in tendering stage).

EXAMPLE 6.6.2.5.1 Contd.

CHART: 6.6.2.5.6

PHASE VIII

TABLE SHOWING CORPORATE MASTER RISK PROFILE

RISK IN	ESTIMATED TIMING OF RISK (IN QUARTERS)												TOTAL
	1	2	3	4	5	6	7	8	9	10	11	12	
Construction	1.6	3.1	12.5	22.8	23.9	24.8	26.5	17.8	18.6	20.0	19.0	19.0	
Property													
Plant Hire													
Pre-Cast Fabrication													
Lending													
Investment													
Manufacture													
TOTAL													

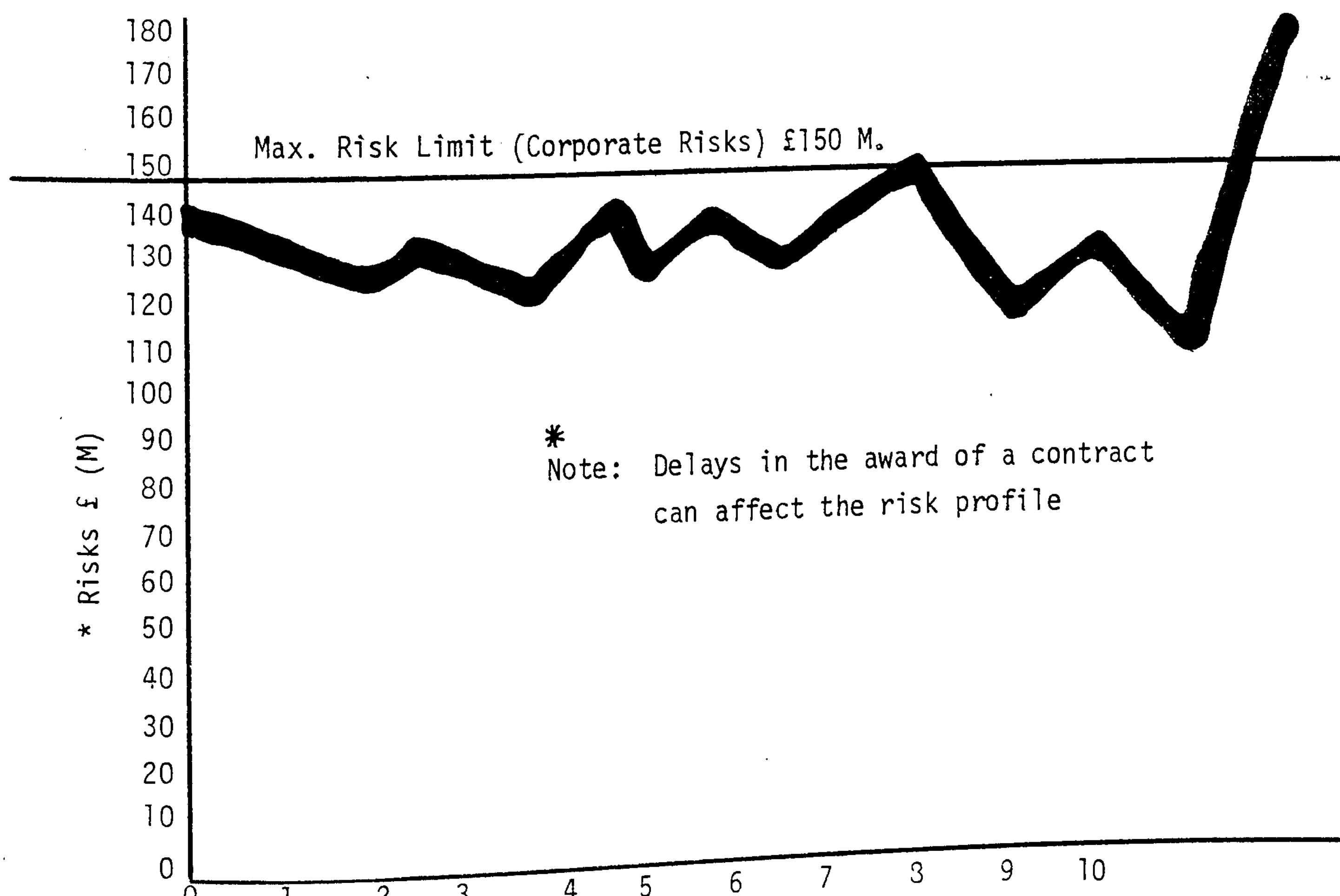


Table: 6.6.2.5.3: Different Professions' views and case studies on risk

List of Appendices

Appendix	Title	Profesional view or case study or chart
A6 .6. 1	FIDIC Clauses on payment, the final account and damages or penalties	A Quantity Surveyor's view
A6 .6. 2	Violation of Government Regulations - A penalty risk for Contractors	A case study
A6 .6. 3	Chicago deep tunnel job	A case study
A6 .6. 4	Risks from a Contractor's point of view	A British International Contractor's view
A6 .6. 5	Uncontrollable risks from a Contractor's point of view	A Contractor's view.
A6 .6. 6	Risk from a claims consultant's point of view	Claim's consultant's view
A6 .6. 7	Liabilities - Manufacturer's liability and owner negligence and engineering mistakes liability	Building Research Advisory Board (USA)'s view
A6 .6. 8	Product Liability	Manufacturer's point of view
A6 .6. 9	Transfer of risk by insuring	An insurance broker's point of view
A6 .6.10	Wrap-up insurance policy	A case study
A6 .6.11	Professional liability	An American Attorney's point of view
A6 .6.12	Effects of inflation on bond recourse-worthiness of a Contractor	An insurance specialist's view
A6 .6.13	A comparison between the sources available for obtaining guarantees (i.e. bonds)	A comparison study
A6 .6.14	Jumbo project liabilities	Recommendations from a Lawyer
A6 .6.15	Protection against certain risks and liabilities	An American insurance expert's view
A6 .6.16	Insuring certain political risks in the private market	An Investment Insurance Manager's view

Appendix	Title	Professional's view or case study or chart
A6.6.17	Approximate costs of basic insurance and bonds	A comparison between ECGD and Lloyds underwriters
A6.6.18	Jumbo projects: Contract liabilities check list of contract clauses requiring special attention	A Lawyer's view
A6.6.19	Risks	From a consulting engineer's point of view
A6.6.20	Assessment of contractor by ECGD	A chart
A6.6.21	Method of assessment by ECGD of its liability when supporting local currency bonds	A Management Accountant's view
A6.6.22	Risks	From a client's point of view
A6.6.23	A comparison between default (conditional) and on demand (unconditional) type bonds	A chart
A6.6.24	Inadequacy of the insurance cover provided	Construction Insurance Broker's point of view
A6.6.25	Over-expenditure and/or unrecoverable variations	A Contractor's view
A6.6.26	Interfacing risks, mishandling commercial and financial matters	A Contractor's view
A6.6.27	Recourse agreement	A Contractor's view
A6.6.28	Exchange risk	A Contractor's view
A6.6.29	Sub-Contractor's default or bankruptcy	A Contractor's view
A6.6.30	Back-to-back Sub-Contractor's terms	A Contractor's view
A6.6.31	Risk of non-payment	A Contractor's view
A6.6.32	Risk of a negative cash flow	A Contractor's view
A6.6.33	Legal action against damages	A Contractor's view
A6.6.34	Risk of under recovery under CPA Clause	A Contractor's view
A6.6.35	The main differences between the risk aspects of a turnkey contract and similar aspects of single discipline construction contracts	A Contractor's view

Table 6.6.2.5.3. Contd....

Appendix	Title	Professional's view or case study or chart
A6 .6. 36	An expert's view on risk minimisation.	An expert
A6 .6. 37	Cost of bonds	A case study
A6 .6. 38	Political risks	An Investment Insurance Manager's view.
A .6. 39	Number of consortium members.	A managing contractor's view
A .6. 40	Risks in large projects	A management consultant's view
A .6. 41	Excessive difference between bid prices	A contractor's view

Table 6.7.1.1

Decis
Level
Sht.1 of

Risk Items	Type of Decision	Decision Level	Decision to Avoid, Prevent, Transfer, Eliminate or Retain Risk	Observations in a particular project		
				Result of Decision	Likely effect on Tender success	
					Unfavourable	Favourable
2	3	4	5	6	7	8
Engineering design. A.1 Variation in design	Solving a specific problem	Low	To retain risk	To provide contingency	✓	
A.2 Consequence of faulty design	Project policy	Medium	To retain risk (but try to reduce it by special design checks.	To provide no contingency		✓
A.3 Technical uncertainty (due to incomplete knowledge or data).	Solving a specific problem	Low	To prevent risk	To over design	✓	
Liquidated damages	Project policy	Medium	To eliminate certain risks	Negotiate Dates		✓
			To retain certain risks (For key dates which are less uncertain to accomplish	To provide no contingency for certain items		✓
Variations	Project policy	Medium	To retain risk	To provide contingency	✓	
The completeness of supply	Solving a specific problem	Low	To avoid risk (by preparing a comprehensive check list reduce the risk)	To provide a small contingency		✓
Prolongation cost	Project policy	Medium	To retain risk	To provide no contingency		✓
Specialist work	Project policy	Medium	To transfer risk to sub-contractors by making sub-contracts back to back	To provide no contingency		✓

Table 6.7.1.1 Contd.
Decision Levels
Sheet 2 of 3

1	2	3	4	5	6	7	8
	Financial risks	Corporate policy	High	To retain risk	To provide no contingency. (Decision delayed until certain information about the client was obtained and found to be satisfactory).		✓
	Guarantees	Project policy	Medium	To avoid the risks of 'on-demand' type guarantees Eliminate risk by negotiations	To provide no contingency. (Although on-demand type bonds were specified after lengthy negotiations the client agreed to modify these to default type).		✓
			Medium	To transfer the risks of having to pay the g'tee monies in cases where the contractor is not at fault.	To provide no contingency.		✓
			Medium	To retain the risks of having to reimburse ECGD the g'tee monies in cases where the contractor is at fault.	To provide no contingency		

Table 6.7.1.1 Contd..
Decision Levels
Sheet 3 of 3

1	2	3	4	5	6	7	8
J	Cash Flows J.1 Due to lack of own performance. J.2 Due to lack of S/C performance. J.3 The client's failure to pay on time. J.4 Actual cost exceeding the estimated cost. J.5 Variations in dispute. J.6 Remedial work.				Not considered		
H	Political risks (Project in a politically stable territory)				Not considered		

FIGS. 6.7.1.1 and 6.7.1.2

DECISION LEVELS IN A PARTICULAR TENDERING SITUATION.

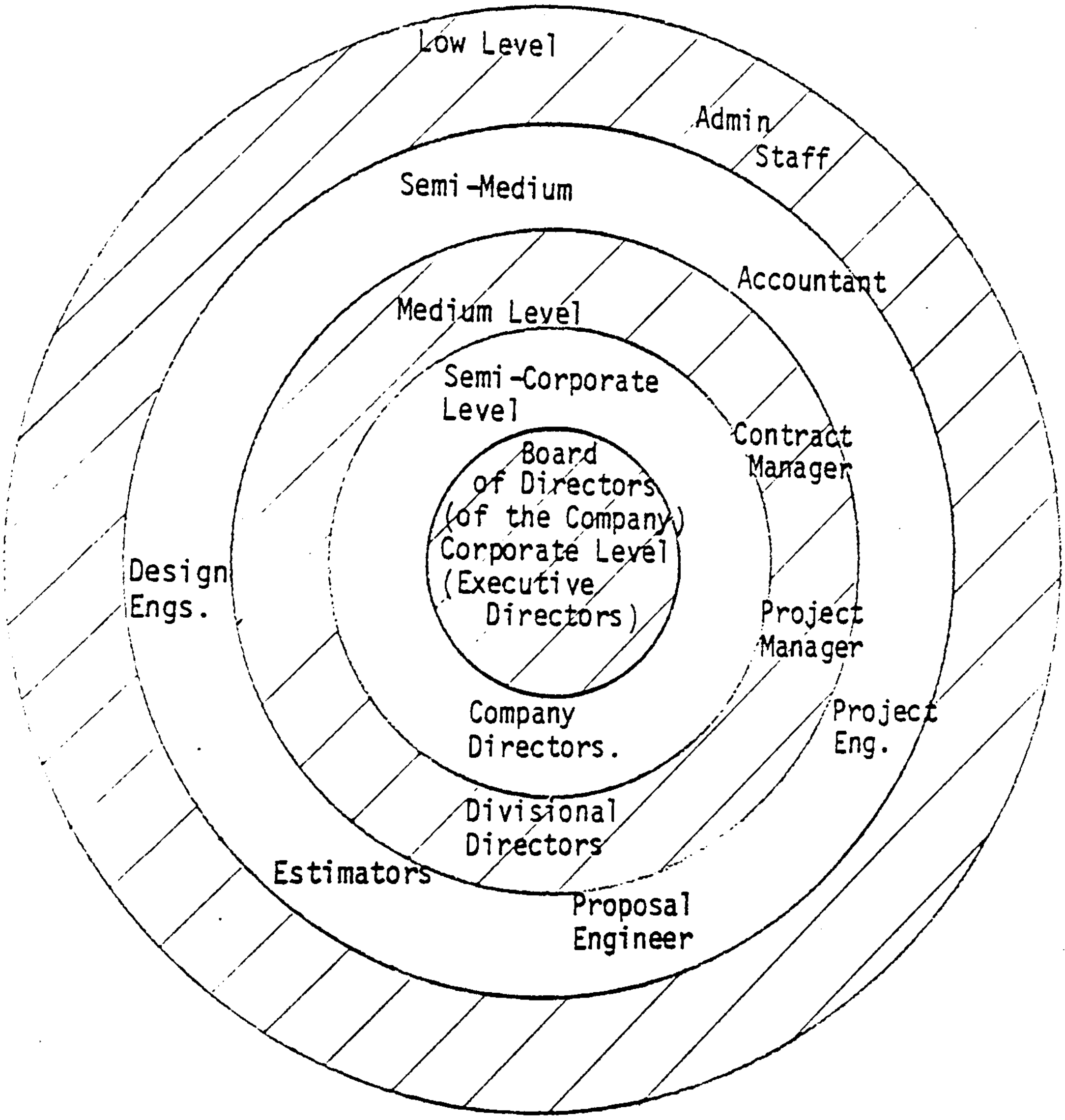


Fig 6.7.1·1

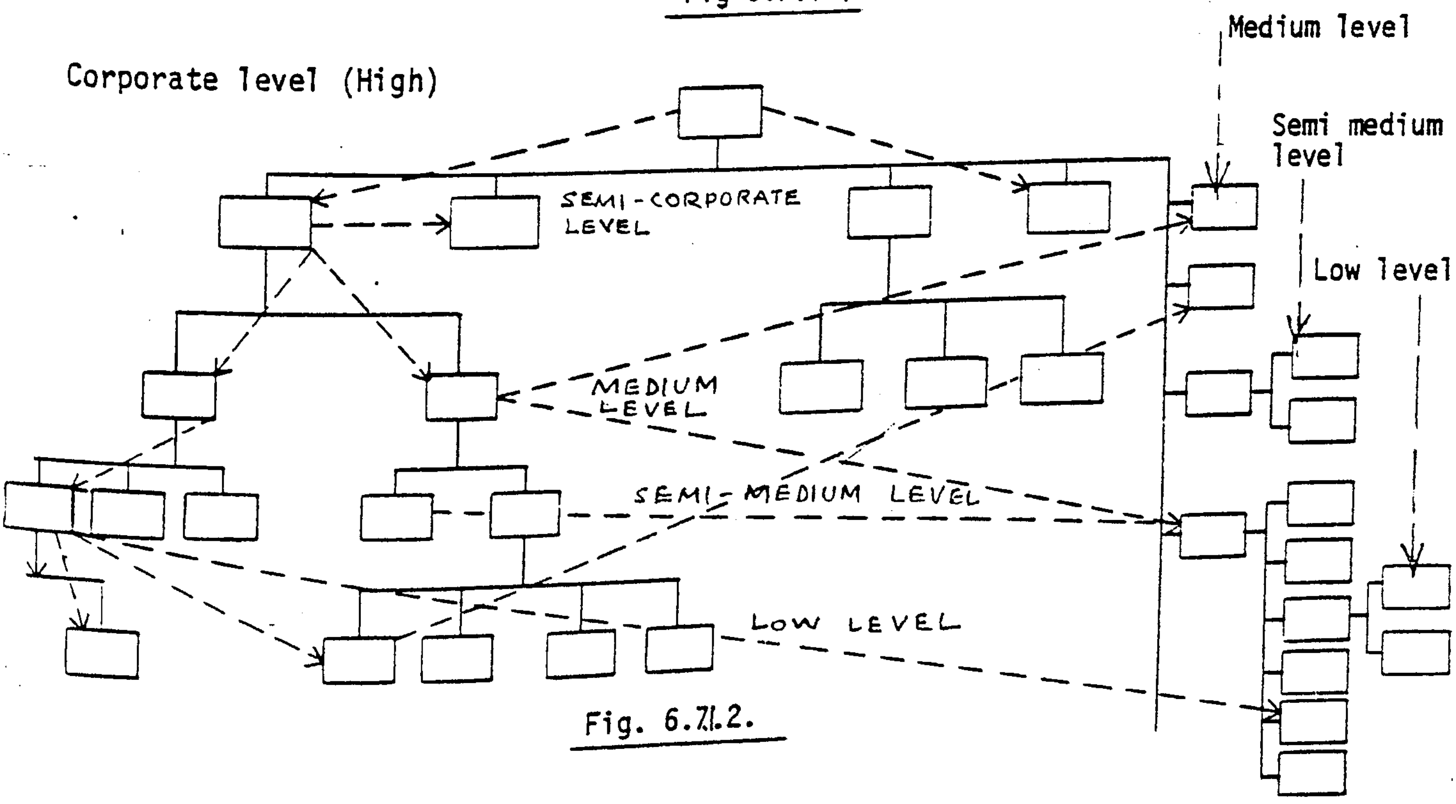


Fig. 6.7.1.2.

Table 6.7.2.1: Measures for risk avoidance

Constructive Measures

Actions to reduce and eliminate uncertainty

- Check list
- Value engineering
- Cash flow statement
- Network planning
- Detail scheduling
- Confirmation of prices from sub-contractors/ suppliers.
- Schedule of items likely to cause remedial work and its evaluation.
- Cost estimates based on reliable sources i.e. working drawings, local contractors, etc.
- Amount of liquidated damages based on careful evaluation of the client and the political situation in the host country.
- Insurance cover for the actual amount at risk. (For instance, in a telecommunication project telephone units may not be at risk hence the cost of telephone units could be deducted from the total amount at risk).
- Sensitivity analysis similar to hazard analysis by insurance companies.

Destructive Measures

Due to lack of action to reduce or eliminate uncertainty

- Overdesign
- A specific percentage of cost as allowance for omissions, remedial work, lower production, etc.
- A generous lump sum allowance for unforeseen ground conditions.
- An allowance in the tender price for full amount of liquidated damages.
- Overinsurance
- Risk evaluation without sensitivity analysis.

NOTE: The terms 'constructive' and 'destructive' are used in relation to bid success.

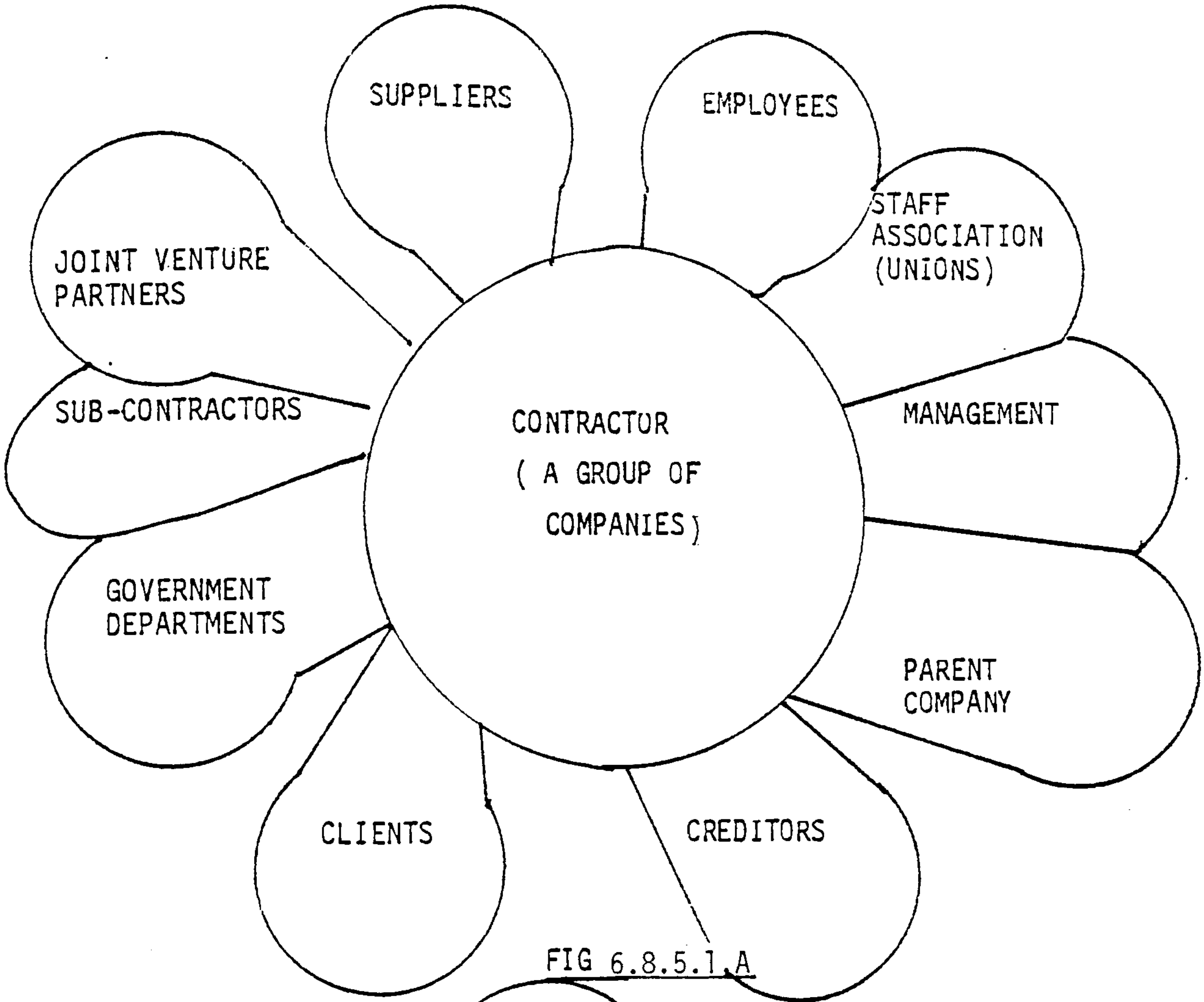


FIG 6.8.5.1.A

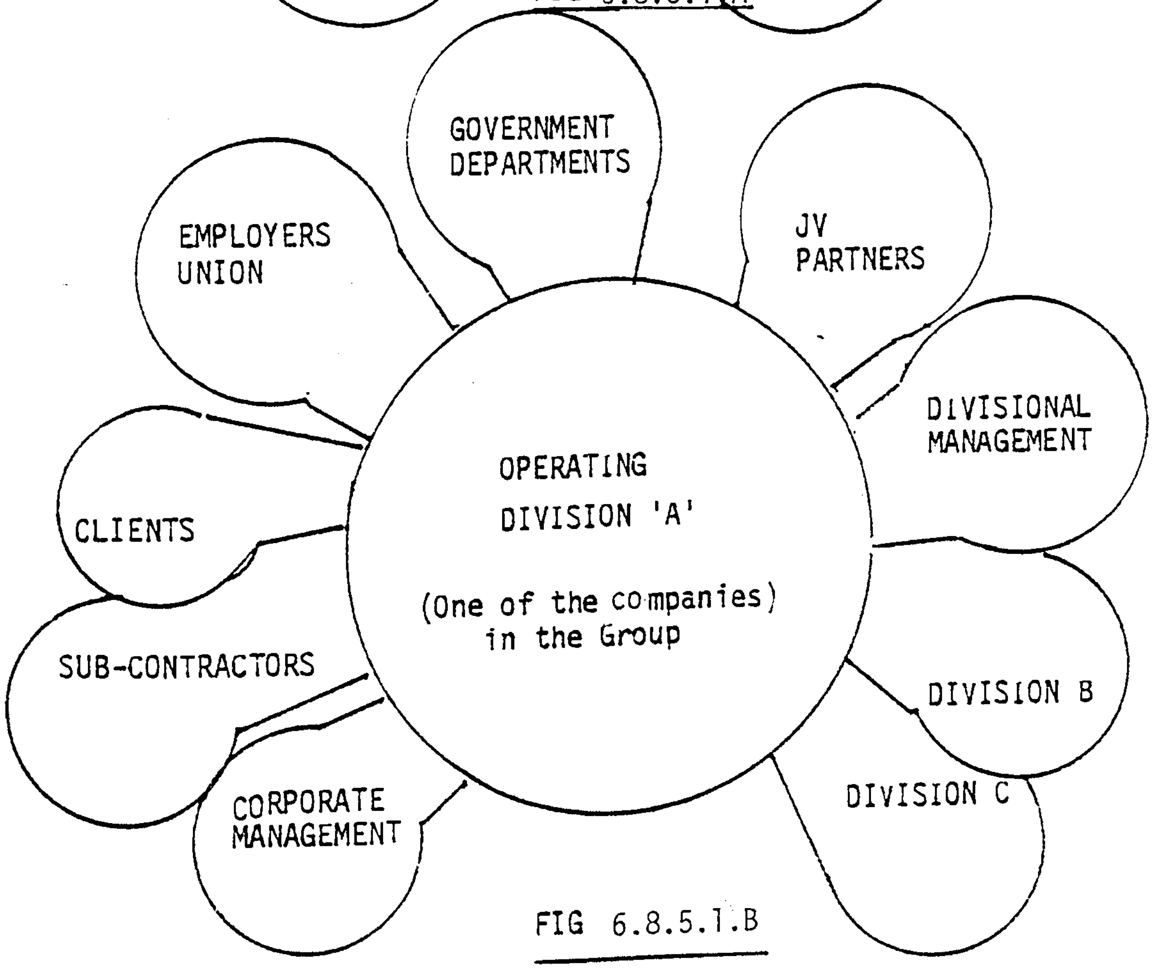


FIG 6.8.5.1.B

Table 6.8.5.1: Differences between the past and today's Firm

	A firm in the past	A firm in today's environment
1.	The role of the firm was essentially an economic one.	Maintain employment in satisfactory working conditions.
2.	The firm was privately owned	More public ownership
3.	The employees of the firm worked because they were economically compensated.	In addition to satisfy the financial needs, there are other needs such as identified by Maslow.
4.	The firm's strategies were based on pursuit of profit.	The conscious approach to obtain added value.
5.	The internal organisation of the firm was based on the concept of task rationalisation and maximum productivity.	The employer has moral and/or legal obligations to train employees to carry out specialist jobs.
6.	Information system in general was that the accountants reported to the owners the cost of each product and determined the profit.	In addition to the accounting source, other professional help is also sought when seeking cost information and deciding the level of profit.
7.	Method of absorbtion costing in determining the level of profit.	Method or marginal costing in determining the level of contribution from a product.
8.	Clients acted individually.	Clients form groups outside the firm and exert pressures to control prices, resources, time, etc.
9.	Decisions were dominated by a single objective, i.e. profit maximisation.	Need to consider multiple objectives of the firm in order to achieve satisfaction beyond the normal economic value.

Table 6.8.5.2: Some of the likely objectives of British Contractors

1. Improve order book.
2. Improve profit for the Group.
3. Improve turnover for the Group.
4. Improve competitiveness.
5. Create opportunities to utilise the Company's or the Group's resources.
6. Keep contract cost down.
7. Keep a high standard of workmanship (can improve image but can be uncompetitive).
8. Use only the British sub-contractors and suppliers (can be uncompetitive).
9. Complete contracts on time.
10. Avoid risks when tendering.
11. Keep the tendering cost down.
12. Improve the volume of tenders submitted.
13. Generate cash for the Group by following a positive cash flow policy.
14. Increase marketing activities.
15.* Maintain the Project Division (responsible for tendering on behalf of the Group) as a profit centre (can result in higher bid prices).
16. Operate in certain pre-selected territories only.
17. Seek projects with opportunities for further work in these territories.

* The tendering cost will increase as the number of tenders submitted increase. Although it can improve the chances of success, it may not necessarily mean a direct benefit to the Project Division. Nevertheless, the Group as a whole can benefit from the contracts secured by the Projects Division.

Table 6.8.5.3: Complimentary, Conflicting and Independent Objectives

Objectives (See Table for reference numbers).	Complimentary Objectives	Conflicting Objectives	Independent * Objectives
1	3,4,5,6,9,12 13,14,15	2,7,8,10,16,17	
2	1,3,6,9,10,11 13,14,15,17	4,5,7,8,12	
3	1,4,5,6,9,12, 14,17	2,7,8,10,11 13,15,16	
4	1,3,5,8,11,16 17	2,10,12,13,14 15	6,7,9
5	3,4,6,7,9	1,2,8,15,16	10,11,12,13 14,17
6	1,2,3,4,5,7	8,9,11,6	10,12,13,14 16,17
7	8,9,10,17	2,3,4,6	1,5,11,12,13 14,15,16
8	7,9,10,13	1,2,3,4	5,6,11,12,14 15,16,17
9	1,2,3,8,17		4,5,6,7,10,11 12,13,14,15,16
10	2,5,7,8,9,13 16,17	1,3	4,6,11,12,14 15
11	1,2,3,4	12,14,15	5,6,7,8,9,10 13,16,17
12	1,3,14	2,4,11,15	5,6,7,8,9,10, 13,16,17
13	6,9,10	1,3,7	2,4,5,8,11,12 14,15,16,17
14	1,2,3,5,12	11,15,16	4,6,7,8,9,10 13,17
15	9,10,11,13	1,2,3,4,12,14	5,6,7,8,16,17
16	2,4,6,9,10,13	1,3,5,14,17	7,8,11,12,15
17	1,2,3,4,6,7,9, 12	8,10,11,14,16	5,13,15

* For a method of checking independency of objectives, see MAUT applications in 6.9.

CHART 6.9.1.1: (Page 1 of 6)

GEN. REVIEW OF MULTI-ATTRIBUTE UTILITY THEORY (MAUT)

1.0 Types of MAU Models

There are two types of MAU Models.
DESCRIPTIVE and PRESCRIPTIVE.

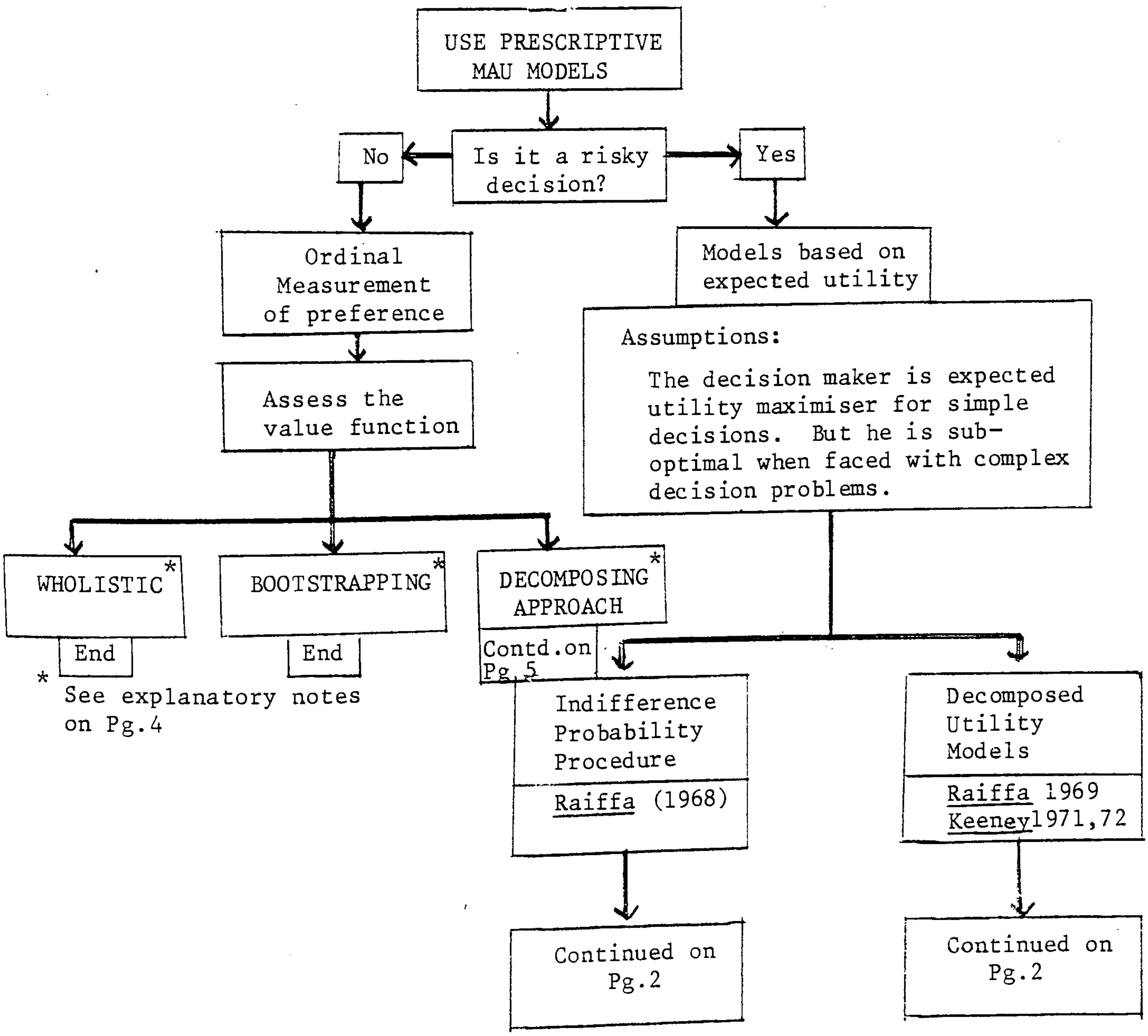
1.1 Descriptive MAU Models

These models explain and predict the trade-offs of the decision makers who are left to their own devices.

1.2 Prescriptive MAU Models

To assist decision makers in their trade-offs and improving their decisions.

2.0 Selection of Projects to Tender



(Continued from Page 1)

Indifference Probability Procedure

Any other outcome Xi — p → Best Outcome X_B

Any other outcome Xi — 1-p → Worst Outcome X_W

$U(Xi) = pU(B) + (1-p)\ U(Xw)$

Assign Values) $U(X_B) = 1$

$U(X_W) = 0$

$U(Xi) = p$

Disadvantage

i) If the outcomes are large it will be difficult to apply the procedure.

ii) Random errors can set in

END

Decomposed Utility Models

Obtain a decomposed riskless value function. Then transform it to reflect the DM's attitude towards risk

Assumptions

Both a riskless value function V and a risky utility function U must order outcomes according to the DM's preferences

Obtain a decomposed riskless value function. Then transform it to reflect the DM's attitude towards risk.

Assumptions

(As above)

(Contd. on Pg.3)

Directly decomposed the utility function

Assumptions

i. Preferences for outcomes are additive in conjoint measurement sense.

ii. Cardinal utility function U exists.

iii. Utility independence

Directly decompose the Utility function

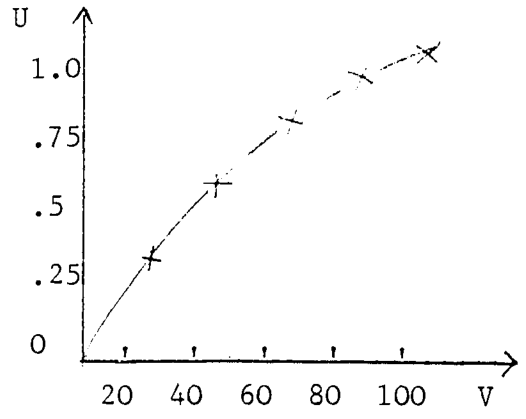
Assumptions

(As above)

(Contd. on Pg.3)

Contd. from Pg.2

Obtain a decomposed riskless value function. Then transform it.



R(V) Approach

U(x) = R (V (x))

Where R = Positive Monotone Transformer

END

Contd. from Pg.2

Directly decompose the utility function

If the above assumptions are satisfied then decompose M.A.U function into one of the following.

I) $U(x) = \sum_{i=1}^{n} KiUi\ (Xi)$

The additive utility function

II) $U(x) = \frac{1}{K}\prod_{i=1}^{n}\left[1+kkiUi(Xi)\right] - \frac{1}{K}$

$U(x)+\frac{1}{K} = \frac{1}{K}\prod_{i=1}^{n}(1+kkiUi(Xi))$

$1+KU(x) = \prod_{i=1}^{n}(1+kkiUi(Xi))$

The Multiplicative Utility function

K = Scaling Constant reflecting the type & degree of non-additivity present.

Xi = ith attribute

Ui = Utility function of Xi

Ki = Scaling constant reflecting the relative utility range associated with attribute Xi

U, Ki & Ui are scaled between 0 & 1,

$-1 \leq K \leq 0, \quad K > 0$

To obtain the scaling constant Ki, the d.m. must wholistically assess the utility of the outcome using Raiffa's Indifference Probability Procedure.

If $\sum_{i=1}^{n} Ki = 1$ use equation (I)

$$U(x) = \sum_{i=1}^{n} Ki\ Ui\ (Xi)$$

If $\sum_{i=1}^{n} Ki > 1$ use equation (II)

$$1 + KU(x) = \prod_{i=1}^{n}\left[1 + kkiUi\ (Xi)\right]$$

Disadvantage: It requires the DM to directly assess several wholistic multi-attribute utilities. Its usefulness is in doubt if there are a large number of attributes.

WHOLISTIC ASSESSMENT

Getting the decision maker to rank the entire set of alternatives intuitively (useful for small set of alternatives).

i) It is unreliable due to human element involved.

ii) Random errors due to boredom of assessment.

iii) As the number of alternatives and value attributes are increased, it produces a state of information overload.

BOOTSTRAPPING

Getting samples of the decision maker's decisions for a few alternatives and then applying the basis of his judgement to the remaining alternatives.

It relies on the fact that the decision maker knows what he is doing.

DECOMPOSING APPROACH

This is based upon the assumption that the decision maker is not well equipped (timewise or resourcewise) for the task of evaluating complex multi-dimensional outcomes.

It is based on researched fact (Miller 1956, Norman 1969) on human ability to process conceptional information e.g. people can process only 5 to 10 'chunks' of information at any one time. (In fact it is 7 ± 2 bits of information)

Value judgement is difficult when associated with multiple criteria. Decomposing procedure implies the quality of the evaluating process.

Contd. from Pg.1

DECOMPOSING APPROACH

Trade-off Judgement

Direct rating scale judgement

Initial Step

Both require the decision maker to specify the complete set of value attributes.

Raiffa(1969) Value hierarchy procedure for generating set of attributes.

1st Step

Specify complete range of outcomes with respect to each attribute

2nd Step

Define a procedure or rule to specify trade-off and rating scale techniques.

Sequential trade-off procedure

Raiffa(1968)(1969)

Assumptions:
i) Attributes are continuous.
ii) They are important and
iii) independent of each other.

Advantages: Reduces burden on the D.M. because only two attributes are considered at a time. Minimum constraints on the d.m's qualitative preferences.

Direct rating scale judgement

Procedure:

(i) Within each attribute, the decision maker should assign numerical values to all possible states of that attribute.

(ii) Assign weighting factors.

(iii) Aggregate the weight and values according to additive combination rule.

Advantages:

Easier to implement. Easy to apply for a large No. of outcomes. Can be applied to a large No. of attributes. Two attributes are considered at a time. Can be used for collective decisions.

Contd. from Pg.5

Sequential trade-off procedure

Disadvantages

Trade-off rates between any two attributes may vary as a function of the states and the other attributes.

The entire trade-off process must be separately carried out for each outcome under consideration. Unreliability enters in each stage of the process. If the errors are not independent serious biases would be present.

It is a time consuming process.

It is difficult to directly assess indifference relations.

End

Contd. from Pg.5

Direct Rating Scale judgement

Disadvantages

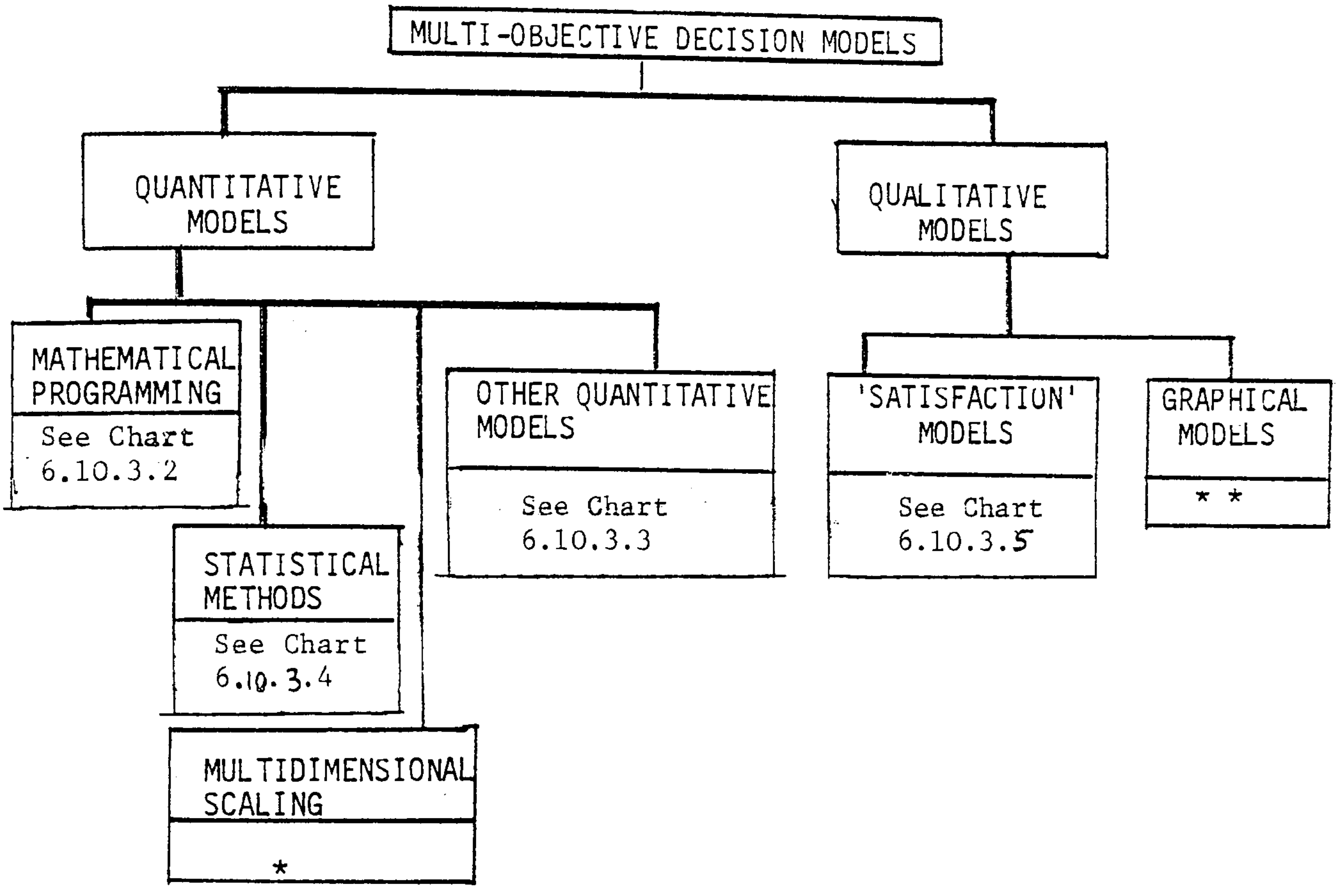
Require much more restrictive assumptions about the d.m's preferences.

Comment

Using the additive composition rule without first verifying the d.m's preferences consistant with the assumptions seems to be a questionable practice.

End

CHART 6.10.3.1: MULTI-OBJECTIVE DECISION MODELS



* Multidimensional scaling deals with ordering pairs of alternatives according to some objectives. They are then represented in a multidimensional space. The alternatives which are clustered together should in theory at least show equal preference. This method is used in marketing to determine what particular item of a product influences the most.

* * Graphical models are used to express different ways of achieving objectives by different alternatives.

CHART 6.10.3.2: MATHEMATICAL PROGRAMMING

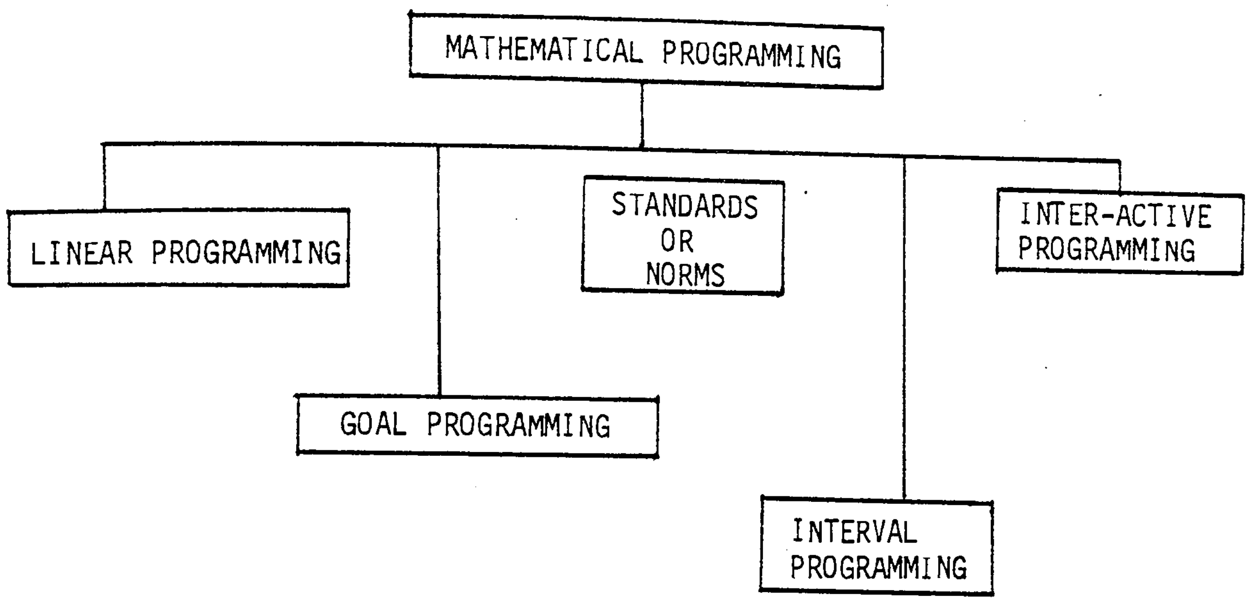


CHART 6.10.3.4: STATISTICAL METHODS

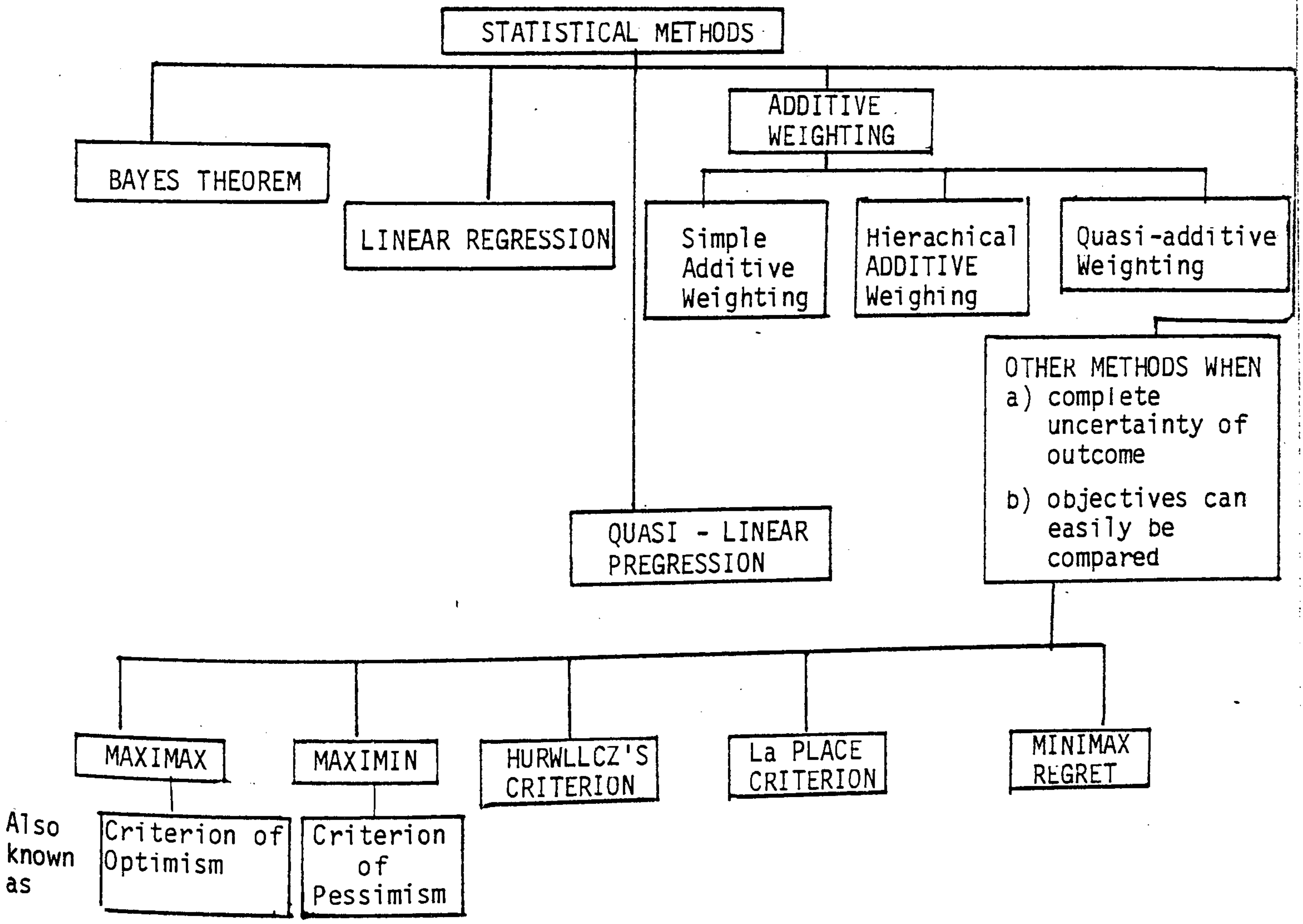


CHART 6.10.3.3: OTHER QUANTITATIVE METHODS

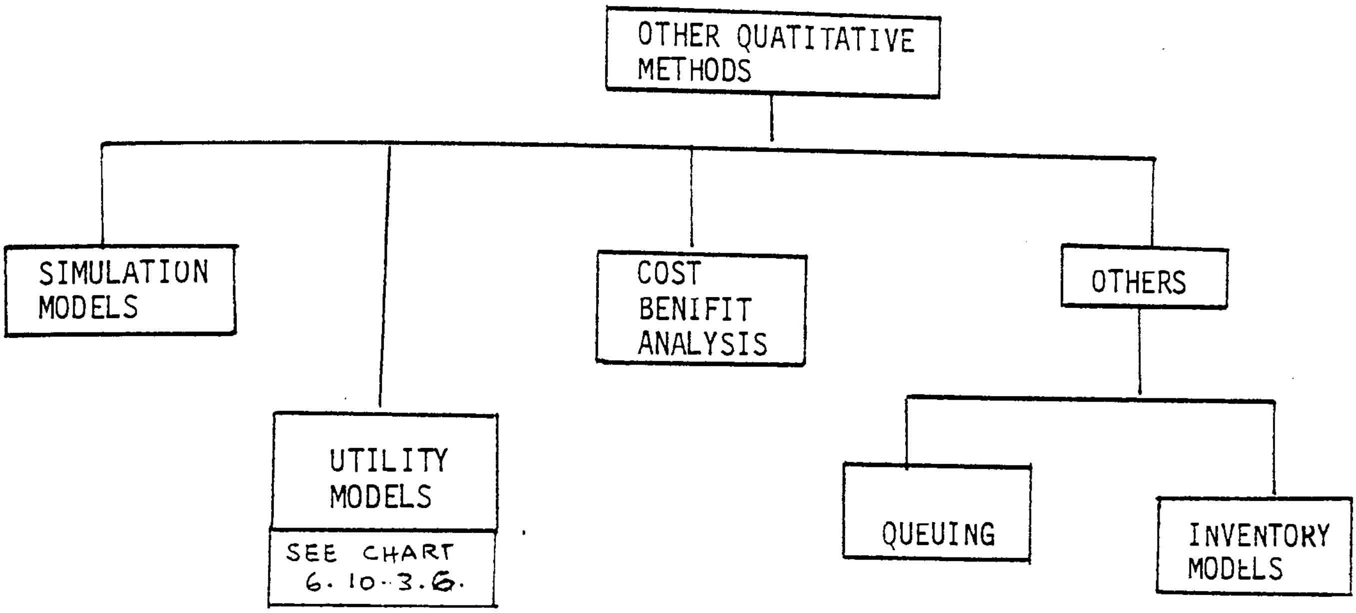


CHART 6.10.3.5: SATISFICING MODELS

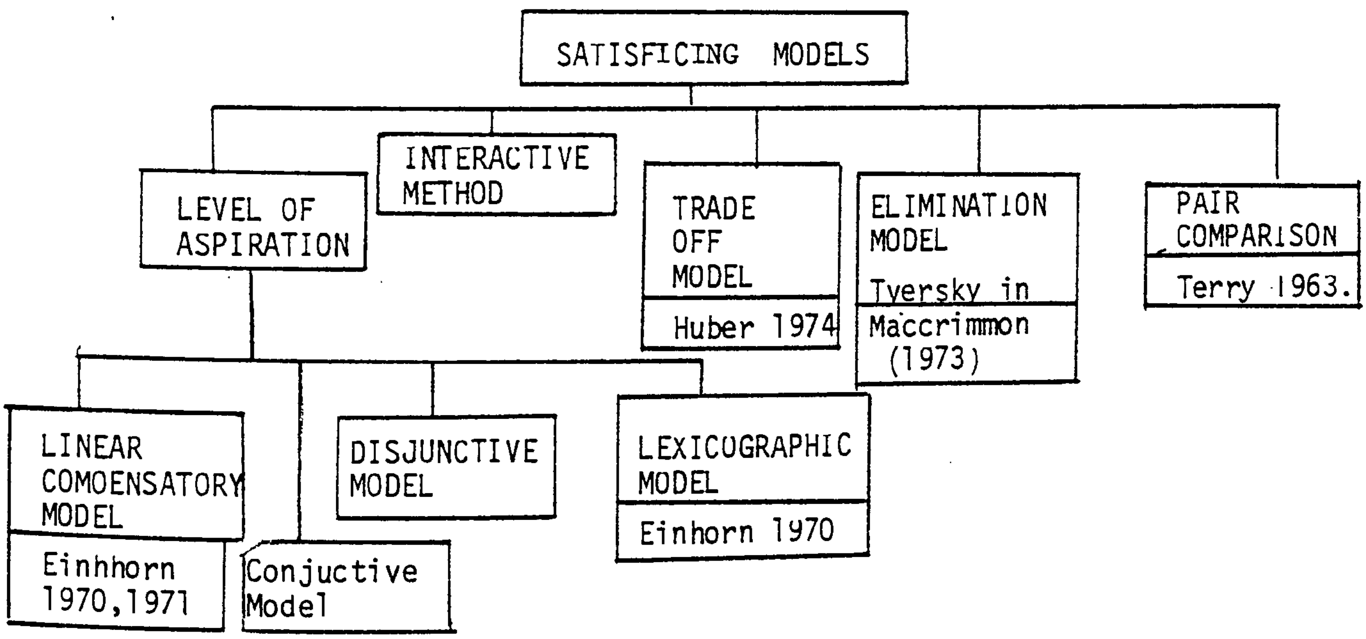
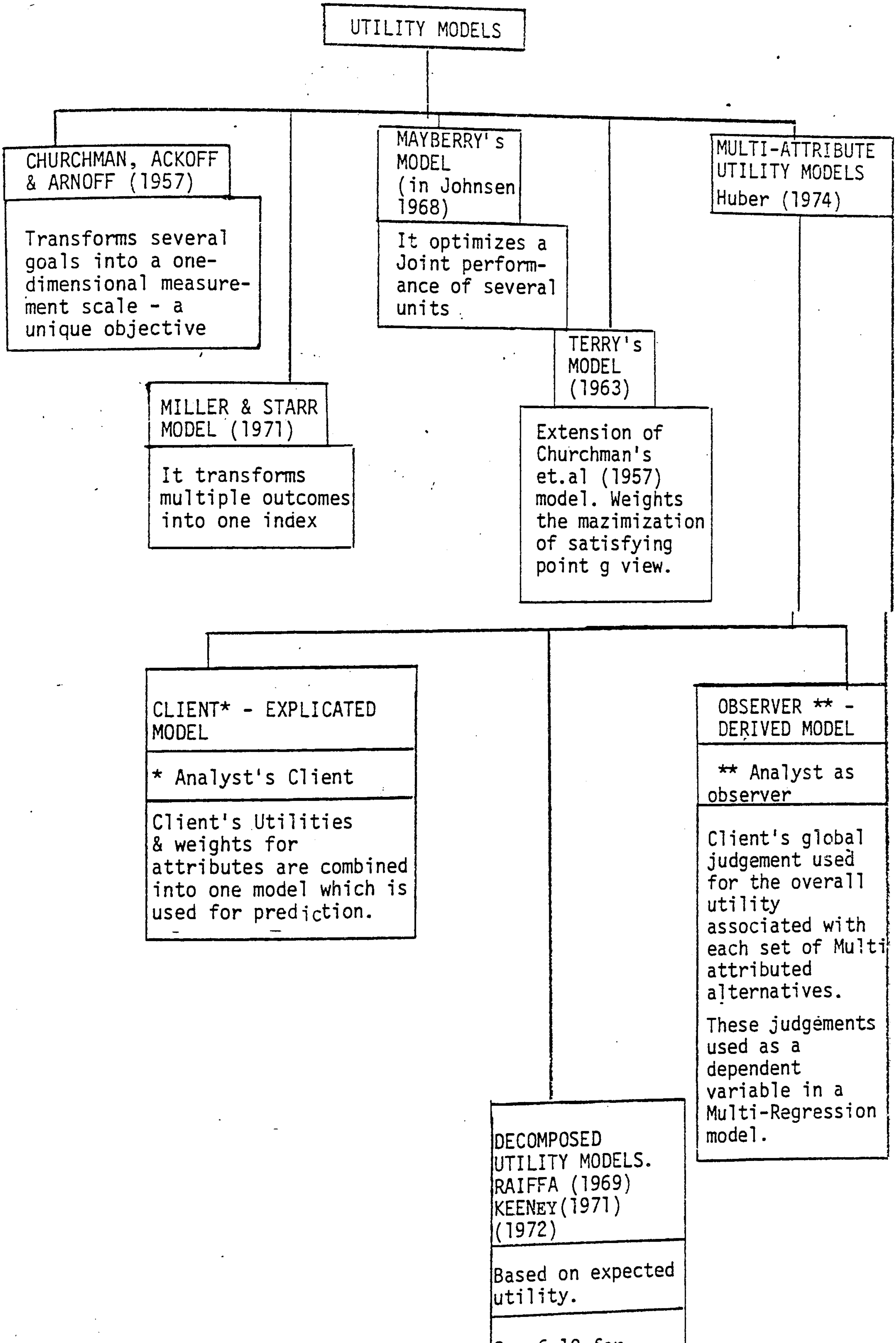


CHART 6.10.3.6: UTILITY MODEL



CHAPTER 7

THE ROLE OF SYSTEMS ANALYSIS IN TENDERING

Synopsis

The main objective of this chapter is to justify one of the claims of this study that there is scope for the application of systems analysis to some of the activities in tendering for overseas projects. A comparision between a theoretical model of tendering system for such projects and the existing tendering process in a contractor's organisation has revealed two missing links i.e. a measure of tendering performance and the feedback of a) the relevant crucial decisions from the past tenders, b) the past tendering performance and c) tendering costs.

A systematic approach has helped to develop a measure of tendering effectiveness (MOTE) and furthermore, the application of systems analysis to such activities as selecting suitable projects to bid, setting up short term objectives, budgeting and controlling tendering costs, etc, has highlighted the importance of a feedback in crucial tendering decisions. It is evident from the results of the applications of systems analysis that with concerted effort, this approach should show improvement in the contractor's tendering performance.

7.1 Introduction

Further to Chapter 3, where it was argued that tendering is a process, an attempt is made in this chapter to apply systems analysis in order to examine its role in measuring and improving (i.e. the effectiveness of) the process. The suitability of this approach is demonstrated by its applications to pre-selected tendering tasks under such catagories as the costs, effectiveness and risks of alternative policies or strategies.

Initially, the discussion centres around some of the relevant aspects of systems analysis such as sub-systems, functions, problem solving, etc. A contractor's existing tendering system is reviewed in order to indentify the defects, if any, in the system.

Finally, the chapter highlights the importance of the co-ordination required for non-conventional tendering activities suggested as vital for the competitiveness and makes an argument for Tender Support Services Manager to take the responsibility for this much ignored but vital aspect of overseas tendering.

7.2 Some relevant aspects of system analysis

7.2.1 Sub-Systems and Systems

A manager referred to such activities as collecting cost related data, the necessary sorting out and the general procedures to make an effective use of computer outputs on costs, as a part of the contractor's total cost control system. He spoke about the system when referring to the above activities which in this case belonged to all-inclusive continuous activity of controlling the cost of a project. In other words, the system was referred to in a generic sense. Fig. 7.2.1.1. shows a typical tendering system which gives an idea of integration. Elements of work processes when integrated form a system.

As seen from the above figure, a sub-system appears to serve one or more higher order sub-systems and in turn may be served by one or more lower order sub-systems. This point is further illustrated when Fig. 7.2.1.1. is compared with Chart 7.2.1.1. The former starts with a sub-system'state the corporate policies' but the latter shows this as an integral part of a system for strategic planning. Fig 7.2.1.2. shows the elements in a particular sub-system shown in Chart 7.2.1.1. The sub-elements within an element - Propose goals - is shown in Fig 7.2.1.3.

There is a clear indication that sub-elements, elements and sub-systems fit together in some fashion to give an assurance of achieving a set objective for the system. A system can be derived by integration of individual components of a total system i.e. integration of sub-systems as shown in Fig 7.2.1.4.

Fig. 6.2.6.2. 'A dynamic decision system' illustrates how an output of one sub-system integrates into the next in order to complete the system. The sequential relationship of sub-systems in an integrated system is illustrated in Fig. 7.1.1.5.

7.2.2 System functions and operations

In the above example of the manager and the cost control system, the function of a manager is to manage and an operation describes how he manages a particular activity e.g. cost control. In other words, the functions are what the individuals do and operations are how the individuals do those functions. Some examples of the two types of operations - manual and judgemental - are given below.

Manual	Judgemental
(Low level operations)	(High level operations)
Arithmetical work	Decision making
Typing	Creating
Editing	Planning

Tendering for a construction project includes both these operations. Some of the errors in these operations are listed in Table 7.2.2.1.

7.2.3 Problem Solving

Some of the basic steps in a systematic approach to problem solving are shown in Chart 7.2.3.1. Optner(1975) considers defining criteria in some specific terms as an important step in the problem solving system. Gregory(*), in his problem solving flow chart (see Chart 7.2.3.2), also highlights the importance of criteria generation in solving a problem.

> The term 'criteria' is defined as the means of measuring, illustrating and choosing the relative difference among alternatives.
>
> An alternative is a solution acceptable within the ranges of cost, time and effectiveness.

7.2.4. Data and information

The difference between data and information is that a data is a raw material from which an information is derived. Information is the end result. Data becomes information when it is reduced, organised and presented in a meaningful form for decision making.

The process of collecting and analysing data for Chapter 6 of this study is illustrated by Figs 7.2.4.1 to 3. They show how a raw data was transformed into a meaningful form for decision making i.e. risk profiles.

---

* Private communication.

During tendering periods, the focus of activities change from the initial emphasis on data collection to problem solving and finally, to decision making by using the information obtained through the previous stage.

7.3 Systems Analysis

7.3.1 The Scope

The following elements appear to be the necessary minimum when dealing with a problem.

i) The existing system,

ii) The requirements analysis,

iii) The systems requirements of the proposed system as they are expressed in the systems design.

The above steps constitute the scope of systems analysis. It is the methodology of study, implementation and installation of systems. It is not only procedural but also analytical.

7.3.2. To assist solving complex problems of choice under uncertainty

According to Quode(1968), systems analysis suggest a course of action by systematically examining the costs, effectiveness and risks of alternative policies or strategies. It designs alternative policies or strategies if those examined are found wanting. It therefore represents an approach to, or a way of looking at complex problems of choice under uncertainty. Churchman's(1968) definition of systems analysis highlights the importance of objectives in such scrutinies.

The examples of a systematic examination in this chapter of the above aspects of tendering are listed with their sectional references in Table 7.3.2.1.

Table 7.3.2.1.

SECTION A	SECTION B	SECTION C
Examination of costs	Examination of risks of alternative policies or strategies	Examination of effectiveness
1. Value engineering (REF:7.4.1)	1. Selection of suitable projects to bid (REF:7.4.5.)	1. Tender management by objectives. (REF:7.4.9.)
2. Human asset approach (REF:7.4.2)	2. Selection of a suitable agent (REF:7.4.6)	2. Project policy statements schedule (REF:7.4.10)
3. Budgeting and controlling tendering costs (REF:7.4.3)	3. Selection of suitable sub-contractors (REF:7.4.7)	3. Selection of suitable tendering personnel (REF:7.4.11)
4. Estimating the costs of expatriates (REF:7.4.4)	4. Ascribing probabilities (REF:7.4.8)	4. Information centres (REF:7.4.12)
		5. Functional analysis & tender response (REF:7.4.13)
		6. Internal tender audit (REF:7.4.14)
		7. Measure of tendering effectiveness (REF:7.4.15)
		8. Tender support management (REF:7.4.16)

7.3.3 Basic tendering system

(a) Open-loop system

The problem solving approaches suggested by Optner and Gregory and discussed in Section 7.2.3. above are applied here to a practical situation to derive the basic tendering process.

The basic elements in the Optner's approach are identified as follows:-

a) Establish objectives,

b) Obtain data and prepare information,

c) Select a suitable process to process the information,

d) Obtain a solution by processing the information.

The above elements are incorporated in Fig 7.3.3.1 which provides the skeleton for a tendering process.

As discussed in Chapter 3, the tendering process is generally subjected to internally and externally applied constraints. The above figure is modified to incorporate this additional element. Fig 7.3.3.2 shows the modified version of the system. Both the above authors have highlighted the importance of generating criteria in order to measure the affectiveness of a system. Fig 7.3.3.3 incorporates this element to complete an 'Open-loop' system.

(b) Closed-loop system (Feedback)

One notable absence from the problem solving approaches discussed above is the feedback element, unless it is inbuilt in 'Information (relevant)' in the flow chart by Gregory. It is shown in Fig 7.2.1.1.

Highlighting the importance of feedback, Lucas(1978) suggests that not only it can correct errors but also be a considerable help psychologically. Fig 7.2.1.1 illustrates the importance of feedback in correcting corporate policies.

The 'Johari Window' developed in USA also refers to feedback in its analysis of the extent of knowledge. In a team task situation, the above concept refers to the state of knowledge of the manager and his team. Some facts are known and some are unknown but they have a pattern. Firstly, the information known both to the manager and to his team and is a public knowledge (say 'U'). Secondly, the information known to the group but not realized by the manager who may be able to clear up his blind spot by appropriate feedback from the group to improve his performance (say 'X'). Thirdly, the information known to the manager and unknown to the group (say 'Y') and lastly, factors unknown to the manager and the group (say 'Z').

The above can be put into some form of matrix as follows:-

Extent of individual's self knowledge

Extent of group's knowledge

	Known	Unknown
Known to group	U	X ← Feedback can improve this situation
Unknown to group	Y	Z

According to most system experts, the basic criterion of a workable system is that it survives (not necessarily achieves objectives though their attainment may be a factor of survival). Feedback is an aspect of control which contributes to the survival of a system. It is sometimes called 'Closed-loop' control system.

It is possible for a feedback system to operate ineffectively. The reasons may be:-

a) The information on which the control is based is faulty,

b) The standard of control applied are inadequate.

Fig 7.3.3.4 incorporates feedback in the system so as to make it a 'Closed-loop' system. A feedback link from a construction process is shown in Fig 7.3.3.5. In this particular case it is made up of two items, i) a feedback of budget and control analysis and ii) a feedback of measurement of construction performances.

In the process of building up of a tender price, the feedback takes place at various stages of the process as illustrated in Fig 7.3.3.6. The feedback of results of the contractor/sub-contractor communication programme is shown in Fig 7.3.3.7.

(c) The 'Expected' and the actual tendering system

The expected tendering system was a 'Closed-loop' system as shown in Fig 7.3.3.4. The modified version of this with controls, correctors and measures at various stages, is shown in Fig 7.3.3.8. It will be referred to in the following discussion as the 'expected' tendering system.

In order to simplify this system, it is reduced back to the basic elements as shown in Fig 7.3.3.9. In order to review the existing tendering system in an international contractor's organisation, a senior manager associated with overseas tendering was requested to complete Questionnaire 7.3.3.1. The existing process is shown in Fig 7.3.3.10. The important finding from this excercise is that it revealed the missing links from the 'expected' tendering process. These are a) a measure of tendering performance and b) the feedback of information of i) crucial decisions from the past projects, ii) past tendering performance and iii) tendering costs.

According to the manager, the lack of feedback and a measure of tendering effectiveness has had some effect on the contractor's tendering performance. Section A7.4.14 discusses in detail, a measure of tendering effectiveness.

Questionnaire 7.3.3.2 lists some of the self probing questions which has assisted in identifying the defective and the missing elements in the existing tendering process in a contractor's organisation.

(d) Client's decision making process, objectives and a measure of tendering performance

When seeking contracts under competitive situations, contractors sometimes ignore the crucial role played by a client's decision making process. If one agrees that a contractor's bid for a project is the outcome of his decision making process, then the contract award for the project is the result of the client's decision making process as illustrated by a model in Fig 7.3.3.11.

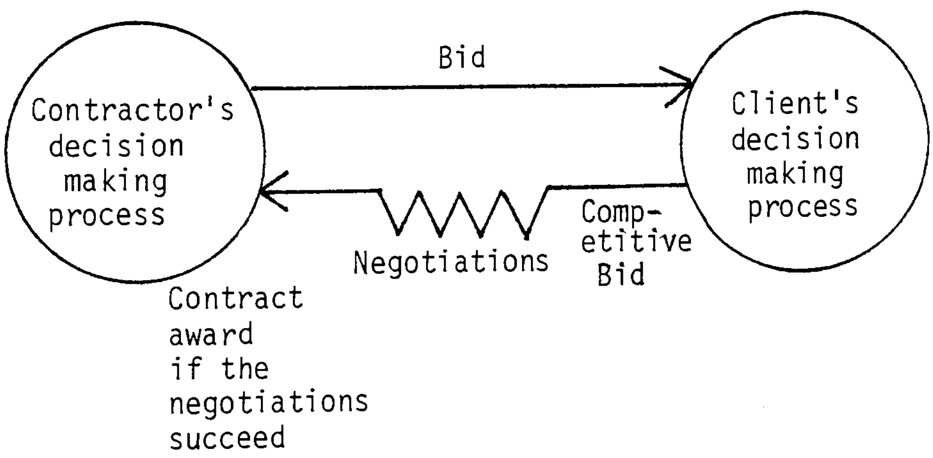


Fig 7.3.3.11

The above model highlights the crucial role of client's decision making process in the majority of contract awards. Based on this principle, objective(s) can be set at the start of a tender period taking into consideration client's needs, his pre-dispositions, his decision making machinery, his likings in such bids, etc. with an input based on relevant feedback from past tenders, the deviation between the set objective(s) and the output (contents in the tender) can be measured. This approach of measuring tendering performance should assist contractors in setting future objectives as illustrated by a model in Fig 7.3.3.12.

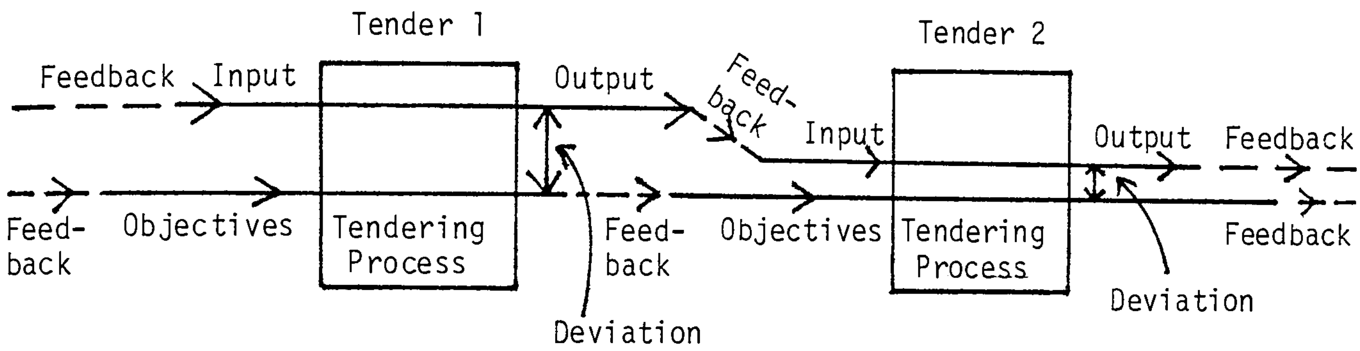


Fig 7.3.3.12

For the methodology of setting up objective(s), tender audits from clients' point of view, measuring tendering performance, etc, see the applications of systems approach at the end of this chapter. Theoretically, the deviations should get smaller and smaller as the contractor gets over, (through an efficient feedback system) his 'learning curve' period for a particular overseas territory. This should result in competitive bids.

7.3.4 Conclusions

The application of systems analysis to examine an existing tendering system in a contractor's organisation has helped to identify the defects and the missing elements in the system. Furthermore, it has assisted in developing those sub-systems which were missing and to make improvements to those which were found to be ineffective as far as the tendering performance is concerned.

With the present state of fierce competition, every aspect of tendering needs to be efficient and effective. Internal and external constraints e.g. time, resources; often influence the way in which tender project managers respond to their tasks. Tender support activities covering unconventional but crucial aspects of tendering can provide the necessary 'greasing of wheels' service. Systems analysis can play an important role in making these services efficient and effective.

It is therefore concluded that systems analysis has a vital role to play when seeking improvements in the tendering performance.

7.4 APPLICATIONS OF SYSTEMS ANALYSIS (See Appendix to Chapter 7).

SECTION A: Examination of costs

7.4.1 Value engineering (A7.4.1)

7.4.2 Human asset approach (A7.4.2)

7.4.3 Budgeting and controlling tendering costs (A7.4.3)

7.4.4 Estimating the costs of expatriates (A7.4.4)

SECTION B: Examination of risks of alternative policies or strategies

7.4.5 Selection of suitable projects to bid (A7.4.5)

7.4.6 Selection of a suitable agent (A7.4.6)

7.4.7 Selection of suitable sub-contractors (A7.4.7)

7.4.8 Ascribing probabilities (A7.4.8)

SECTION C: Examination of effectiveness

7.4.9 Tender management by objectives (A7.4.9)

7.4.10 Project policy statements schedule (A7.4.10)

7.4.11 Selection of suitable tendering personnel (A7.4.11)

7.4.12 Information centres (A7.4.12)

7.4.13 Functional analysis in tender response (A7.4.13)

7.4.14 Internal tender audit (A7.4.14)

7.4.15 Measure of tendering effectiveness (A7.4.15)

7.4.16 Tender support management (A7.4.16)

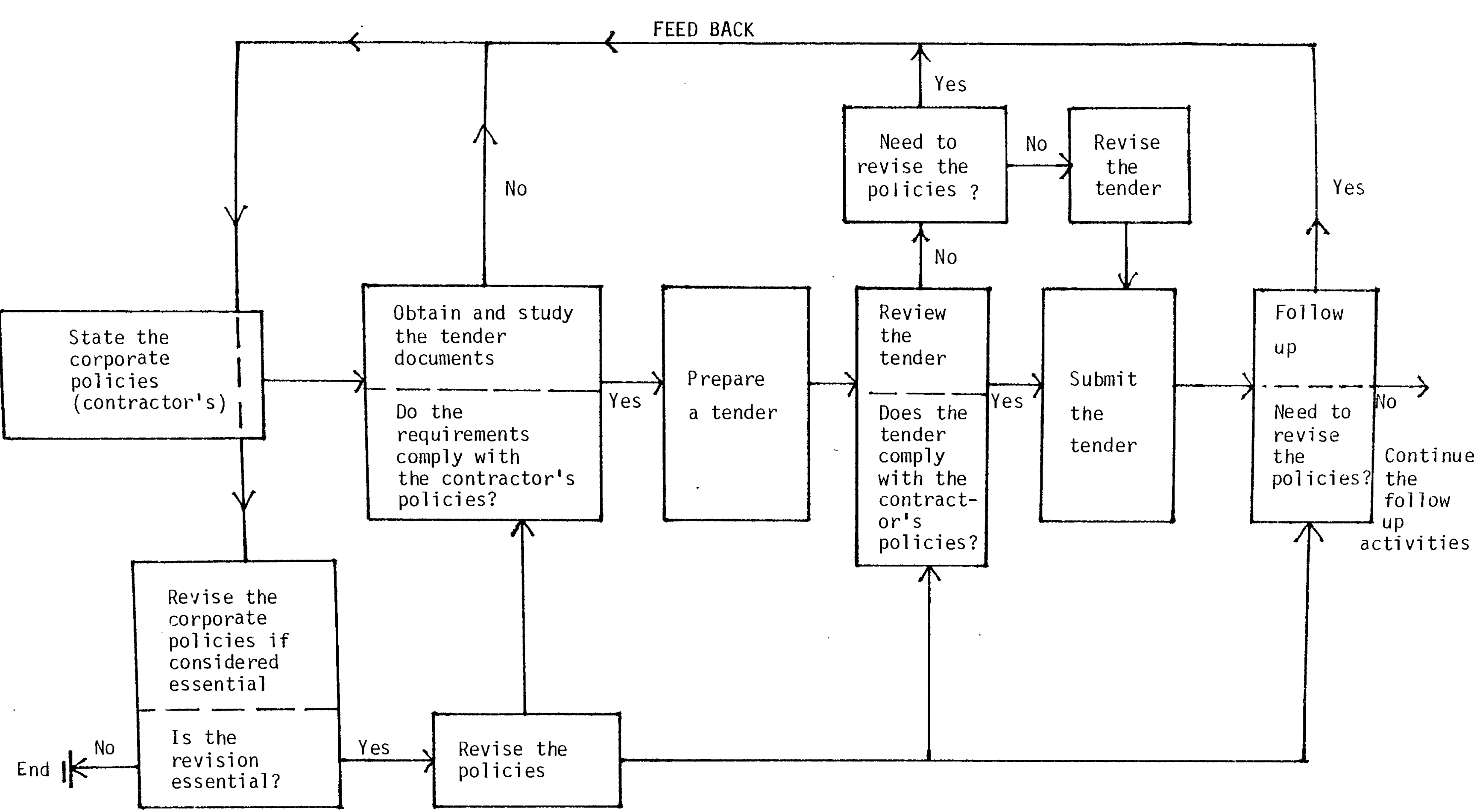
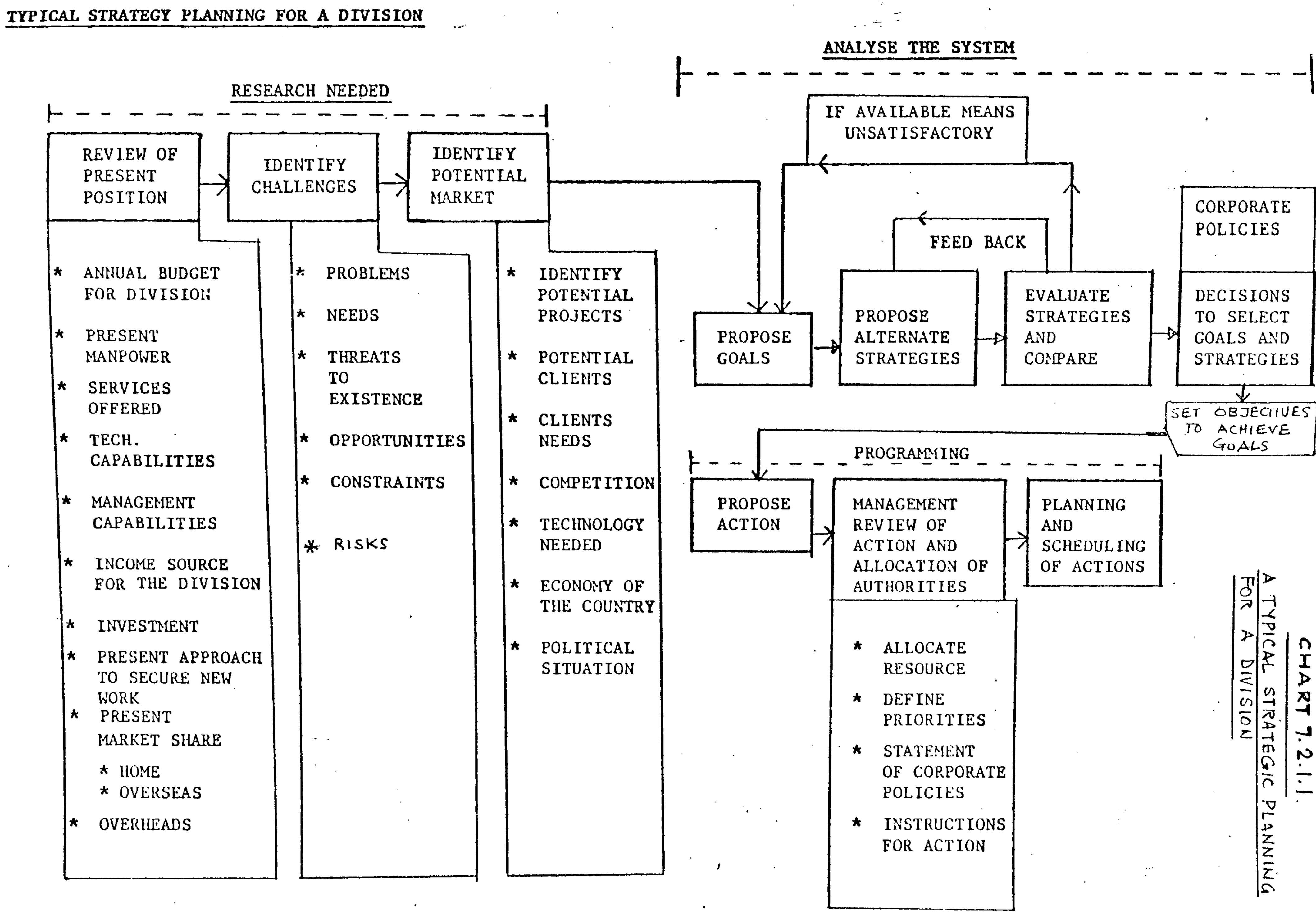


FIG 7.2.1.1: A TYPICAL TENDERING SYSTEM

CHART 7.2.1.1

A TYPICAL STRATEGIC PLANNING FOR A DIVISION



FIGS 7.2.1.2 to 5 (INCL): SUB-SYSTEMS AND A SYSTEM

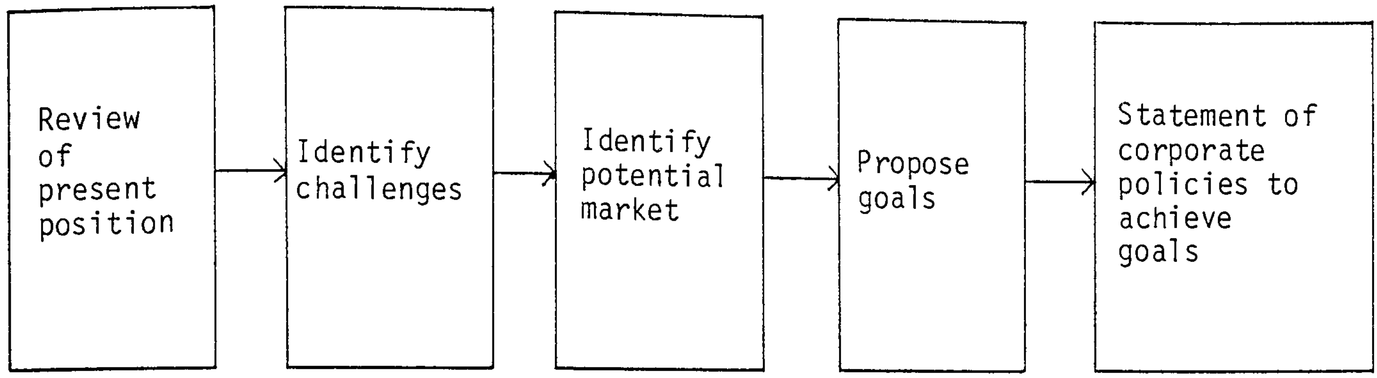


FIG 7.2.1.2: Elements in a sub-system

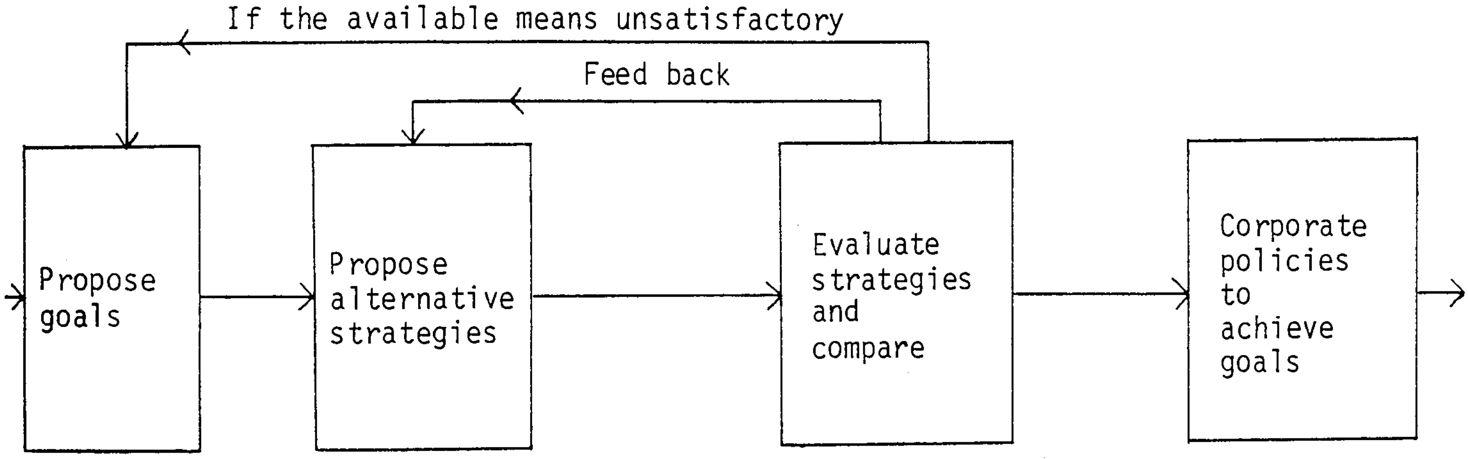


FIG 7.2.1.3.: SUB-ELEMENTS OF AN ELEMENT IN A SUB-SYSTEM

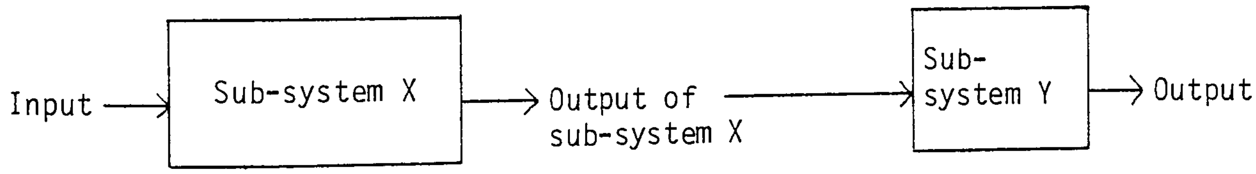


FIG 7.2.1.4: INTEGRATION OF SUB-SYSTEMS

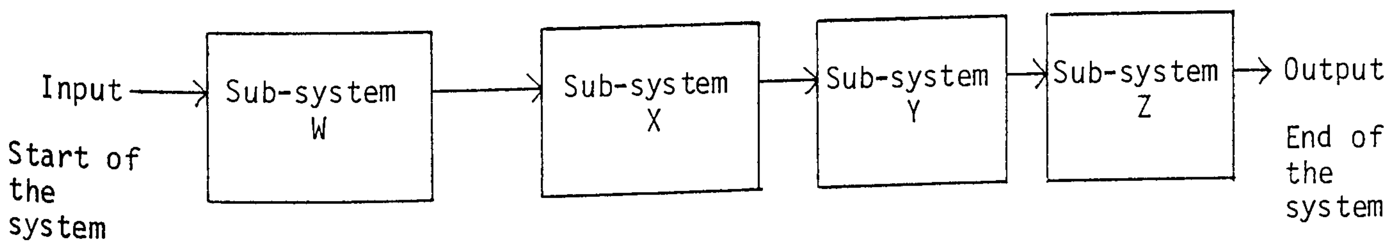


FIG 7.2.1.5: A SEQUENTIAL RELATIONSHIP OF SUB-SYSTEMS

TABLE 7.2.2.1

SOME OF THE ERRORS IN MANUAL AND JUDGEMENTAL OPERATIONS

Manual (Low level operations)	Judgemental (High level operations)
- Misspellings	- Failure to fully explore the problem
- Incorrect arithmetic	- Lack of consideration to all elements contributing to an outcome
- Transposition of numbers	- Failure to think of all possible alternatives
- Transposition of letters	- Inability to interpret the limiting factor in a design process
- Incomplete operations	- Failure to apply a known technique
- Improper sequence	- Inability to conceive of a way to resolve an apparent contradictory situation
- Use of incorrect numbers, codes, letters, etc.	
- Use of incorrect documents i.e. procedures, rules, etc.	

CHART 7.2.3.1: BASIC STEPS TO THE SOLUTION OF A PROBLEM

Discovery of the problem

↓

Assessment of the relevance of the problem and its value to a management group

↓

Definition of objectives and constraints of the proposed problem-solving system

↓

Definition of criteria and measures of effectiveness for the proposed system

↓

Determination of the objects and the structure of the existing system

↓

Determination of the defective elements of the existing system

↓

Assessment of the relative importance of the elements of system and sub-systems with respect to the objectives of the system

↓

Determination of solution finding process

↓

Determination of objects and the structure necessary for a choice alternative

↓

Selection of alternatives

↓

Construction of a model to choose among alternatives

↓

Implementation of the solution

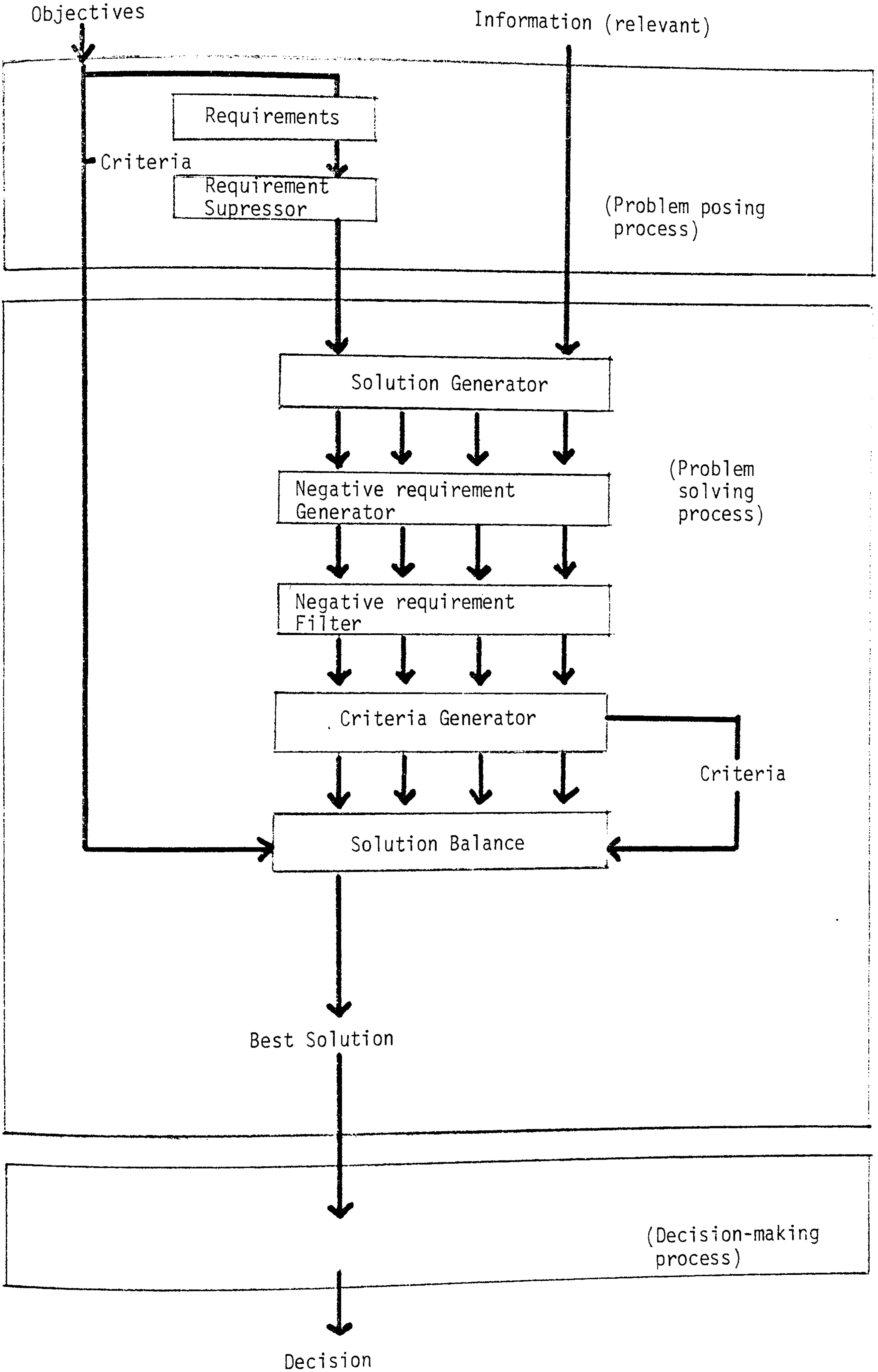
↓

Evaluation of the consistency of the solution with the original objectives and constraints

↓

Evaluation of the results

7.2.3.2 Gregory's (*) Problem-Solving Flow Chart



FIGS. 7.2.4.1 to 3 Stages from Data to Information

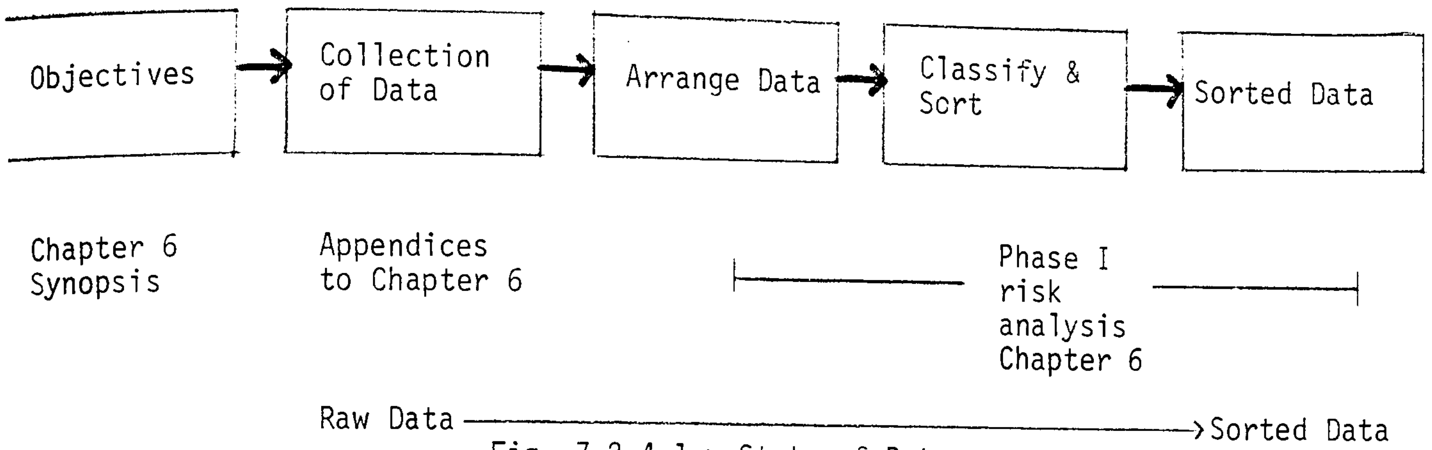


Fig. 7.2.4.1 : State of Data

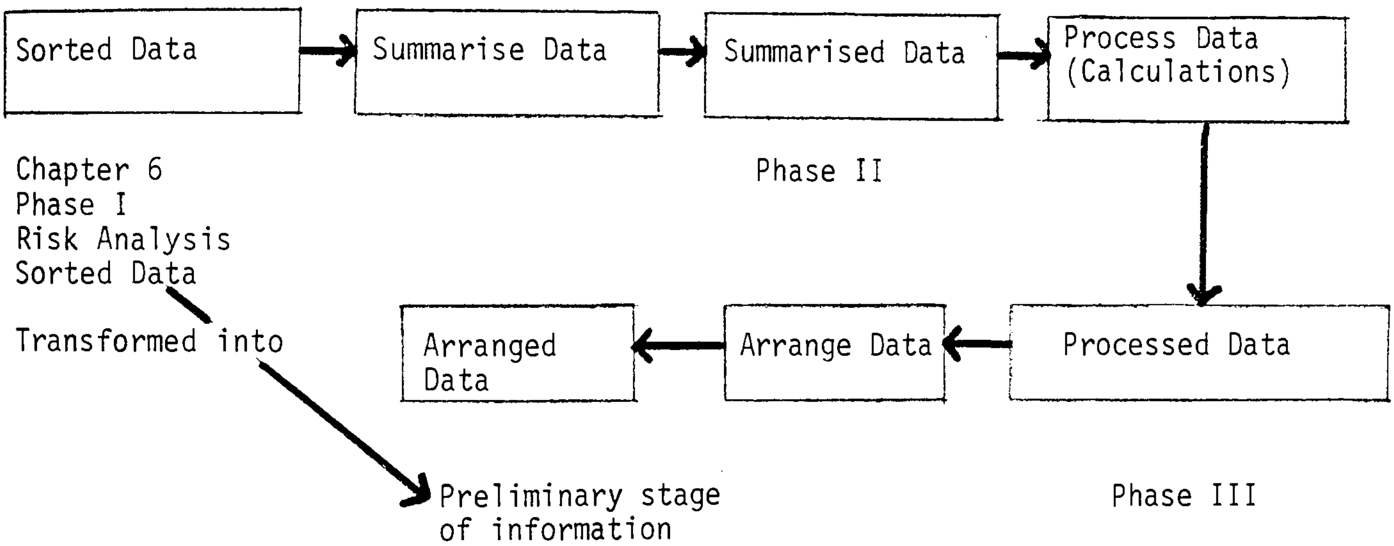


Fig. 7.2.4.2 : Transformation of Data

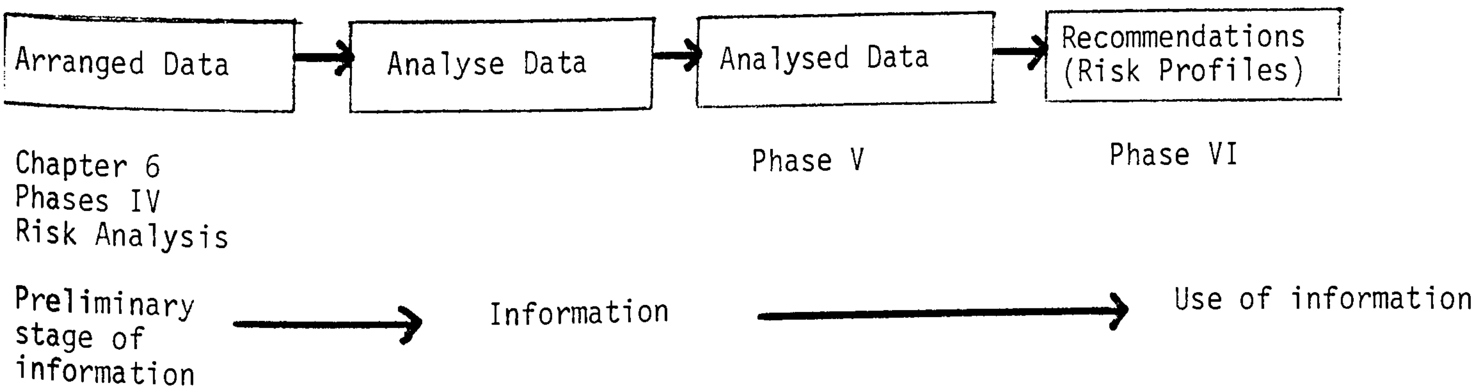


Fig. 7.2.4.3 : Use of Information

Figs. 7.3.3.1 to 4 : Systems

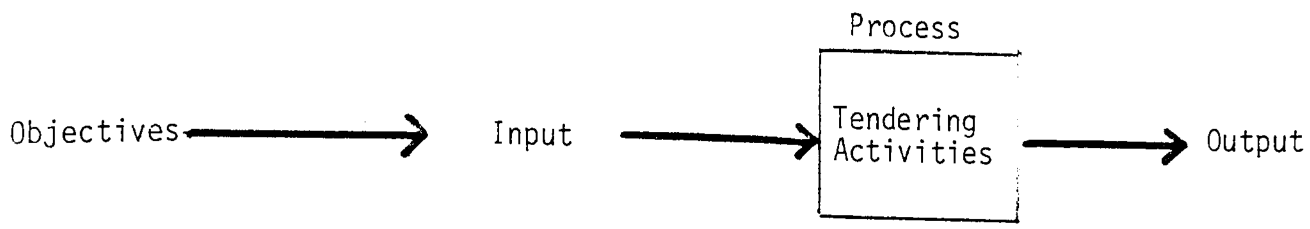


Fig. 7.3.3.1 The Basic System

Fig. 7.3.3.2 A Modification to the Basic System

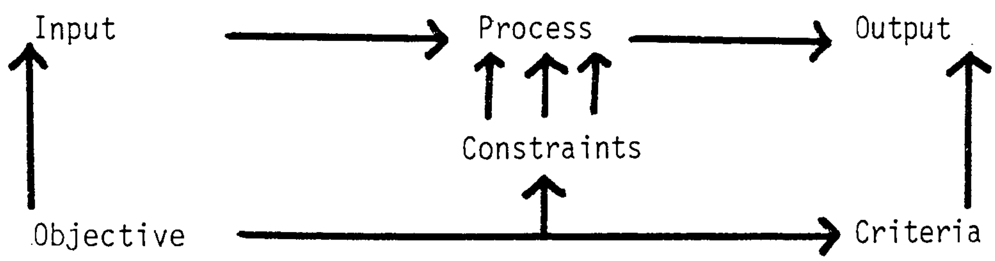


Fig. 7.3.3.3 'Open Loop" System

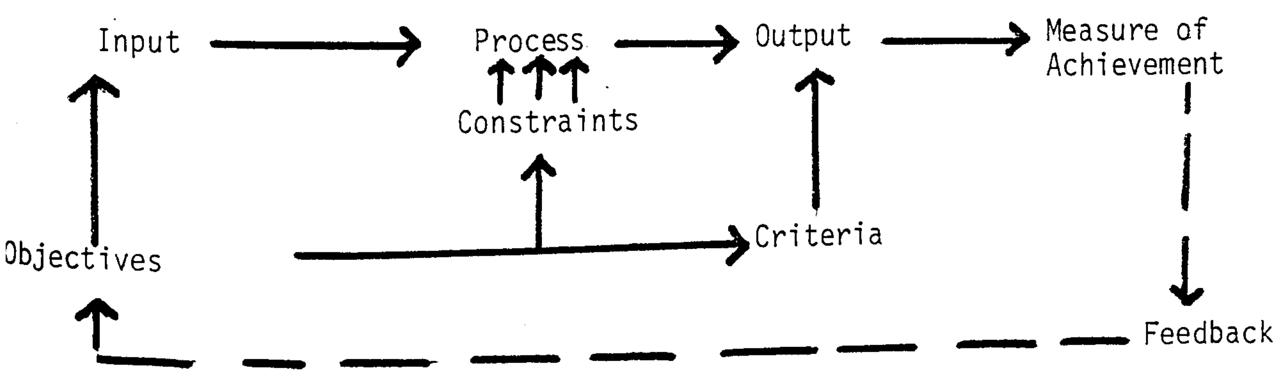


Fig. 7.3.3.4 'Closed Loop' System

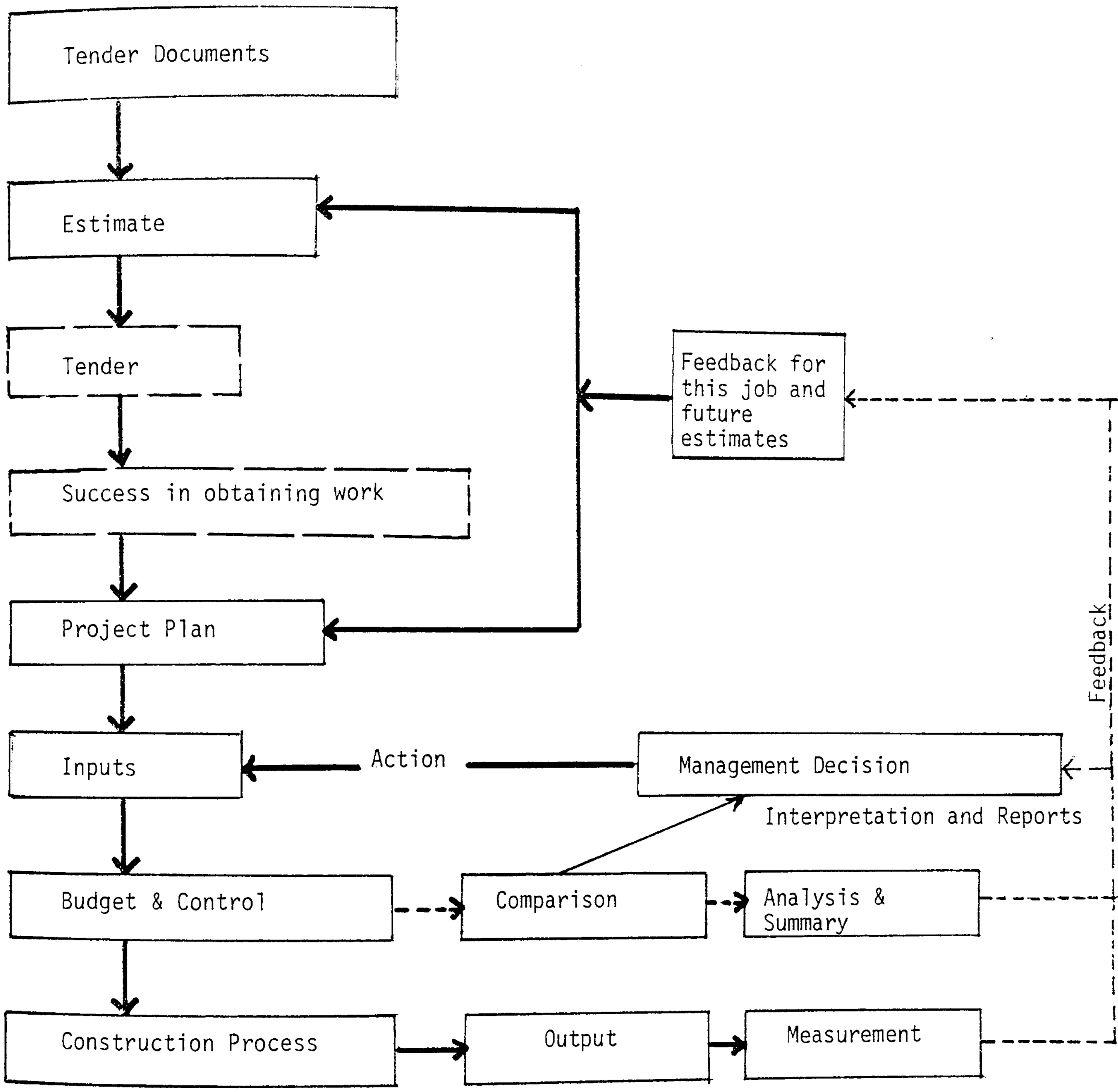


Fig. 7.3.3.5 Feedback Link in a Construction Process

FIG. 7.3.3.6: FEEDBACKS IN 'BUILDING-UP PRICE' PROCESS

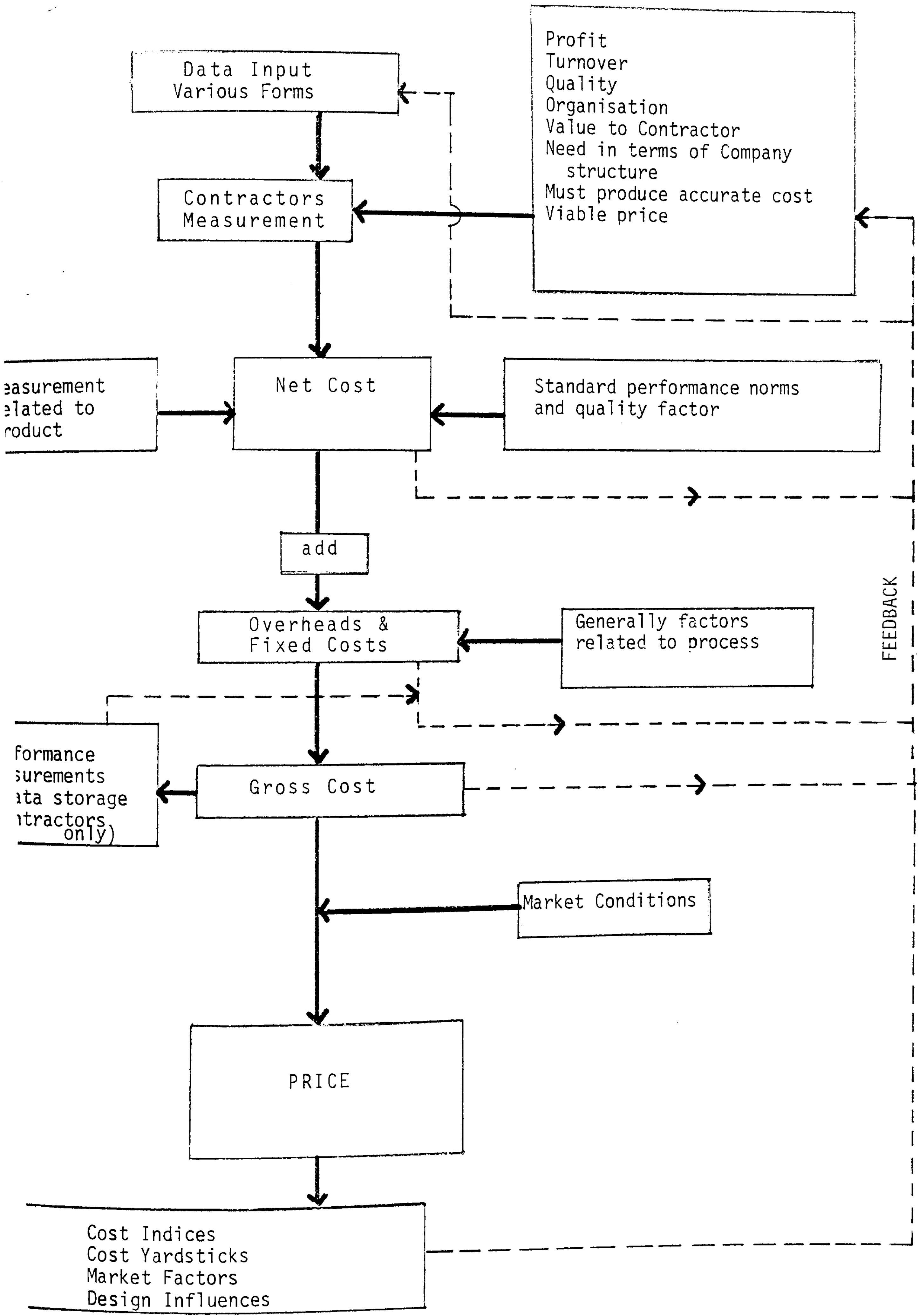
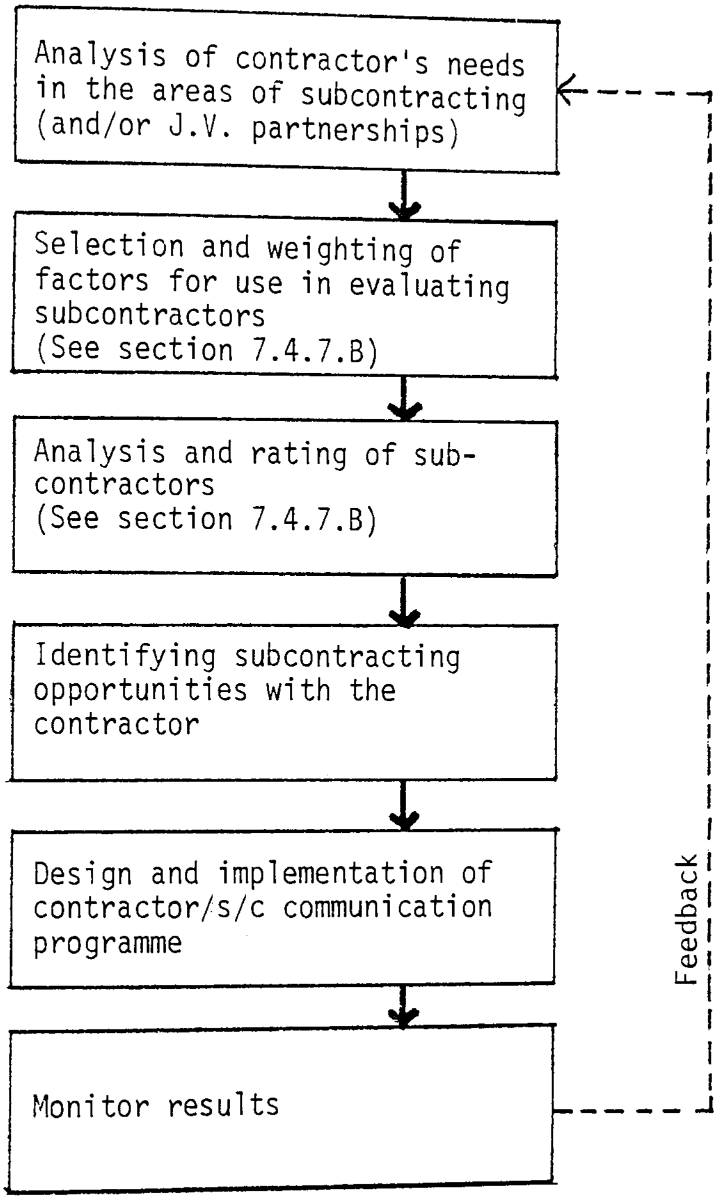


FIG. 7.3.3.7:

Selection of Subcontractors (and/or J.V. Partners) by Pre-Planning



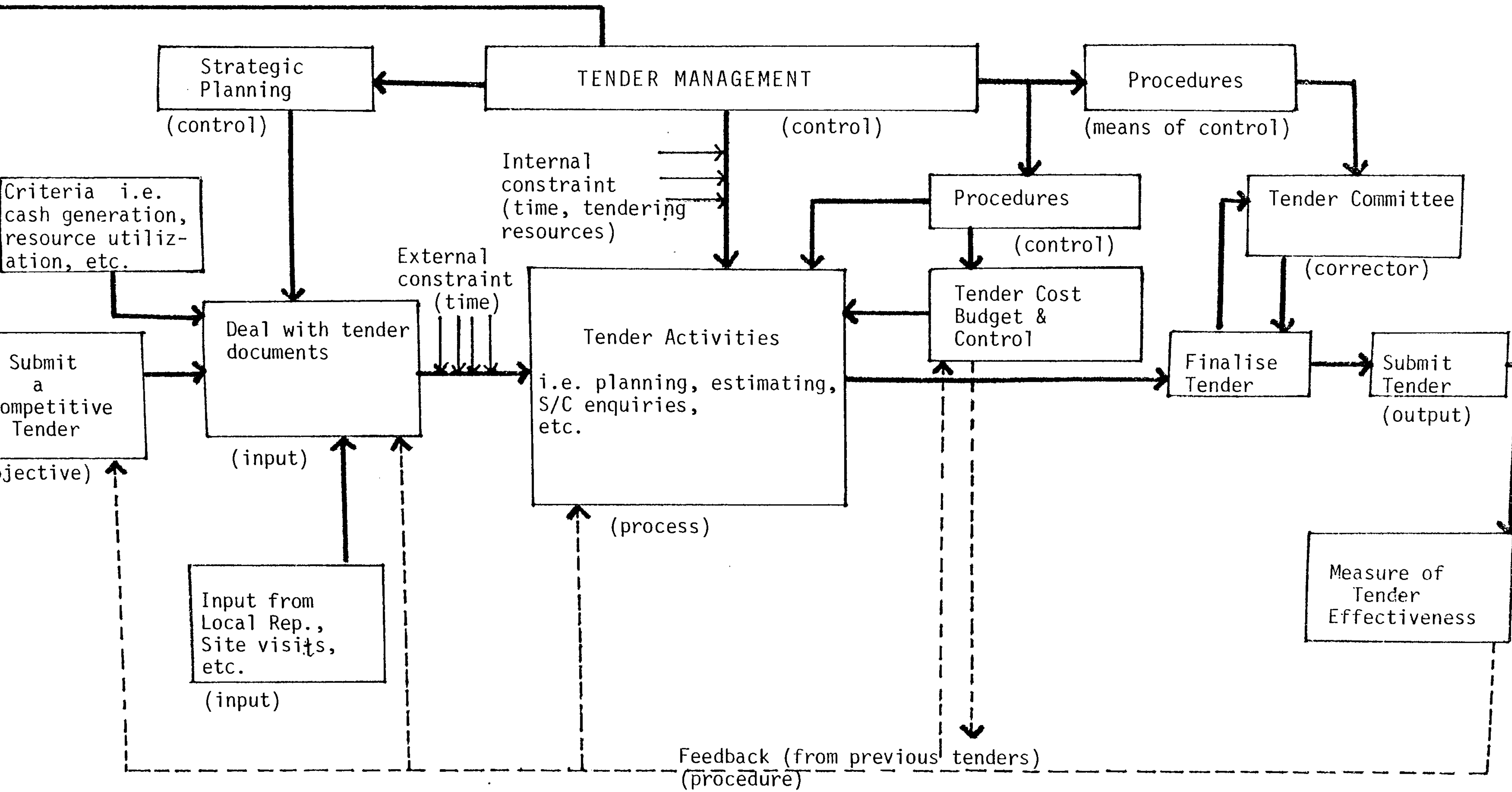


FIG. 7.3.3.8 The 'Expected' Tendering System

Questionnaire 7.3.3.2 Self Probing Questions to Determine Missing & Defective Elements in a Tendering System.

1. What is being sold - and tendered for?

2. Is there clear company policy on what is being sold?

3. Are the sales executive and tendering/project terms fully aware of company policy and what they are selling?

4. Is there understanding of how the services/products are to be presented?

5. Do the tendering/project team understand how the order will be executed if their tender is successful?

6. Is there an effective costing procedure?

7. Is there competent tendering staff?

8. Is there effective decision - making machinery?

9. Is there a policy which considers Client's decision making process?

10. Is ther an effective field sales force to obtain enquiries?

11. Is there an efficient intelligence service - markets, competitors, inside information?

12. Is there a "data bank" of background costs and statistics including competitive selling price levels?

13. Is the feedback system effective?

14. Is there a measure of tendering performance?

Questionnaire 7.3.3.1 Existing Tendering System: Management Control: Procedures

Question	Yes	No	Comments
1. Have conditions changed since the tendering procedure was put into effect?	√		
2. Were the procedures specially set up to correct a situation that has been since revised?	√		
3. Is the cost of procedure justified?	√		From the management's point of vie - safe guard
4. Are the procedures necessary to satisfy the requirements of			
4.1 Clients?		√	
4.2 the corporate management?	√		
5. How necessary is the outcome from the procedures?			Necessary fo the safe guard of the Company.
6. Is there any room for revision to the procedures?			
6.1 complete rivision necessary?	√		
6.2 minor revisions will do?			
6.3 major rivisions necessary?			
7. Are the outcome from the procedures used as intended?			Doubtful
8. What is lacking in the system? (See Fig 7.3.3.9)			Measure and feedback *

* Technical feedback is in evidence but the feedback of crucial decisions, past tendering performance and tendering costs are missing from the system.

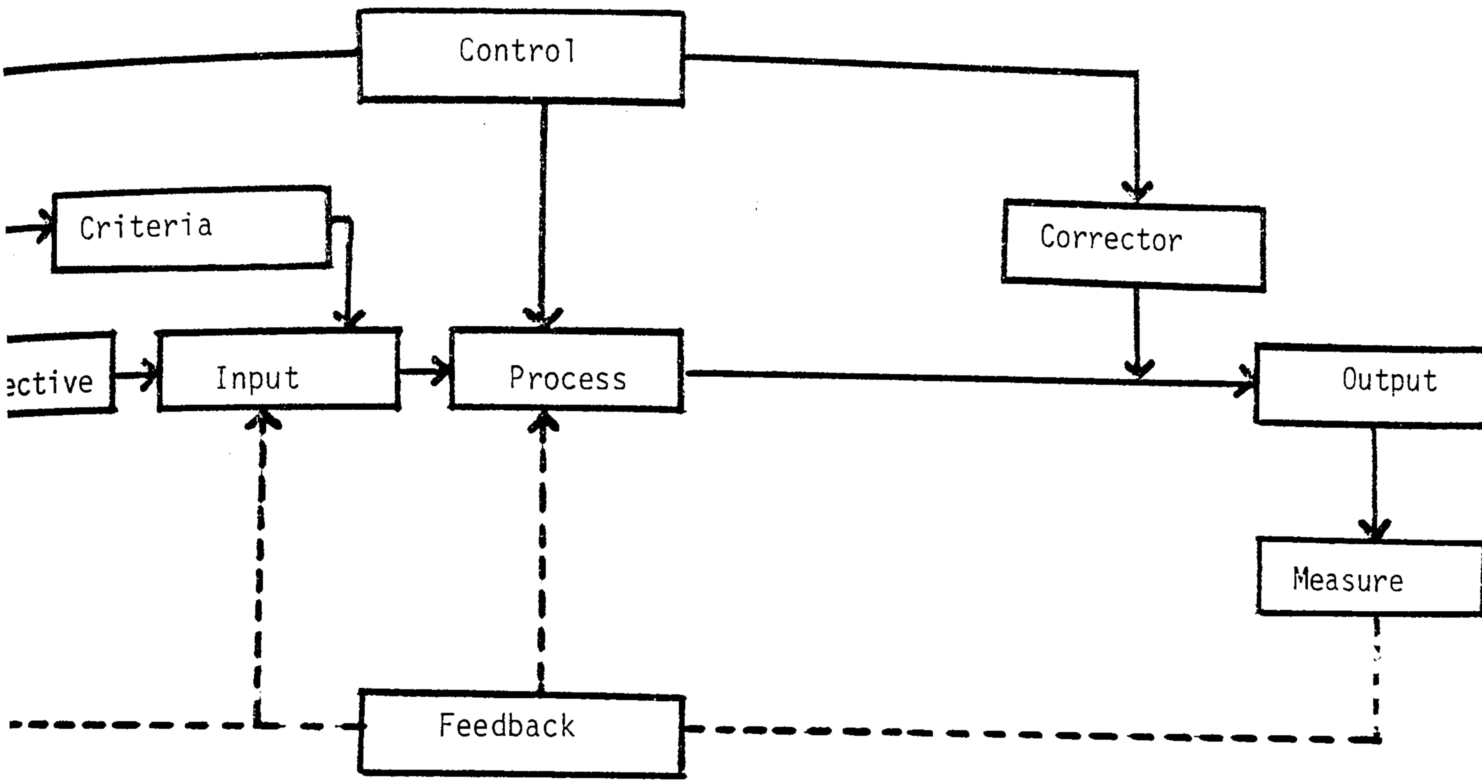


FIG. 7.3.3.9 'Expected' Tendering System in Terms of Basic Elements

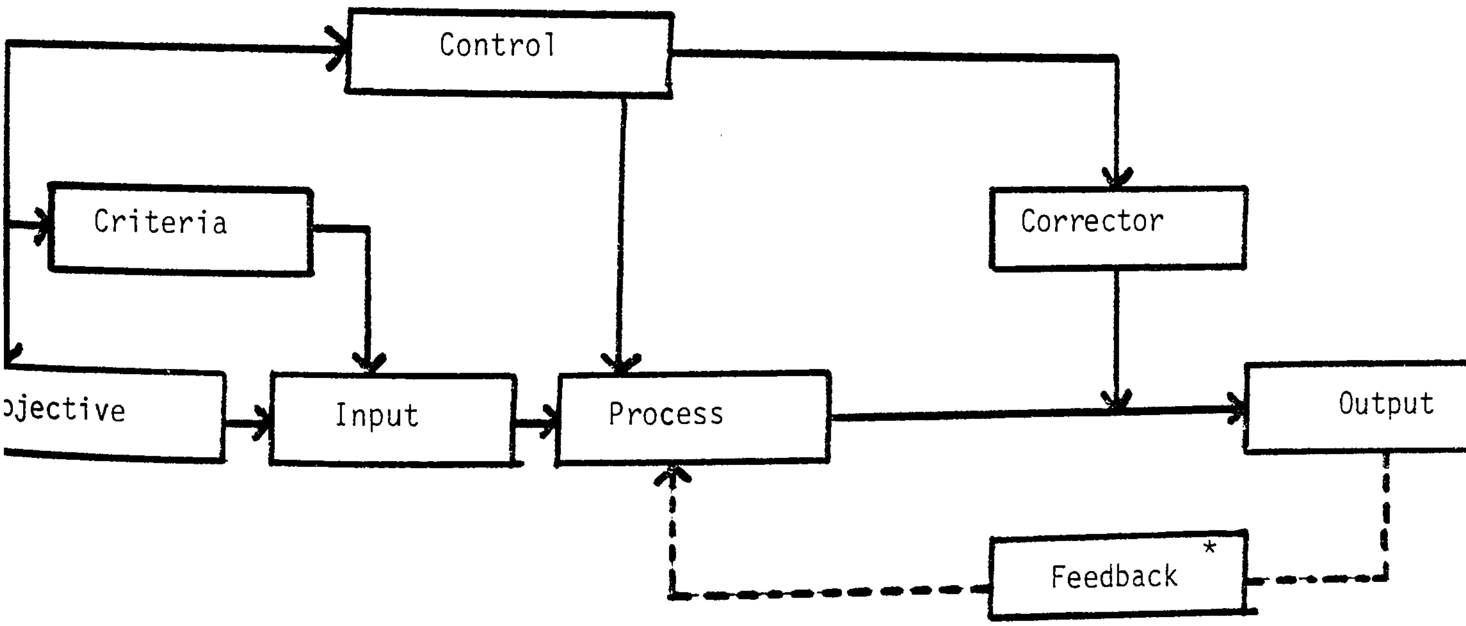


FIG. 7.3.3.10 The Tendering System in a Contractor's Organisation

(Missing Links: Measure and Feedback*)

f. Questionnaire 7.3.2.1

Ineffective feedback : only technical information feedback was in evidence but the feedback of crucial decisions in the past, past tendering performance and tendering costs was missing.

CHAPTER 8: SUMMARY

With rising economic uncertainty and expenditure cut in the home market, British contractors are seeking their growth through overseas turnkey type contracts. This has created a need for the role of project leader. The total responsibility of such a role in these contracts has forced British firms to take joint venture or consortium approach. The problems in this area e.g. joint and several liabilities, have been examined by Grovernment sponsored committees with a moderate degree of success. The competition is fierce, especially from Asiatic and Far-Eastern countries, and this has affected the normally expected client/contractor relationship.

The responsibility of a project leader is a source of many problems, within and outside contractor's organisation. This study concentrates on the problems within such an organisation.

Tendering is a process and like other processes, is subjected to time and resource constraints. Hasty decisions under such conditions can have serious repercussions on the contractor's business. When submitting a bid on behalf of the Group, the leading division needs concerted efforts from other divisions within the Group. But sometimes, because of a 'political' conflict within divisions, uncertainty is created which can impede the chances of a competitive bid.

The study identified three major stress raisers - complexity, uncertainty and time constraint in tendering personnel which need careful consideration in some tendering situations. It discusses methods (e.g. use of heuristics, decomposing), techniques (e.g. computer rating charts), etc, to deal with such undesirable stress factors.

SUMMARY (Continued)

Tendering personnel in general, show esteem needs, i.e. feeling of achievement. Becuase of their persevering aptitude, they are more likely to venture beyound their individual limits of information processing. This can result in misjudgement and misinterpretations.

One of the characteristics of the construction industry is that, in the majority of cases, it has to deal with one-off jobs. Hence, guess-work based on intuition and experience is not always sufficient and need a more structured approach. Decision theory which deals with two main decision variables - utility and probability - has something to offer in dealing with risky decisions. The uncertainty aspect should form an integral part of a decision situation.

In dealing with risks, contractors use some form of trade-off to keep the risk element within their acceptable limit. Experts' assessments of individual items in the category of risk are likely to improve judgements in such trade offs and control the contingency element in a tender. The study has shown that with the help of risk controlling actions - avoid, transfer, eliminate, retain and prevent (ATERP). - it is possible to produce project and corporate risk profiles useful as monitoring devices.

The present competitive market conditions require contractors to consider other objectives than just profit maximization. In such multi-objective situations, it is possible for conflicting objectives to exist and therefore there is a need for explicit corporate policies to enable middle management to carry out the necessary tradeoffs between competing objectives.

SUMMARY (Continued)

If tendering is treated as a system consisting of purposefully designed sub-systems, it is likely to give some assurance of achieving the set objectives. This approach enables various controls, correctors and measures to be introduced in the system in order to improve its effectiveness. An advantage of this approach is that if a bid is unsuccessful at the end, it can identify workable as well as unworkable solutions thereby assisting in improving the 'learning curve' of a contractor. Tendering for large scale overseas projects can be seen as a set of complex problems of choice under uncertainty. The application of systems analysis to the tendering process as a whole, can assist in examining systematically, various costs and risks involved. With a feedback element providing the necessary closing link to the system, the approach is likely to assist in a contractor's attempt to reduce the level of uncertainty.

At times, contractors' management include newly acquired personnel who, although expert in their own field, may not have the full knowledge of their new employer's capabilities, resources, past performance, etc, and hence their decisions are likely to be based on experience in their previous employments. There is a danger that their strategies and judgements may not necessarily be in line with the contractor's corporate policies. Such situations are likely to affect the contractor's competitive position. A data bank consisting of historical information with efficient retrieval system can assist such personnel to acquire the necessary knowledge to sharpen their judgements on matters such as ascribing probabilities to the events with a direct influence on producing a competitive bid. The advantages of formal/informal teams as regards to efficient feedback have been discussed in appropriate literature.

SUMMARY (Continued)

Contractors in general, do not get sufficient opportunity to exploit the full potential of value engineering. Its logic is comparable to well known techniques such as work study and time reduction analysis and hence should play a prominent part in contractors' attempt to reduce prime costs. Even a few general heuristics such as 'eliminate the need', 'reduce or modify' 'change design', etc, can assist in a contractor's search for ways of reducing prime costs of projects. Because it is based on functional analysis, it is possible to plan objectively, a response to clients' requirements by ascribing 'requirement values' and 'attention values'. This type of 'Tender Response Needs Analysis' (TRN - Analysis) appears to have a potential for using the tendering resource more effectively.

A lack of effective communication is often a source of frustration within tendering teams. 'Wish someone would tell me what is happening' is a typical grumble one hears from tendering personnel. A project policy statements schedule (PPS - Schedule) can provide a means for the necessary communication.

In general, there appears to be a casual approach to tendering costs, i.e. without budgeting or means of control. This can affect contractor's overheads and ultimately his competitive position if 'internal pressures' force him to recover these overheads without due consideration to market factors. Tender Performance Analysis (TP - Analysis) during tendering and Tender Cost Variance Analysis (TCV - Analysis) after completion of a tender, not only can provide objective assessments of a tendering performance but also can be a useful source of feedback to the TCV - monitor. These analysis and the monitor can act as measures and correctors, respectively, to the tendering process as a whole.

SUMMARY (Continued)

In pursuing projects which are unsuitable from the point of view of their corporate policies, feasibility, political environment, etc, contractors can waste their scarce tendering resources. A detail screening of prospective business enquiries can weed out any unsuitable projects including 'pet' projects which get through the initial coarse screening thus ensuring that tendering resources are onlyutilised for suitable projects. Such a scrutiny can be computerised to make it more efficient.

Compatibility indicies can improve decisions in the area of selection of suitable agents, sub-contractors, etc, by considering all the important aspects which affect such a decision.

Like any other task, tendering too has some interesting and some tedious tasks. For example, estimating the cost of a large contingent of expatriates can be repetitive, and time consuming. By computerising these tedious aspects, it should be possible to improve the efficiency of the tendering process as a whole.

Internal tender committee reviews which are, in the majority of cases, designed to protect the contractor's interest, fail to answer the most important question 'How the contractor's bid is likely to be received in the client's quarters?' In order to get some idea of the client's response and to seek opportunity to improve the chances of success, an internal tender audit (IT - Audit) based on client's point of view (CPV), can highlight the areas which need further attention. Thus CPV - evaluation not only can assist management in positive decision making but it can also be a vital source of feedback over a period of time. The CPV - evaluation of a tender as a whole and its important aspects can provide targets for the tendering team to aim at.

This measure of tendering effectiveness (MOTE) is based on a simple logic i.e. the more attractive a bid is to the client, the higher is its CPV - value.

In spite of taking all the actions that a contractor may think necessary to improve his chances of success, there may be factors which may be completely out of his control and may disappoint him at the end. There appears to be a need for trade off between the cost of tendering for a bid and the cost of improving it.

Tender project managers have a considerable interface and team responsibilities during tendering. An assistance in co-ordinating critical aspects is likely to provide a 'greasing' effect. A Tender Support Manager (TS - Manager) through his permanent team of TS - Management can help in the smooth running of the tendering process by carrying out unconventional but crucial tasks.

The objective approach of systems analysis to improve the effectiveness of a tendering process, is also likely to assist in identifying steps necessary to avoid a tender failure. Due consideration is, however, required to the human content within the system.

CHAPTER 9

CONCLUSIONS

1.0 Tendering process and its management

Tendering for construction projects is a process when operated without appropriate controls, measures and correctors (through feedbacks) leads to an ineffective use of tendering resources resulting in incompetitive bids. Improvement in tender performance can be achieved by learning from the past tender submissions.

2.0 Uncertainty

2.1 In spite of uncertainty and its peak at the initial stage of tendering some crucial tendering decisions have to be taken during this period.

2.2 A newly formed organisational structure when considered by other divisions as a challenge to their authority, is a potential source of 'political' conflict. This introduces uncertainty in many aspects of Group tenders.

3.0 Constraints

Time and resource constraints affect the quality of tendering decisions.

4.0 Complexity

Because of their inherent persevering aptitude and esteem needs, some tendering personnel are likely to venture beyond their individual ... faced with extremely complex tasks.

Conclusions (Contd.)

4.0 Complexity (Continued)

It can lead to cognitive callapse resulting in misjudgements and misinterpretations if the time constraint is severe.

5.0 Stress-raisers

Complexity, uncertainty and time constraint are likely to be the major stress raisers in tendering personnel.

6.0 Trade off

Under a severe time constraint, the tendency is to trade off complexity for uncertainty. A 'jumped' price is an example of such a trade off.

7.0 Structured approach to decision making

7.1 Because multi-disciplined construction projects are one-off jobs, structured approach to decision making is likely to supplement one's intuition and experience.

7.2 Utility approach appears to have a potential for transforming subjective judgements into more objective means (aid) of decision making.

7.3 Identification of the 'real' demand for a project is likely to reduce the level of uncertainty surrounding the client's decisions.

7.4 In dealing with risks, the tendency is to trade off undesirable elements to keep the risks within acceptable limits.

Conclusions (Contd.)

7.0 Structured approach to decision making (Continued)

7.5 Risk profiles appear to have a potential for monitoring risks.

7.6 The use of heuristics in decision making can provide some control over complexity and time constraint.

7.7 Becuase of the present market conditions, the tendency is to change the emphasis on objectives (e.g. a lower priority for profit maximization) when pursuing construction opportunities. If there are conflicting objectives, explicit corporate policies for achieving the company's objectives can assist middle management in making rational decisions during the tendering stage.

7.8 The development of a data bank on the past tender submissions with an efficient retrieval system can assist tendering personnel (especially the newly acquired personnel) to sharpen their judgements.

8.0 Systems approach

8.1 The application of systems analysis to a tendering process is likely to improve its effectiveness.

8.2 Tender management by objectives appears to have a potential for reducing uncertainty.

8.3 Value engineering can reduce prime costs in tenders.

8.4 An objective response to a tender enquiry can be planned by analysing the clients needs.

8.5 The concept of treating a newly formed tendering division as an investment centre and its staff as 'human' assets appears to have a potential for providing the necessary breathing space.

8.6 A schedule of policy statements for a project is likely to improve communications during the tendering period.

8.7 A Tender Performance Analysis and Tender Cost Variance Analysis can provide objective assessments of tendering costs.

8.8 A computerised detail scrutiny of a prospective business enquiry can save time and resources.

8.9 Compatibility indicies can assist in transforming subjective assessments into objective means (aid) of decision making.

Conclusions (Contd.)

8.0 Systems approach (Continued)

8.10 Individual information centres can be efficient sources of feedback of specialist information.

8.11 An internal audit of a tender from the client's point of view can identify the aspects of tender which need further consideration in order to improve the chances of success.

Such audits over a period of time appear to have a potential for providing a measure of tender effectiveness.

8.12 There appears to be a need for tender support services to carry out crucial activities generally considered as outside the scope of tender project management.

CHAPTER 10

RECOMMENDATIONS FOR THE SPONSOR

Problem areas and recommendations

1. Incomplete tendering process

1.1 The present tendering process is incomplete as regards to the following

- A measure of tendering effectiveness.
- A feedback of relevant tendering decisions in the past.

The introduction of both the above elements should assist in reducing the Contractors 'learning curve' in this specific field i.e. tendering for large scale overseas turnkey projects.

1.2 The Contractor's tendering process should be periodically reviewed to identify defective or missing elements.

1.3 The recommendations in the past tender appraisals should be periodically reviewed and a procedure to implement such recommendations should form part of the Contractor's tendering process as a whole.

1.4 In case of a failed tender, the basis of a review should be:

'Had the tender team taken all reasonable steps to avoid the bid failure?'.

The outcome of this review should be an itegral part of the feedback for subsequent tenders.

A successful tender should be similarly reviewed to identify the steps which made positive contributions to the bid success.

Recommendations (Contd.)

1.0 Incomplete tendering process (Continued)

1.4 (Continued)

Such a review should also be incorporated in the feedback system.

2.0 Absence of targets for tenders

2.1 The make up of the tender price for a project should be decomposed into the following main sections for target purposes.

Prime cost
Contingency
and Contribution.

2.2 During tendering, the prime cost of a project should be periodically projected and the likely diversion from a set target should be discussed at an appropriate level.

2.3 In deciding the target range for the Contractor's tender price for a project, known estimates of the cost of the project should be throughly scrutitnized.

2.4 The Contractor should consider the tender management by objectiv approach (discussed in this study) to control his tender prices.

Recommendations (Contd.)

3.0 'Temporary' task

Where tendering teams are assembled for specific tenders and disbanded after performing such a 'temporary' task, due consideration should be given to special qualities required to lead such a 'temporary' team and the effects of uncertainty on the staff concerned.

4.0 Sub-contract prices

4.1 Prior to the commencement of tendering activities for a project, the Contractor should have a clear policy on obtaining sub-contract prices.

4.2 The prospective sub-contractors should be made aware of the adverse effect of their unscrutinized pricing on the overall tender price.

4.3 Valve engineering should be an integral part of a planned approach to reduce sub-contract prices.

4.4 Where a sub-contract price is obtained through a pre-selected sub-contractor, an effective communication channel should be established to take corrective actions in time to keep the sub-contract price within a pre-determined range.

4.5 Where sub-contracts cost is likely to be a major portion of the prime cost in a tender, an experienced member of the tendering team should be given the task of ensuring that the cost is kept to an absolute minimum.

Recommendations (Contd.)

5.0 Uncertainty surrounding client's decisions

Studying a client's decision making process should be an integral part of the Contractor's overall strategy for the bid.

Such an investigation about a client should include the following:

- identification of the real demand for a project.
- the 'politics' in the client's organisation.
- the clients pre-dispositions about Western contractors especially about British contractors and in particular about the Contractor's organisation.
- the person (or a Group) in the client's organisation with real authority.
- the likely external influence on the client's decisions.
- the client's preference in crucial matters.

6.0 Critical decisions under time constraint

6.1 At the start of a bid, the Contractor should identify all the decisions which are critical in making his bid competitive.

6.2 The members of such a tendering team should be made aware at the earliest opportunity, of all the requirements for such decisions.

6.3 All critical decisions in a tender should be planned similar to a construction activity in order to avoid such decisions to be taken under adverse conditions.
A 'decision programme' for a tender incorporating all critical decisions showing the types of inputs at various stages and the sources for such inputs, should be issued to the staff concerned at the start of

Recommendations (Contd.)

7.0 Inadequate communication during tendering

Prior to the commencement of tendering activities for a project, a project policy statements schedule should be issued to the parties concerned.

8.0 The level of contingency in tenders

8.1 There should be a corporate policy on the top limit for the total amount of contingency in a tender. This should only be relaxed in special circumstances.

8.2 Any contingency allowance in estimating should be shown separately. The total contingency should be monitored during tendering and controlled by periodic reviews.

8.3 If it appeared at any time during tendering that the total amount of contingency is likely to exceed the approved maximum limit, the decisi regarding submitting the bid should be reconsidered.

9.0 Uncertainty about the objective (s)

In pursuing a particular project, the Contractor should make his objective (s) explicitly clear. (These could include profit maximization, resource utilization, seeking experience, gaining a foothold in a new territory, future opportunities, etc).

Recommendations (Contd.)

10.0 Uncertainty about corporate policies

10.1 The Contractor's corporate policies to achieve the objective (s) in pursuing a particular project should be made explicitly clear.

10.2 There should be regular reviews of such policies to ensure that the desired objective (s) will be achieved.

11.0 Critical decisions under a stressful environment

The management should ensure that the responsibility of a critical tendering decision does not rest on a single person who is temporarily experiencing extreme stress because of either personal or organisational (or both) environment (s).

12. Risks

General

12.1 In carrying out risk analysis for a project, the analyst should be honest about the uncertainty aspect in the analysis.

12.2 The Contractor should consider preparing check lists for all the risky decisions in tendering.

12.3 Uncertainty

In carrying out risk analysis, evaluate uncertainty about

(a) facts,

(b) What people think about facts,

and

(c) the future consequence of present decisions.

Recommendations (Contd.)

13.0 Uncompetitive prices

13.1 The Contractor should consider

i) establishing value engineering as an integral part of tendering activities to reduce prime costs.

ii) preparing budgets followed by control of tendering costs to reduce overheads.

iii) allowing adequate time and resources for internal audit of submission documents from the clients' point of view to identify areas which need further consideration to improve his bids.

iv) the 'Human Assets' approach to decide the level of contribution from a project.

v) emphasizing on the tendering staff the need for cost consciousness in dealing with each and every aspect of a tender.

vi) using any surplus foreign currency accumulated in semi-developed countries e.g. India, to buy locally manufactured goods or services to reduce the prime cost in a tender.

vii) a long term corporate policy on the terms of payment for project in countries where there is a considerable advantage to be gained through export of cheaper locally manufactured goods and or services for future projects in third countries.

Viii) securing information of the Group's surplus currency in such countries so that it could be used most effectively.

ix) acquiring appropriate firms to reduce prime costs.

x) Long term policies on local participations and joint ventures to reduce prime costs.

Recommencations (Contd.)

13.0 Uncompetitive prices (Continued)

13.1 Continued.

xi) extensive research in to the following aspects of tendering to reduce prime costs or make bids attractive.

a) Competitive means of

- securing insurance and bonds,
- obtaining goods and services from semi-developed countries,
- providing engineering services.

b) Cheaper terms of payment in projects requiring finance.

c) efficient intelligence service to obtain information about a project at the earliest opportunity.

d) methods of establishing trade relations as a result of a clients project.

e) methods used by competitors to reduce cost.

f) competitiveness of local contractors in selected countries.

g) the laws related to taxes, custom duties, currency, expatriates, profits in preselected countries.

14.0 Delays in JV/Consortium/sub-contract agreements.

14.1 There should be a long term policy on the use of JV/Consortium partners and sub-contractors.

14.2 The Contractor should have basic understanding with a number of manufacturers, contractors, financiars and sub-contractors in order to be in a position to finalise JV/consortium or sub-contract agreement (s) within a very short time.

14.3 The Contractor should establish efficient communication channels at adequate levels to enable him to complete such agreements in a quick time.

Recommendations (Contd.)

14.0 Delays in JV/consortium/sub-contract agreements (Continued)

14.4 The contacts in such organisations should be well informed of the Contractor's policy regarding future opportunities.

15.0 Unfortunate tendering decisions

The Contractor should consider establishing an effective communication channel between contracting and tendering departments to avoid the repeat of any unfortunate tendering decisions.

16.0 Complexity, uncertainty and time constraint associated with tendering tasks

16.1 Complexity

i) Decompose a complex task to suit a particular need.

ii) Consider using carefully scrutinized heuristics.

iii) Identify or develop alternatives.

iv) Establish criteria for decisions.

v) Consider using systems analysis approach.

16.2 Uncertainty

i) Identify various expertise within and outside the organisation

ii) Use check lists.

iii) Consider using systems analysis approach.

16.3 Time constraint

i) Ensure that the resources are adequate ,

ii) Consider computerising repetitive tasks ,

iii) Take measures to reduce delays in decisions which are likely to have adverse effect on tendering time.

Recommendations (Contd.)

17.0 Internal bureacuacy

The gap between the Contractor's own requirements (regarding submitting a tender) and a client's requirements should be reduced as much as possible to avoid undue pressures on the tendering team.

18.0 Loss of time in seeking decisions

18.1 The Contractor's representatives should be given a guide line within which they should have a flexibility to take decisions while they are in the 'field'.

18.2 The Contractor should consider using rating charts (on similar basis as discussed in this study) to assist decisions dealing with selection of projects to bid.

18.3 The Contractor should consider the compatibility index approach (on similar basis as discussed in this study) to assist decisions dealing with selection of sub-contractors and an agent.

19.0 A lack of monitoring device

The Contractor should consider

19.1 establishing a measure of effectiveness for every tender submitted.

19.2 monitoring the tendering performance over a period of time.

19.3 providing a target range for each tender.

Recommendations (Contd.)

20.0 Inadequate tender support services

The Contractor should consider establishing tender support services to carryout crucial tasks (e.g. value engineering, risk analysis, tender audits, tender cost budgets and control, monitoring tendering performance, etc) to improve the tendering effectiveness.

SUNDRIES

- Recommendations for further work .

- Response, Comments, Queries/Replies and views on some of the contents:-

  - The Sponsor's response to the proposals,
  - A Contract Manager's comments, queries and replies to queries ,
  - A Risk Expert's views on Chapter 6.

- List of Appendices.

- List of Departmental Papers (D.P.).

- List of Internal Notes (I. Notes).

- Acknowledgements.

- References .

RECOMMENDATIONS FOR FURTHER WORK

The recommendations for further work are basically in three areas

1. For a particular contractor
2. For further research
3. For broadening the issue

1. For a particular contractor

1.1 To develop a coarse screening procedure on the lines suggested in this study to improve the efficiency in decision making in selection of projects to bid.

1.2 To establish important criteria for selecting agents and sub-contractors suitable for particular types of projects.

1.3 To establish the means to sharpen subjective judgements on allocation of compatibility indices.

1.4 To establish a list of criteria and the level of decomposition of each criterion in rating charts for selection of projects to bid.

1.5 To establish procedures for:

a) value engineering technique
b) project policy statement schedule
c) information centres
d) internal tender audits and a measure of tendering performance
e) project and corporate risk profiles
f) feedback of past tendering decisions

RECOMMENDATIONS FOR FURTHER WORK (Continued)

1.6 To prepare a check list of critical tendering tasks.

1.7 To develop diagnostic approach for particular types of project

1.8 To plan tender response based on particular types of project

1.9 To develop a comprehensive check list of follow up activities after submission of a bid.

2.0 For Further research

2.1 A 'stock taking' of all the reports so far by government sponsored committees and other sources but not yet released to establish the present need of British contractors in view of the changing environment in the Middle East.

2.2 An empirical study of internal and external problems faced by British contractors and to identify interface problems and their likely consequences. For example, a study of time, people, organisations, decisions, delays, risks, arguments, etc; involved in a collaboration agreement for a large scale overseas interdisciplinary project.

2.3 To simplify the multi-attribute utility approach so as to make it appealing for practicing managers.

2.4 To enable nomograms to be produced in a wide range of decision making situations.

2.5 To provide simplified PERT-type approach to assist ascribing probabilities in general decision situations in tendering.

RECOMMENDATIONS FOR FURTHER WORK Continued

2.6 To provide broader empirical evidence for the findings of the pilot work in this study on occupational stress in tendering personnel.

2.7 To provide empirical evidence to establish the usefulness of Human Asset Approach under the present Laws of this country.

2.8 To test the following hypothesis by empirical means:

2.8.1 A corporate risk profile is useful in controlling corporate risks created by potential bids and also during the construction phase.

2.8.2 The maximum risk in a project is on the 'day one' of construction.

2.8.3 Risk profiles can cope with long delays inbetween a tender submission and the contract award.

3.0 For Broadening the issue

3.1 Utilisation of nomograms developed for multi-attribute utility approach in banking, insurance, etc. fields for improving the efficiency of decision making.

3.2 Simplification of the decomposition approach for use in important personal decisions such as house purchase.

RECOMMENDATIONS FOR FURTHER WORK Continued

3.3 Extending the internal tender audit approach and the measure of tendering performance in other fields such as manufacturing, to improve competitiveness.

3.4 Extending the compatibility index approach in many selection decisions such as buying a car, selecting a territory for marketing etc.

3.5 Utilisation of risk profile approach in controlling risks in other group management such as group of hotels, companies, etc.

THE SPONSOR'S RESPONSE TO THE PROPOSALS, A CONTRACTS MANAGER'S COMMENTS ON THE STUDY AND A RISK EXPERT'S VIEW ON CHAPTER 6

A. THE SPONSOR'S RESPONSE

All of the proposals (Recommendations) were submitted to the Sponsor for evaluation. An extract from the Industrial Supervisor's (a director designated by the Sponsor at the start of this research project) letter dated 17th December 1979 to the University commenting on the proposals is quoted below:-

"His ideas and recommendations are thorough, and I think comprehensive, and will give us a lot of food for thought over the next year. Most of his recommendations make sound sense, and our difficulty will be to sort out from the wealth of his findings which ones are of the most immediate practical value to be implemented".

B. A CONTRACTS MANAGER'S QUERIES/COMMENTS ON SOME OF THE CONTENTS AND BRIEF REPLIES

CHAPTER 2:

(i) Section 2.23: Benson Committee.

Comments

Nothing subsequently came of the Committee's Report.

(ii) Section 2.24: British response to the challenge from overseas interdisciplinary corporations.

Comments

British contractors not only suffered from Japanese competition but also from Germany, South Korea (even Brown Boveri).

NEB's participation in jumbo projects failed because the Board added far too much cost for only an "insurance" input.

If Japan wants a job they get support which we cannot match e.g. Their cable price FOB is less than a British manufacturer's material cost alone.

Overall Comment:

This chapter shows a good understanding of the problems faced but does not really offer any solutions.

Reply:

The chapter is meant to discuss the problems only. Possible solutions to the selected problems are given in Chapters 6 and 7.

CHAPTER 3:

Overall Query:

Does the fact that most tenders are "one-off" exercises, and many aspects not suited to a "procedures" rule-book approach, affect the concept of tenders being subject to analysis as a process?

Reply:

Fig. 3.4.3 treats tendering as a tree assembly line for "one-off" product.

CHAPTER 4:

(i) Section 4.2.6: Evaluation of risks and contingency pricing.

Comment: "Diversity" should be considered in addition to "frequency" and "severity" of risks.

(ii) Section 4.2.7: Competitive pricing.

Comment: The problem is that, in the power generation field, UK supplies are geared to CEGB specifications which are often not suitable for developing countries and far too expensive.

(iii) Section 4.2.9: Tender Reviews.

Comment: A major project can have such far-reaching effects on the company that review at the very top level is essential. The problem is to keep it within bounds.

(iv) Section 4.3.3.2: Uncertainty in assumptions.

Comment: A sensitivity analysis helps deal with this problem.

Overall Comment:

This chapter is good in analysing the problem. I am not sure that there are any good solutions that I have come across.

The problem is that the solutions offered are themselves fairly complex, and have to be by people in the small tendering team who are already struggling to keep their heads above water with all the time and other pressures working on them.

Reply:

This study appreciates this problem and has suggested in Chapter 7, a role for Tender Support Services Manager.

CHAPTER 5:

Section 5.3: Time Constraint

Comment: True. Time constraint causes stress and errors. What can we do about it?

Reply: See Fig. 5.3.1. Identify critical decisions in tendering and plan decision time as illustrated in Fig. 5.3.1. Also see Recommendations 6.0 (especially 6.3).

Overall Comment:

This chapter shows a good understanding of the problem.

Disagree with the heuristic approach. Unless some real thought is given to its application by someone who can back his judgement by experience. An ordinary "rule of thumb" used without thought can be a recipe for disaster.

Reply:

Section 5.7.1 defines heuristic as 'recommendation for action likely to help in the solution of a problem but no necessary certainty of success'. It also highlights the fact that heuristic methods rely much on intuition, discovery and experience in working similar problems.

CHAPTER 6: Introduction

Comments: (i) Contractors have to do guess work because full information will never be available.

(ii) It is very true that the utility of a contractor for a project can be different under different situational factors.

Section 6.2.5: Contractor's criticism of Decision Theory.

Comments: Systematic approach to decision making.
A systematic approach obviously correct providing one has the time and resources to do it and these resources are being used in a most effective way.

Reply: Hence the argument for tender support services and a measure of tendering effectiveness in Chapter 7.

Overall Comments: (chapter 6.)

Comment: (i) Worked examples dealing with multi-attribute utility theory (MAUT) depends too much on the judgement of the DM who is answering questions and you may well find that a different manager or possibly the GM or Ex. Director would give quite a different set of answers. Therefore, one need to consider the sensitivity of the approach to different answers.

Reply: The intention of including MAUT in this study was to establish its usefulness in tendering decisions. Its potential has been illustrated but when using in practice, corporate preferences will have to be obtained.

Comment: (ii) One's approach will also vary from time to time, and any table of utilities will need constant up-dating.

Reply: The structured approach to decision making will require explicit corporate policies which will change according to internal and external environments. Hence the need to up-date the preferences.

Comment: (iii) Risk Analysis: The principle of a project risk profile and on to a corporate risk profile is a good one.

Comment: (iv) MAUT: Again, the principle appear sound, but it does have several in-built weaknesses.

(a) The decision maker will not trust the mathematical approach unless he really understands what the utility factors mean, how they derived and how sensitive they are to changes in preferences and/or allocated values.

Reply: See Appendix A6.0.1 for similar criticism of Decision Analysts by Admiral Rickovers.

This criticism is discussed in Section 6.2.5.

(b) So far, your example considers 3 attributes. You may well find that some managers will have additional or different attributes. Can you deal with more than 3?

Reply: Keeney & Raiffa (1976) have identified MAUT solutions with more than 3 attributes.

Comments (Contd.)

CHAPTER 7: Section 7.4.2: Human Asset Approach.

Profit Centres:

Comment: One problem with Profit centre is that maximising one division's profits may not maximise the Group's interest. Hence failures of co-operation between different parts of the Group.

Comment: Section 7.4.1: Value Engineering.

I believe there is an important role for VE in tendering. Tenderers are often asked to bid against a client's specification, but may also if they wish tender to their own alternative design. When all competitors are bidding to a possibly expensive design, if VE can produce a cheaper but equally acceptable alternative, one can possibly undercut all the opposition.

An example (from .... diesel station) is where consultant specified a full basement to the power station building which added considerably to the civil costs and was not necessary with a different cooling arrangement for the sets.

Comment: Section 7.4.10: Project Policy Statement schedule.

The concept of a Policy Statement Schedule, revised periodically as necessary and issued to all hands is a good idea to assist communications, which is one of the most difficult things in a job.

Comment: Section 7.4.11: Section of suitable tendering personnel.

All the recommendations make sense but there are so many that it will take a super organisation to cope.

Comment: Section 7.4.5: Selection of suitable projects to bid.

I prefer this solution to MAUT because it considers more variables and is altogether easier to handle and to understand.

This probably does have practical application.

Comment: Section 7.4.4: Estimating the costs of expatriates.

This basic approach is what we do at present; but not computerised, the problem is not arithmatic but determining local price and cost levels.

Comment: Section 7.4.12: Information Centres.

C. AN INTERNATIONALLY RECOGNISED RISK EXPERT'S VIEW ON CHAPTER 6:

(An interview on 21st March 1980, with Dr. D. Hurta, Professor of Management at the US Naval war college, (formerly chief of the Decision Analysis Office, Defence Systems Management College, See Appendices A-A1 and A.6.2.1)).

Comments:

"The majority of topics discussed under Chapter 6 'Decision making in risky situations' are being discussed in the present Seminar on Risk Analysis (20-21, March 1980, at Hyde Park Hotel, London). Multi-attribute utility approach is increasingly used in strategic decisions in America. Application of MAUT in bidding situations is a useful contribution. Risk profiles should assist managers in decision making. Remember, Decision Theory can sharpen DM's judgements but cannot replace his experience. MAUT, Risk profiles, etc., should be seen as decision aiding tools only".

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LIST OF DEPARTMENTAL PAPERS *

DEPARTMENTAL PAPER NO.	TITLE
6.1	Decision analysis - A general review of earlier studies and the controversial assumptions.
6.2	Measure of utility: ordinal and cardinal utilities and indifference curves.
6.3	Utility and measurement of utility
6.4	The sources of contribution to Decision Theory
6.5	A brief review of gambling theories
6.6	Subjective probabilities, processing of uncertain knowledge, Development of SEU model
6.7	Decision behaviour based on expected value.
6.8	Information processing and searching strategies
6.9	Decision type, decision levels and organisational 'fat'.
6.10	A review of Multi-Attribute Utility Theory (MAUT)
7.1	Ascribing probabilities of having to pay liquidated damages - by using PERT approach
7.2	Q-Sort Deck statements describing qualities required in tendering personnel.
7.3	Comparison of VE and Works Study
7.4	Heuristics in VE Studies
7.5	Phases of VE.

LIST OF INTERNAL NOTES *

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6.1	Phase I Risk items and sources of uncertainty - A check list Phase II Initial risk assessment Phase III Risk evaluation Phase IV Risk control decisions and final evaluations Phase V Risk evaluation summary
6.2	Budgetary control of contingency
7.4.2.1	Cost of Tendering
7.4.2.2	Human Asset Approach
7.4.3.1	Check list of tendering activities
7.4.3.2	Chart showing tendering activities
7.4.3.3	Schedules for estimating tendering costs.
7.4.4.1	Cost of expatriates: Breakdown for computer application
7.4.5.1	Grading of the available project information
7.4.5.2	Computer Rating charts for selection of projects to bid Charts 1 to 20 inclusive. Computer print-outs
7.4.11.1	Measures to improve efficiency and competitiveness of tendering personnel
7.4.15.1	Optimization of tenders.

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At the initial stage of such a project, every researcher faces the most difficult task of acquiring the data. The nature of this research study is such that most of the required information had to be obtained by discussing various aspects with individuals concerned within and outside the Sponsor's organisation. Instead of attempting to make an inexhaustible list of these individuals, I am taking this opportunity to express my sincere gratitude to each and every individual including my past colleagues and associates who, through their critical but constructive comments, have assisted me in my task.

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I am most grateful to all the young ladies in the sponsor's organisation who assisted in typing this Report. I very much appreciate their help and would like to thank each and everyone for their contribution.

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