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ENGINEERING DESIGN CAPABILITIES IN INDIA 1/

by

the secretariat of UNIDO

By way of introduction to the purpose of this paper, which is a discussion of the problems of increasing engineering design capabilities in India, it may be of interest to give a brief statement concerning the UNIDO project there.

The project is the Institute for Design of Electrical Measuring Instruments, and it is situated in Bombay. The Plan of Operation was signed in April 1969; however, UNIDO had a Project Manager assigned from December 1968.

1/ This document has been reproduced without formal editing.

The Plan of Operation envisions a five year programme costing $833,000, with counterpart contribution in kind of about the same amount. The project is to have seven United Nations Experts and thirty professional persons on the counterpart staff. Other Indian personnel totals 81 persons. The project offers twelve Fellowships. The facilities are to include a Mechanical Workshop, Heat Treating, Inspection, Electroplating, Paint Shop, Calibration and Testing Laboratory, Drawing Offices and Library. A Training Section will be for sixty trainees on three levels; engineers, supervisory staff, and skilled workers.

Many of the medium-sized instrument industries are long established, some even before independence in 1947/. Their proprietors are highly skilled and successful, with much experience in the business world. There are also more recent comers, entrepreneurs, men of vision who have recognized the demand for certain products, are manufacturing them and selling them.

These business men are, for the most part, educated and knowledgeable people. They read foreign trade and technical publications, travel abroad, negotiate with present and prospective collaborators. They are confronted with Government regulations of the most trying and frustrating kind--labor laws, currency regulations, materials allocations, and import and export restrictions.

These problems also apply to the small-scale manufacturer, but to a lesser degree. He is not usually involved with export nor with collaboration. His experience has most probably been wholly in India, perhaps confined to one small area.

Manufacturers are always seeking ways to increase their business, but they do not appear to be unduly concerned about the design capabilities of their organizations. If the question is raised, they may well point to sales figures as testi-

many that their performance in this field must be adequate.

At the present time three methods are used by manufacturers for introducing a new product to the market:

1. Collaboration, usually with a foreign company;

2. Acquisition of a foreign made item and copying the design; and

3. Company research and development.

Most industries prefer the first approach, that of foreign collaboration. However, the number of prospective collaborators is limited and Government rules for collaboration are understood to be quite restrictive. Companies with substantial capitalization and persons of considerable private means will be most likely to succeed in attracting a collaborator.

Such collaboration in the private sector is seen to be mutually beneficial. The Indian manufacturer is supplied with a fully developed ready-made item, the technical know-how, and a market for his products. The collaborator receives the benefits of this production, as well as an extension of his field of operation. One manufacturer in Bombay is exporting 3000 meter movements a month to his foreign collaborator.

There is a growing awareness on the part of the Indian manufacturer involved in a collaborative business that he must diversify and establish independent interests in anticipation of the time when the foreign connections will be severed. But this is another problem.

Smaller companies cannot attract a foreign collaborator. They resort to purchasing, or otherwise acquiring, a suitable item for manufacture and copying it in secret until it is ready to go on the market.

This procedure sometimes leads to failure because the manufacturer may not have sufficient knowledge of the properties or principles of operation of the product. It may contain special metal alloys and other materials of which he is not aware. Or, if he does know they are integral but not obtainable, he may attempt material substitutions which will result in poor performance or outright failure.

Acquiring import licenses is a major problem to small scale industry. The Government policy is to allow imports of raw materials by actual users according to the availability of foreign exchange. This severely affects the small manufacturer who must apply for a yearly quota of imported raw material.

There are all degrees of technical ability, training and ingenuity, and many succeed financially through the process of direct copying.

The procedure of planned research and development is the least prevalent approach. Usually it can be practiced only by those companies with substantial capitalization. However, this is not always the case; a concept of the value of the scientific approach can provide the motivation. Two young men engaged in cottage industry level manufacture of chemical porcelain developed, through a planned programme, their own body and glaze for crucibles. Their crucibles compare favourably with any on the world market. But generally speaking, research and development is costly, takes time, and there is always fear of a leak to competitors. Indian manufacturers appear to have unlimited patience and a sense of timelessness which helps them in dealing with Government departments; but they also have an almost excessive sense of urgency when it comes to conducting their immediate business affairs.

In order to answer the question, what is the state of development of engineering design capability, a definition of design capability is needed. Then the situation in India can be matched with the elements of the definition.

Since we are concerned with the goal of marketable products, design capability, by definition, should contain all the essential steps to engineer a product from inception of an idea until the idea becomes a manufactured item. This is also known as R&D, research and development. There must be technical leadership and expertise on the part of the person or persons who can take an idea and follow it successfully through each stage of development.

Market research is not to be considered engineering design capability, although it is of primary importance since it determines whether a market will exist for the product after time and money have been expended in its development. Market research also reveals the competitive potential, and constant efforts in this area are necessary.

First comes the idea. It is market researched and an estimate made that the product will still be in demand at the time when its development is completed. It has also been determined that the specifications of the product appear to be better than anything envisioned by the known capabilities of the competition.

Development planning is done. The knowns are separated from the unknowns. The unknowns are distributed for solution among scientists, engineers, mathematicians or designers, as required. After some time it is to be hoped that the unknowns will be solved, and the results are all reduced to manufacturing

drawings.

Models are made and tested and, if successful, a pilot run of from five to fifty units is constructed. Much experience and knowledge of the product is gained and, when production problems are ironed out, permanent tooling is made and actual mass production commences.

This can be a complex, extremely sophisticated process. In modern technology, computers are called upon to help keep everything flowing smoothly and to ensure that no step is omitted.

In its simplest form much foresight, skill and astute execution are required for the successful completion of a development programme. For today's product one man, no matter how clever, cannot hope to do everything by himself.

Only one electronics company in India is known to follow the procedures of a progressive development programme. It is safe to say that the design capability, as defined above, hardly exists in the instrument field in India. The leadership of most organizations would consider such a procedure a waste of time because, although the product they market may have some faults, they expect that it will sell anyway.

The actual state of development of the engineering design capability follows a short-cut procedure. It is the method followed many years ago when only sketches were made by the proprietor and given to the master mechanic who made the pieces and, by filing and fitting and correcting errors at the bench, got the thing to work. It cannot be denied that this is design capability of sorts, but not for today's products.

What are the factors which mitigate against improving the design capability?

Indian manufacturers are keenly aware and wary of competition. There are instances of trade secrets which died with a father who refused to turn them over to his sons. Manufacturers are reluctant to take up the manufacture of an Indian originated product which has not be exclusively their own idea and developed by themselves. Any Indian originated product offered by an outsider may also be known and in development by some other manufacturer. R and D, as practiced in the West, is a cooperative venture involving even hundreds of scientists and engineers; in India it appears to be difficult for the proprietor to share his ideas with even his trusted employees. Thus, he frequently tries to do the R and D himself, as well as carry on his business. At best, he will give hastily conceived yet specific instructions to be followed by a member of his staff, but permit very little design initiative to the engineer. It has been observed that R and D in medium sized companies suffers from this attitude.

The business man's sense of urgency has been mentioned. He is driven to high speed and short cut methods through his fear of competition and his acute sense of cost consciousness. Consequently, he is almost parsimonious with his employees and his methods of business operation; he just cannot permit his overhead costs for R and D to become a significant factor. Some are amazed when they learn that, in the West, a development programme from inception to market may take as long as five or seven years. Even one year for the development of a product seems too long. He is reluctant to spend the time and money in the development stage to acquire experience and understanding

of what he is making. His only thought is to make a model, manufacture a quantity, and sell them fast.

This attitude toward R and D makes the task of upgrading the design capability more difficult. As a test of this, a course in advance engineering drawing was offered to practicing mechanical designers and which included limits and fits, general tolerances, and geometric tolerances--all required for precision design work. The response was nil. It was explained that the mechanical designers had sufficient knowledge to do what is presently expected of them by their companies and, if they received more training, they would either demand more money or seek jobs elsewhere. This is fundamental information with which few designers are familiar. On the other hand, a proposed course on transducers was well received, since this is more esoteric and does not have an immediate market value for the students.

This point of view held by the manufacturers also leaves open to question the notion that instruments which are designed and manufactured at a Design and Prototype Centre will be taken up with alacrity by the manufacturers. Past experience has shown that this is not the case, and there is still no indication of any interest or support for such a programme by the manufacturers. In fact, it has been stated that the contrary is true. Concern has been expressed that design centres would encourage cottage industries to make instruments, and that villagers would be coming to the market place with baskets of instruments that would undersell theirs. In today's market the buyers are not discriminating; price is the main factor, they would not purchase the quality products at a higher cost.

What are the factors which mitigate toward improving the design capability?

Probably first and foremost, the realisation on the part of business and Government that something is wrong, something is not functioning properly, because, even after twenty years, technology must still be imported on a large scale. Hardly a day goes by that an eminent scientist or political leader does not raise the question in the press. Indian science and technology is a subject for debate in Parliament. Businessmen also seem to be seeking for a breakthrough, so that their own companies may prosper more.

Another significant positive influence is the Defence Establishment. The Chief Inspectorate of Electronics is upgrading the quality of technical products manufactured in India. They have good testing facilities, including environmental, and samples of components as well as the entire equipment must be submitted for type approval tests before acceptance by the Defence Establishment. A demand for higher quality will demand a higher design capability.

A problem for which the design capability is not responsible is a shortage of essential materials. Beryllium copper for springs is not available; low temperature coefficient modulue of elasticity materials are not available; instrument suspensions and instrument springs of required materials or characteristics must be imported. The finest designer cannot design instruments to a required accuracy if he cannot specify proper materials. The problem is aggravated by the advance technology required to produce these materials and the low quantity required per year. It is not an attractive commercial proposition.

The industrial productive capacity for instruments now being manufactured is sufficient to meet the demand. There is even overproduction for watthour meters. The industry is looking for new products to produce, rather than new markets for their present production. Of course, the export market is always attractive, but foreign competition is too great in most instances. Instruments and instrumentation for process control are a wide open field, and it is believed that these instruments will be attractive for manufacturers to produce.

There is a need for a more effective design capability, but industry itself must take the initative. The effort must be one based on mutual respect and cooperation between the assisting agency and the manufacturer.

In the final analysis the question resolves itself into one of education as the only real way to increase the engineering design capacity. Practical courses of training are offered to young men but, if the proprietors are not convinced as to the value of such education, they will not permit the trainees to practice it. If the proprietor cannot understand the mathematics of a computation or the symbols of an engineering drawing, he will reject it. Conversely, it is customary not to do anything to indicate to the proprietor that the employee may have more technical knowledge than he. Therefore, the technical level of the organization is governed by the proprietor.

It is believed that the proprietor will be convinced intellectually of the efficacy of a programme of development, but to induce him to try it will be more difficult. He is being asked to invest in the distant future, and who knows what the future will bring. He may be willing initially to experiment with a programme of development on a small scale.

For short term results, education of the young designers and engineers in advanced subjects in the instrument field is to be tried. The educational programme will be explained to the proprietors at meetings and their approval or suggestions will be solicited.

In conclusion, the Indian instrument companies are not lacking in basic technical training and manufacturing ability, but rather in modern engineering management techniques as practiced by the western countries. However, the Indian manufacturer is exceptionally capable, and he knows better than anyone what suits Indian commercial conditions. The assisting agencies should demonstrate other methods which are considered more advanced, but the final decision on what is to be done naturally rests with the proprietor.

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