

Chapter 5 Research & Development

Importance of R&D

For a company to prosper and grow it must do more than keep up with its competitors and it must in fact get ahead of them whenever possible. Getting ahead means innovation which hinges on research and development (R & D). Research seeks to make basic discoveries and uncover new principles or facts so far unknown or unrecognized.

Development concerns the most economically feasible method for applying the facts or principles identified by research before a product goes into full scale production. Industry is aware that tomorrow's profit depends to a large extent on today's research and the fact that money invested now in R & D probably will not generate income for several years to come. One thing for sure is that without R & D effort, there may not be any future for the company.

Research

The commonest areas of research in the broad sense are:

- a) Pure Research
- b) Applied Research
- c) Product Research
- d) Manufacturing Research
- e) Materials Research
- f) Market Research
- g) Operations Research.

Pure Research or Fundamental Research refers to investigations undertaken primarily of the sake of knowledge itself. In this type of research, there is no consideration of commercial gains. The effort is directed towards learning the laws of nature or the detailed study of accepted theory in the light of development of new knowledge. The direction of any pure research is not specified in advance but is determined as the work progresses. Traditionally, Pure Research has resulted in 'Breakthroughs' which have been recognized by coveted awards like the Nobel Prize.

Usually Pure Research is carried out in Universities funded by the government / industry. However many large corporations like DuPont, Eastman Kodak, General Motors, AT & T, General Electric, IBM etc. have been carrying at Pure Research.

Applied Research is primarily directed towards solving some specific problem which has a practical purpose. Typically applied research finds uses for results of Pure Research. Development of transistor, computer chips etc are examples of applied research. Applied Research is designed to solve practical problems of

the modern world, rather than to acquire knowledge for knowledge's sake. One might say that the goal of the applied researcher is to improve the human condition.

Several researchers feel that the time has come for a shift in emphasis away from purely basic research and toward applied research. This trend, they feel, is necessitated by the problems resulting from global overpopulation, pollution, and the overuse of the earth's natural resources, global warming, etc.

Product Research attempts to uncover new product ideas which will meet the requirements of current as well as prospective customers. In expanding product research, efforts may be directed toward new and different products, new uses for present products or utilization of a by-product. The stimulation for product research may come from results of some pure research effort, some ideas from customers, need to utilize special technical skills available in a company, desire to expand product line in a feasible direction, etc.

Manufacturing Research is directed towards development of tools and equipment, handling devices, and methods of manufacture which can result in costs and increase productivity. Manufacturing research is carried out parallelly with product research as the feasibility of product research depends on the feasibility outcome of manufacturing research. Fiber optics, Robotics, humanoids, Just In Time (JIT) manufacturing, etc have added new focus in the area of manufacturing research.

Materials Research is linked with both product research and manufacturing research as the discovery of new materials has impact on both. The jet and missile age has put great emphasis on materials research leading to success of many space programs. Superplastic steel has made possibility of casting complex shapes such as precision gears by eliminating the need of costly final machining and joining commonly required with very hard forged steels.

Materials research has also introduced new materials such as plastics that can conduct electricity, that change color with changes in temperature, that degrade in sunlight without spoiling the environment, and superplastics from which automobile engines can be made. High-tech ceramics, which incidentally do not resemble traditional earthenware pottery, have been developed which are stronger, harder, lighter, and more durable than metals.

These ceramic materials have already shown up in base ball bats, golf clubs, and are being considered for aircraft and automobile engines. Some engine components made from advanced ceramic materials have the potential of eliminating radiator systems and the need for lubricants such as motor oils.

Market Research is a systematic, objective collection and analysis of data about a particular target market, competition, and/or environment. It always

incorporates some form of data collection whether it is secondary research (often referred to as desk research) or primary research which is collected direct from a respondent. The purpose of any market research project is to achieve an increased understanding of the subject matter.

With markets throughout the world becoming increasingly more competitive, market research is now on the agenda of many organizations, whether they are large or small. To conduct market research, organizations may decide to undertake the project themselves (some through a marketing research department) or they might choose to commission it via a market research agency or consultancy. Before undertaking any research project, it is crucial to define the research objectives.

After considering the objectives, Market Researchers can utilize many types of research techniques and methodologies to capture the data that they require. All of the available methodologies either collect quantitative or qualitative information. The use of each type of information very much depends on the research objectives but many believe that results are most useful when the two methods are combined.

Operations Research (OR) is focused on the application of information technology for informed decision-making. In other words, OR represents the study of optimal resource allocation. The goal of OR is to provide rational bases for decision making by seeking to understand and structure complex situations, and to utilize this understanding to predict system behavior and improve system performance. Much of the actual work is conducted by using analytical and numerical techniques to develop and manipulate mathematical models of organizational systems that are composed of people, machines, and procedures.

Development: Development is concerned with the most economically feasible method for applying the facts or principles identified before a product goes into full scale production. Development is carried out typically after applied research which itself is completed after related Pure Research. For the chemical industry, evolving a new process technology from bench scale laboratory studies to pilot plant or semi commercial plant and then scaling up to a full scale commercial plant is an example of development.

In the engineering industry, process development focuses on machines, tooling, methods, plant layout, special device design, CAD / CAM etc. The development team which is interdisciplinary in nature reduces the discoveries of research to practicable and viable ways of implementation. Product development is the bridge between research work and engineering work. The product development team makes several product designs, tests and evaluates the designs. The product development team works in close rapport with the process development team and the market research team.

Organizing for R & D: More than a head, R&D projects require a champion and if the project does not have a champion, one must be got as soon as possible. A champion is someone in an influential position who likes and actively promotes the project to the company. Champions emerge or are selected. They often come from technical or marketing and occasionally from business. Communication between the champion and the other departments must be good.

Champions from marketing are often more effective. If a project is completed and still does not have a champion it will probably be shelved. This should be no surprise. It means that not even one influential person inside the company liked the project enough to fight for it.

The spread of off shoring activity worldwide has brought in its wake challenges to the science and practice of management, particularly in the case of off shoring of R&D.

Management science experts and firm executives are now faced with issues of matching organization structure, management practices and business procedures to the needs of outsourcing/off shoring of innovation and R&D.

One of the world's best-managed companies, General Electric, operates four corporate research centers around the globe--in Niskayuna (New York), Bangalore, Shanghai, and Munich.

Niskayuna is the largest and oldest lab (1,700 scientists, started 1900) and Munich is the newest (100-plus scientists, started 2003). In 2005, General Electric had more than 2,000 employees in its John F. Welch Technology Center in Bangalore, serving both its corporate research group (approximately 600 of the 2,000-plus employees) and multiple business units, and doing applied as well as fundamental research--all at a fraction of the cost of the Niskayuna research center.

And, although GE's Bangalore technology center was officially started in September 2000, it is obvious that the company's India R&D strategy started much earlier, having evolved from its market presence in diverse industries (power, medical, appliances, plastics, and finance). GE's global R&D strategy and its R&D center in India exemplify the kind of shifts in R&D and product strategy that almost every industry is going through.

Research Project Evaluation: Keeping in mind the limited resources of money and talented human resources as well as the uncertainties and risks involved, it is essential that only those R & D Projects that will bring the greatest return to the companies are considered and initiated. Some of the criteria used to evaluate R D projects are:

- Does the project meet the company's product line objectives?
- Does the company have the resources it needs?

- What are the commercial and national economic profitability prospects?

Pay Back Period (PBP) which is the number of years required to recover the investment is often used for R & D project evaluation. $P = I / O$ where P is pay back period in years, I is Rupees invested in R & D project, O is uniform annual return from project in Rupees per year. For example if Rs 120,000/- is needed for a R & D project which is expected to generate Rs 30,000/- per year, then Pay Back is $120,000 / 30,000 = 4$ years. If risk factors in terms of probability of success for various R & D project alternatives are available, then the pay back period can be suitably estimated.