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An Analysis of the Status and Functioning of R&D System in Food Manufacturing Companies in Japan

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1. Objectives :

The objective of this paper is to make an analytical distillation of the status and functioning of R&D system in food manufacturing companies in Japan against a brief review of their techno-economic background.

2. Method of Analysis :

Analysis of the status and functioning of R&D system in food manufacturing companies is made by considering qualitative and quantitative dimensions. The required information was collected through interviewing executives and top officials using depth interview schedule developed for the purpose. This was supplemented by related field data provided by the food manufacturing companies and various other organisations concerned. The available published data also was utilized.

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3. Techno-economic Background of Food Industries in Japan :

Prior to World War II, Japan's food industrial structure, like many other underdeveloped countries, was dominated by industries like breweries, milling, fishery, livestock and dairy products, etc. These industries provided simple articles of food for general consumption.

The two most notable features of the food industries during this period were: (i) this sector consisted a big 'small units' sector, and (ii) the relative importance of food industries was greater in providing employment. This was due chiefly to their low productivity. High employment orientation and low labour productivity were mainly due to the fact that much of the operations in this sector were done by manual labour with simple tools.

Due to the existence of few monopoly units and a large number of small and less efficient units, the economic structure of food industries was not conducive for the operation of the innovative system. No special attempts were made by smaller units as processing of food was carried as joint undertaking with agricultural sector for use and benefit of the rural areas. No compelling need for the introduction of new technologies was felt by even bigger units as they were enjoying monopoly.

But post-war Japan witnessed rapid structural changes with high rate of economic growth. Almost the first task of the government was to bring about structural and economic reorganization of all industries. The general industrial policy of Japan during this period was designed to break-up monopolistic tendencies, encourage cooperation, removal of various economic controls, increasing internationalization of domestic industries through technological, trade, and capital liberalisation.

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A revolution in food consumption pattern in the direction of Japanese diets also was another factor that brought about structural changes in food industries. A continuous increase in the amount of amount of money spent on food, continuous shift from low value added type to high value added type of foods, shift from home eating to eating-out took place.

In order to cope up with the competitive impact created by the government policy and the changes in the food consumption pattern, food manufacturing companies had to seek new ways of adjustments. These adjustments took the form of economic reorganisation of units to remove bottlenecks of scale, incorporation of changes in the product structure to suit the changing consumption patterns, entering into capital and technological tie-ups with foreign firms to meet the challenges of the open economy, scaling up of R&D activities to cope up with the changing technological environment, etc.

As a result of the above changes, in the first place, food industry has emerged as an important segment in the total manufacturing industries' sector. For example, excluding the alcoholic beverage industry, food industry supported 90,000 business establishments with approximately a million employees in 1969 producing goods worth of 5,100,000 million yen. It represented 13.9%, 9.1% and 8.9% of corporations, employees, and products respectively of all Japanese manufacturing industries. The 1960-69 growth rate averaged 12.0% annually while it was 15.8% for manufacturing as a whole.¹

Secondly, consistent tendency towards a decrease in the number of small enterprises is noticed since 1954. While the total number of

¹ Ministry of Agriculture and Forestry, *Agriculture and Food in Japan*, (1974), p. 44

small business is decreasing those with less than 10 employees have decreased by 10%, while those with 10-99 employees have expanded by 20%, and those with more than 100 employees have trebled.² In certain production lines where large scale production is possible the trend is towards concentration and growth in size of enterprise. Concentration is most evident in the manufacturing of mayonnaise, beer, whisky and butter followed by glutamic acid, yeast and powdered milk.

Structural and organisational changes that took place as described above have set in new trends in food industries. These new trends are:

- a) food industries are growing into big business,
- b) few lines of food manufacturing are experiencing declining trend and few others are experiencing expanding demand trend calling forth adjustments in the product structure,
- c) all these adjustment processes have involved R&D in some form or the other and hence food manufacturing companies are scaling up their R&D efforts, and
- d) above all, it has created a system for food industries receptive, responsive, and adaptive to innovations and facilitated creation of new patterns in scientific and technological capabilities.

4. An Analysis of the Status and Functioning of S&D System in Food Manufacturing Companies in Japan:

(a) Changing Pattern and Philosophy:

As stated earlier, Japan underwent far-reaching changes in economic thinking after II World War. Major changes were sought to bring about structural reformation with the balance being tilted towards non-food industries. R&D policies were attuned to the policies of

2 O. E. C. D. *Food Marketing and Economic Growth*, (1970), p. 96

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open economy to meet international economic and technological challenges to attain technological leadership in certain areas. R&D policies and programmes were given 'outward' emphasis.

Whereas in respect of food industries consideration was different. Japan's food and feed self-sufficiency rate has been low and the nation's requirements were met by importation. Partial fulfilment of the nation's total food and feed requirements was attempted by domestic efforts through pursuing R&D in secondary lines of enquiry like introduction, assimilation, and domestication of foreign technology. The objective of technological leadership in this category of industries was not thought of. Hence, if in respect of non-food industries the direction was 'outward', in respect of food industries the direction was 'inward'.

Changes are also noticed in the relative importance of objectives in the total spectrum of R&D objectives and one can observe the movement upward in the scale if one can think of different levels in the scale - shift from profit objective to welfare objective, from development of technologies on on-going business to pursuing R&D in newer areas, etc.

For instance, the predominant objectives of the food manufacturing companies hitherto were product / process improvement and cost reduction. R&D for improving the existing products and processes or R&D in extending the technology connected with on-going business were the main objectives. This was so because the incentives and rewards come from the market either due to reduced cost or improved performance achieved through R&D. Companies had little genuine interest in carrying out R&D in newer areas. Also, most of the food industries were long been protected by the government policy.

But in recent years the food manufacturers are heavily pressurised by the tight input system; are forced to work out measures to fight industrial pollution and are required to observe strict standards as to the composition of products, additives, and agricultural chemicals; are facing waves of internationalization and capital decontrol in which case competition among Japanese and foreign manufacturers are expected to intensify; also the companies are fearing shortages of natural resources supporting their industries. In such circumstances the companies are trying to find out an answer through reinforcing their R&D efforts. Now, more important R&D objectives seem to be R&D for new product / process development, conservation and substitution of scarce resources, salvage of waste materials for controlling pollution, etc.

A clear indication towards long range R&D in food industries is found if one observes the changes that are taking place in this sector. For instance, the current position of food industries are strong as a result of earlier R&D efforts. In recent years the interest seems to be towards long range R&D. Attempts are being made to recognize the future demands of the society and economy on R&D, technological demands of the products on R&D, terms of meeting them, and the time span within which they can be expected to meet etc., are all underway. To determine R&D requirements on above lines a wide use of R&D management techniques like Technological Forecasting, systems concept, and control methods, is made.

Also, a change in the thinking about R&D in food industries is noticeable in general. Until now this sector was mainly concerned with adapting to itself technologies developed in other industries, by other disciplines, and in other countries. Not only such a process of

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adaptation is speeded up in recent years but also one finds that demands in this sector are stimulation R&D in interrelated disciplines and industries - R&D in materials, machines, and control.

b) Presentation and Analysis of Data on R&D in Food Manufacturing Companies:

Food manufacturing companies in Japan are responsible to a great extent for growth of R&D through their recognition and commitment to the function. The extent of commitment to R&D function can be seen by the increasing number of companies accepting the function as essential. For example, the importance and necessity of R&D was recognized by food manufacturing companies as early as 1898 when Yamasa Shoyo Co., Ltd., established its research institute in Thiba. Since then, many companies have established their research institutes. We find to-date as many as 32 companies having their own research branches to support their R&D activities.

Also, increasing number of companies are committing to the function by way of committing more men and material. For example, all the six big companies with a capital of 10 billion and above, 75% of the companies with a capital of above one billion and below 10 billions, and 60% of the companies with a capital of above 100 million and below one billion yen are all conducting intramural R&D.¹

Commitment of the food manufacturing companies by way of expenditure increased from 4,793 million yen in 1961 (2.9% of the total expenditure on R&D in manufacturing industries that being 1,48,609 million yen) to 29,278 million yen in 1972.² As measured by the

1 Bureau of Statistics, Office of The Prime Minister, Japan, *Report on the Survey of Research and Development in Japan*, 1973, pp. 66-69.

2 *Ibid.*, pp. 54-56

intramural expenditure on R&D as a percentage of sales, the data increasing amount of sales proceeds being dedicated to R&D year by year. It increased from 0.35 in 1961 to 0.43 in 1972 ¹

As regards the manpower engaged in R&D in food industries, the number of regular researchers increased from 2,344 in 1962 to 5,129 in 1973. During the same period the number of regular researchers in all manufacturing industries increased from 42,857 to 1,17,544. ²

It appears from the analysis of volume of expenditure on R&D and the manpower engaged in such activities in food manufacturing companies, one striking feature is, though in absolute amount and number an increase from year to year is noticed in these industries, it is far below the level of both financing and personnel when compared with other industries which are far ahead. But, however, it can be hoped that in the coming years a decisive take-off may occur both in expenditure and manpower dedicated to R&D activities at the company level.

As is well known, R&D process has three important phases, basic research, applied research, and developmental research, though in recent years many more phases are recognized in the total process. Broadly speaking, a trend which is usually observed in many countries, basic and applied research are carried out by universities and institutions of higher learning, the companies emphasize developmental research. Such a trend is also noticeable in Japan in respect of other manufacturing industries. The percentage distribution at these stages in manufacturing industries is 8.4, 22.5, and 69.0 respectively on basic, applied and developmental research.

1 *Ibid.*, p. 58

2 *Ibid.*, p. 52.

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But a slightly higher percentage of spending on basic research by food manufacturing companies is reported, the percentage being 9.3 on basic research, 25.6 on applied research, and 65.1 on developmental research. Higher percentage of spending on basic research is reported by companies within the bracket of the capital size of one billion to 10 billion yen, the percentage distribution on basic, applied, and developmental research by this category of food manufacturing companies being 16.4, 31.6, and 52.0 respectively.¹ Smaller food manufacturing companies with a capital size ranging between one million yen to one billion yen are spending much on developmental research following the trend in other industries.

The possible reasons that can be thought of for higher percentage spending on basic research by food manufacturing companies are, the integration of R&D programmes involving R&D in not only food manufacturing stage but also R&D in agricultural raw material development; another reason could be that some big food manufacturing companies due to their long history in the business have built up certain well-developed R&D disciplines with reputation. Most of the companies have invested in building their own R&D divisions and specialized disciplines though occasionally they have given some aspects of research to outside agencies.

Since food industry is a diverse group with sections of prosperity and sections of depression, a correct appreciation of the level of R&D efforts calls forth product-wise analysis. Such an analysis was carried out by considering equipment investment, investment on R&D, investment at different stages in the total R&D process for different products. The analysis brought out the following points:²

1 *Ibid.*, p. 116

2 Source: Survey by the Japan Development Bank, Japan.

- 1) Out of the total equipment investment of 3,817.14 billion yen in 1973 by all manufacturing industries, food industries group constituted 174.25 billion yen, out of which meat, milk and related products and alcohol (beer and wine) constituted 77.23 billion yen.
 - 2) If equipment investment in each product group is considered as equal to 100, comparison of ratio of R&D investment to equipment investment shows that it is highest in the case of wheat flour and feed industries followed by milk, meat and related products. The ratio for the total food industry group is 2.0 and for all manufacturing 3.8.
 - 3) If equipment investment in each group is taken as 100 and compared with the amount of investment for commercialization of new goods, the ratio stands at 4.1 for all manufacturing industries, 6.1 for food industry group. It is highest for edible oil and processed goods (15.9) followed by milk, meat and related goods (9.5).
 - 4) Importance of investment at different stages in the total R&D process seems to be different for different food products. For instance, investment for commercialization of new products seems to be very high in respect of edible oil and processed goods, meat, milk being second in the order.
 - 5) Considerable differences exist among different food industries in the type of R&D activities carried out. Through discussion it was found that in the case of flour milling industry lot of research activities are carried technology, lot of basic research is carried out by the beet sugar companies in the development of high quality raw material for processing. Lot of basic research is carried out by the milk processing companies on bio-medical aspects of milk products.
- c) Functioning of the R&D System in Food Manufacturing Companies:

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The most important qualitative factor which merits consideration is that R&D in food manufacturing companies in Japan was not developed in isolation. As is known, success of R&D calls forth linking of efforts in different directions - linking of different stages in the total R&D process (applied research - product & process development - manufacturing development - manufacturing economics - marketability); linking of R&D efforts pursued in other companies and organizations concerned within the same product group; linking with organizations and institutions outside the product group; technological tie-ups with foreign companies etc.

The food manufacturing companies in Japan were successful in developing such links. Such a sort of linking facilitated making technological possibility an economic reality, determination of areas of cooperation and competition among different companies and organizations, technology transfer from the so-called science based industries to food industries, etc.

As stated earlier the food manufacturing industry consisted of few big units controlling a greater share of market, and many small units. R&D requirements of smaller units were mainly met by the research institutes, central and prefectural government experiment and research stations. R&D in big companies was mostly self-managed and self-financed. The big companies had their own R&D laboratories and institutes. All the stages in the total R&D process - from the research idea generation to the marketability of the product were in the control of one company. The functions of technology production and consumption were in the hands of one and the same organization - i. e. company. Such a situation facilitated avoidance of weaker links in the innovative chain, which is very common if the functions were

controlled and managed by different organizations. Such a sort of linking facilitated development of competitive technology.

Another type of linking noticed is, though the different companies were competing units, they were successful in determining areas of R&D cooperation among themselves. Such a sort of linking facilitated development of food technology on problems of common interest to all cooperating organizations and avoidance of parallel R&D by different companies which is expensive and time consuming. For instance, inter-company R&D cooperation and exchange of R&D results is discernable in areas where regional differences in R&D results existed. In such cases decentralization of R&D efforts distributed in different cooperating companies and synthesis of R&D results obtained from such efforts facilitated building technology base necessary for the whole industry.

Third form of R&D link developed by food manufacturing companies is the development of link with other organisations and institutions which have a link with the product - backward or forward. For example, beet sugar manufacturing companies have developed links with research and experiment stations concerned with R&D in sugar beet itself. This can be termed as backward technological linkages.

The fourth form of link that developed is the cases of food manufacturing companies having links with non-food manufacturing industries. Such a sort of development facilitated transfer of certain essential elements necessary for R&D in food industries from the so-called technology based industries to food industries. One such element, to cite as an example, is the knowledge of managing R&D gained in technology-based industries.

Fifth form of linking is development of technical tie-ups with foreign food manufacturing companies. To cite as an example of new

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technical tie-ups of Japanese food manufacturing companies with foreign companies a mention may be made of such tie-ups in confectionary industry - Meiji Seika with Interfood of Switzerland (a joint venture on a 50-50 basis called Suchard Tobler); Fujiya with Rontry-Meckintosh and Tokyo Tohoto Confectionary with Midwest Biscuit of the U S.¹ Such a sort of link facilitated the Japanese food manufacturing companies to give a direction to their R&D efforts - direct domestic R&D as supportive in certain product lines, and to launch R&D in certain other areas.

These links have stabilized in food manufacturing companies facilitating the emergence of technological adaptive system. The companies are now in a position to respond effectively to environmental stimuli and the R&D systems can yield the desired results.

5. Concluding Remarks :

The above review reveals the sort of R&D efforts by the food manufacturing companies in Japan, the major partners in the total R&D efforts. An increase in the extent of commitment to R&D, a movement upward on the scale of R&D goals, an indication towards long range R&D, are noticed. The company, with strong economic and technological capabilities and a technological adaptive system, has emerged capable of handling new technological challenges.

But all along, the food manufacturing companies' endeavours were motivated by strong economic and commercial goals for achieving greater market share, higher productivity, cost reduction, increased competitiveness.

Commercial goals, though very important and right until the

1 The Oriental Economist's *Japan Economic Year Book*, 1973, p. 186

company stabilizes its position, are short range considerations. They are right when the company is progressing towards a strong position in the market. In such a situation though attempts are made towards long range considerations they are sporadic and blurred because of heavy preoccupation with immediate goals.

Having successfully achieved commercial goals and having developed a technological adaptive system, the food manufacturing companies, it is suggested, can now think on the lines of giving a distinctive character to their R&D efforts by incorporating technological leadership goals in selected areas.

It is too early to judge the potential scope of R&D in new areas as it is beset with uncertainties. But once the companies' R&D activities are biased towards now areas and technological leadership goals, the capabilities for accomplishment of the goals will develop automatically. Such a bias may be more needing in the face of falling food self-sufficiency ratios in Japan and Japan's increasing participation in solving world food problem.