Chapter -1
INTRODUCTION

1.1 TRIGGERING POINT

With the growing impact of technology on business and the growing prominence of research and development in the spectrum of corporate activities, considerable attention has been directed to the special problems of the R&D function, its organisation, its planning and control, its budgeting, and especially the formulation, evaluation and selection of the R&D projects, their successful execution and implementation.

The breakdown of traditional management approaches in R&D has been conspicuous, and considerable experience and insight have already been brought to bear on the problem. Further to this the rapidly changing business environment is imposing an array of new problems and requirements on the technology-based corporations.

With this background the present study is triggered by the following developments mainly in fields of R&D management and Information Technology.

(a) Emergence of project management as an important functional discipline

Formulation and execution of projects have been the main mode of creating new infrastructure and technologies throughout the civilization, even though the nature and complexity of the management functions varied over the time.

The post world war-II era is characterised by large scale government sponsored mega projects mainly in the domain of aerospace and military applications. However, during the recent times the rapid growth of research and development activities has given rise to a totally new kind of innovation oriented business environment wherein the projects are viewed as a source of new business generation.

All this resulted in the emergence of project management as an important functional discipline which has a major influence on the
performance of the organisation as well as on the economy of a
nation as a whole. Hence, there is a need for continuous improve-
ment in all the activities related to the projects right from the idea
generation, project formulation, project appraisal, project execution,
and project completion.

(b) Emergence of portfolio management

A large number of R&D organisations both at the national level as
well as at the company level with a specific responsibility of prod-
uct/technology development have given rise to a new organisational
setup, wherein at any given time, a portfolio of project exists at
various phases of their life cycle.

A new decision making requirement arises for this kind of
organisations for the optimisation of resource utilisation through the
selection and execution of the most appropriate portfolio mix of the
available projects. This has given rise to a new dimension in the
project management by the amalgamation of the portfolio theory
and practices from the financial management discipline with classi-
cal project management practices.

The portfolio mix of projects is the order of the day and is going to
remain for the time to come in future. Hence there is strong
requirement to develop appropriate management mechanisms to
deal with the portfolio mix of projects at any given point in time.

(c) Emergence of new practices to reduce cycle time from the
design to production to marketing

Technology generation through R&D projects has become a new
source of competition in the world, sphere headed by mainly the
success of Japan in the consumer product industry. However, with
the intense international competition, rapid technological advances
and increasingly sophisticated and demanding customer, it is be-
coming difficult to compete on the product’s technical performance
or price alone. Development of high quality products, that satisfies
the customer’s expectations in every respect, faster, more efficiently
and at a competitive price, has become essential for the survival.
This has resulted in the emergence of various new strategies to
reduce the time-frame from the design to production to marketing of a new product. Of these, Concurrent Engineering emerged as the most promising strategy for this purpose. In practice the implementation of concurrent engineering varies widely ranging from mere parallelisation of activities that are normally performed in a sequential manner to the simultaneous design and engineering of new products by cross functional teams right in the computer based design domain. One of the most common practice of the concurrent engineering implementation is the development production concurrency as has been practiced in the Indian Guided Missile Development Programme.

Since Concurrent Engineering is a new and emerging practice no standard readymade solutions are existing to assess the implication of concurrent engineering on the other project management activities. Hence there is a need for establishing framework for analysis of concurrent engineering practices and their effect on the other management practices.

(d) Advent of information technology and emergence of decision support systems

The advent of information technology with large processing power available with compact computers have opened up many opportunities for optimization of managerial decision making processes. The latest developments in this field, viz., the networking and connectivity and the creation of virtual organizations are some of the most advantageous developments for the R&D projects. Of these, the emergence of decision support systems is the most significant development as it enables integration of a wide variety of managerial functions that are normally carried out in isolated functional silos.

1.2 PROBLEM DEFINITION

1.2.1 DECISION PROBLEM

R&D managers all over the world are continually faced with a series of decisions as to, how a project is to be selected, how best we can monitor and assess its performance at any stage during its life cycle, what mid
course corrections will avoid time and cost overruns and when to initiate its closure to prevent further drain of valuable resources etc.

In the case of organisations dedicated to the research and development, the decisions will be more complex such as what portfolio mix of projects will result in most optimum utilisation of the resources and will be most beneficial for the organisational growth, how best the available knowledge on the projects can be used to ensure successful completion of the projects meeting the technical performance with minimum time and cost overruns, what are the implications of using new practices such as concurrent engineering on the overall performance of the projects etc.

There is an urgent need to find answers to these and many more such questions that arises during the day-to-day functioning of an R&D organisation.

1.2.2 CONSTRAINTS

Currently no standard systems are available and no readymade solutions can be found for the above problems from the literature. Hence, realistic assessment & evaluation of a portfolio of R&D projects with uncertainty and complexity has remained as an important problem in the field of R&D management.

During the last four decades following the world war-ll, many new methods of working and new ways of thinking have been introduced in the field of R&D management. Hundreds of models have been developed in the mid 70's and 80's on the R&D project selection and initial project appraisal. Similarly considerable amount of literature has been published in the areas of tools for planning, monitoring and controlling of the R&D projects. However, all these models are specific to an application/functional area and there is no integrated model available that can provide a total view of the project.

The problem is further compounded in the case of high technology research organisations due to the need for assessment for a portfolio of R&D projects rather than a single project.
1.2.3 RECENT EFFORTS

Recently efforts are being made to evolve models for project management systems, mainly by taking advantage of advances in information technology and communication. The emerging environment provides networking, connectivity and groupware facilitating collaborative work of geographically dispersed teams. Evolution of decision support systems, expert systems and availability of large computing power facilitate real time decision-making in a complex environment. This rapid change in the ambient necessitated a continuous review and updation of all the existing practices and tools.

1.2.4 PRESENT STUDY

The present study is a step in this direction and aims at evolving a new, integrated model for the assessment of a portfolio of R&D projects with uncertainty and development-production concurrency.

1.3. SCOPE OF THE PRESENT STUDY

The present work intends to focus towards real life problem of an R&D organisation in the assessment of a portfolio of R&D projects characterised by uncertainty and development-production concurrency. The present work intends to evolve an integrated model for the above task with the help of a decision support system framework. The model is intended to serve as a decision support aid for the top management with the following capabilities:

a) to enable quantitative evaluation and selection of a portfolio of R&D projects competing for investment, based on a finite number of input parameters,

b) to enable recognition of variance from the anticipated performance for a given ongoing project at any point during its life cycle, and

c) to prove the required guidance regarding the continuation, review, closure of the projects, with a view to prevent further drain of resources through detection and closure of poor projects at the earliest possible time.
1.4 GENERAL APPROACH AND PLAN OF WORK

In order to evolve the new integrated model, the present work adopted a hybrid approach involving both case studies as well as study of real life problems with the help of "action research" approach. The plan of work involves the following steps:

a) literature survey to identify various models in the specified problem domains of
   - project evaluation and selection
   - portfolio analysis
   - uncertainty and risk analysis
   - concurrent engineering
   - Project monitoring & status evaluation, decision effectiveness, user commitment, cost effectiveness and other factors that directly contribute for the successful execution of projects

b) study of existing models to identify their strengths & weakness, critical input/output parameters, their interrelationship and benchmarking

c) survey of selected sample of real life R&D projects to gain further insight into the real life problems

d) evolving of new models/methodologies based on the identified gaps

e) Formulation of the new integrated performance management model incorporating the selected new and existing models with the help of a decision support system framework.

1.5 LITERATURE SURVEY

Over the last many years, several models have been evolved and are available in the literature, particularly for the selection of R&D projects. When these models have been studied from utility point of view, to our surprise we found that many of the models are not readily usable for real life applications. This is because the techniques described in the literature were developed to meet the specific requirements of some firm or some
readily be applied in other firms or industries. In other cases the techniques were developed in academic sittings, and they do not adequately reflect the realities faced by R&D managers in industrial or government laboratories. Moreover one does not know which model is appropriate to use for his application. To arrive at an appropriate model for real life applications it is necessary to carefully analyse the existing models. Keeping this in view a literature survey has been carried out and the details of the literature survey are presented in the next chapter.