Indicators of Techno-Management Capability Building in Indian Computer Firms

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Revised received: 09 May 2001; accepted: 26 June 2001

The paper attempts to define indicators of Techno-Management Capability in firms. That is the managerial ability of technological progress paths that are technology-intensive, dynamic complex and risky. The study shows how India developed over the last fifteen years in the area of electronics because of its target oriented electronics policy. Nevertheless, it could not compete internationally, especially in hardware because of weak component base. The paper concludes with some suggestions to develop Indian software industry where India could compete with other developing countries.

Introductions

To gauge the dimensions of the IT industry in India, it would be pertinent to look at the achievements and projections of the Indian hardware and software segments against the domestic and overseas scenario. The total software production, both in the domestic and export sectors, was around $3 billion in 1997-98. For the same period the hardware production, including sales within the country of imported hardware, is valued at around $2.5 billion. In comparison the world market for software is estimated to be $400-500 billion, while the hardware production worldwide would be about $300-400 billion. Thus the share of India’s software and hardware industry would be less than 1 per cent of the world market. It shows that India is a marginal player in IT. India's hardware market product-wise for the years 1996-97 to 1998-99 indicated a growth rate of 15-20 per cent per annum. In the global scenario, India’s hardware production figure of $2.5 billion for the year 1997-98 should be compared with $8-9 billion of Malaysia and Thailand, and $18-20 billion of Singapore and Taiwan (Dataquest, March 15, 1998).

In 1996-97, there were only 1.5 PCs/1000 persons in India, while China had as many as 4.1 PCs/1000 persons. The comparable world figures were much higher. In the software arena, exports from India are growing at an healthy rate and are of the same order as those from countries like Israel, Ireland and Singapore. However, with the entry of many East European countries as well as Russia and China into the global market, India will have to cope with stiff competition in future. For the software sales and production for domestic market more than one third of the $1 billion comprised imported items in the form of software tools, network software, and application packages. It suggests that software development exclusively for the domestic market, is not very significant.

A few years ago, very low level of computerization in the country was assumed to be due to the lack of adequate computer education, absence of hardware manufacturing ability, poor communication infrastructure and statutory constraints. The reasons appear to be different. The major constraint is the absence of a strong base in hardware and components within the country. India, with complex societal problems requires extensive computerization. In industry and market, the only option would be to globalize for sheer survival if not for prosperity. Globalization implies competition which calls for refinement of manufacturing processes, optimization of resource utilization and enhancement of quality of products and services. A high degree of automation in industry is thus imperative for achieving world-class precision and quality in products and services. In addition, the latest in communication technology and automation is required for efficient and effective management of transportation networks.

The country needs to experiment with computers and communications to provide education and basic
literacy to its growing population, considering the shortage of schools, teachers, and other infrastructure facilities. Computerization is also required to bring in a quantum jump in the utilization of the government's subsidies and aids to the under-privileged. In other words, a central policy dilemma is how can IT be best leveraged to improve productivity, efficiency and effectiveness in any sphere of activity within or outside the government. It should also be borne in mind that the development of domestic IT market is essential for gearing up for increased competition in the international arena. It is through domestic software assignments that Indian professionals can be best trained for client assignments overseas.

To achieve computerization of this magnitude, the country needs a thriving, hardware and components industry. Five years down the line, India will need 4-5 million PCs, meeting a need of this order, given the existing hardware and component production capacity within the country assumes significance of two reasons. First, importing all hardware would be a drain on foreign exchange, which country like India cannot afford. Secondly, meeting this would create opportunities for training engineers to become world class designers, which India can easily afford. Besides, components, hardware has become design intensive. India’s design engineers thus could be trained to develop designs for software-integrated silicon components, which can then be mass produced utilizing the excess manufacturing capacities the world over. It is estimated that in future 50% of the component cost would be attributable to the embedded software, which will well be within the country’s capability to design. In the sphere of software exports, India will face international competition from Russia and China especially in the type of assignments currently being undertaken.

The paper defines the theoretical framework of techno-management capability and its indicators. It shows how through securing higher values of indicators of techno-management capability Indian electronics companies in general grew over the last few years and specifically how Wipro Information Technology, a large domestic firm, adopted technological development and managerial path towards a success that is rather uncommon. These indicators of TMC, as the experience of a rather successful Indian company shows, are based on the four concepts of brand, quality, innovation and integrity. Attaining higher values of indicators is not dramatic, but is instead evolutionary. A firm’s attaining higher value must, as is argued, be in tandem with the society’s attaining higher status in infrastructure and in culture. It is argued that indicators of TMC, as these are based on the four concepts of brand, quality, innovation and integrity at the firm level, when constructed at the national level, do take into consideration both the firm-level indicators and the national level capability and infrastructure.

**Capability Building: Theoretical Framework at Firm Level**

The core concept is the Dynamic Techno-Management Capability which connotes firm’s ability to manage dynamic, complex and uncertain technology development system. Firms differ in performance within the same industry. There are growing number of economists who see differences amongst firms as crucial factors in understanding and analyzing economic performance at the macro-, industry-sectoral and national level. Firms are regraded as repositories of productive knowledge, accumulated through a dynamic cumulative process. The second point then is the contents of firm’s assets. These are internal assets consisting of tangible assets-including physical and often financial assets; and intangible assets, that are embodied in human resources and technology. Importance of external assets, consisting of tangible assets such as contracts and intangible assets such as brand images, relationships and networks has been explained. Intangible assets constitute the major share of the external assets. The third point is the characteristics of rents - monopoly rents, Pareto (Marshallian) rents, entrepreneurial (Schumpeterian) rents, or quasi-rents! The rent comes from inimitable, unique and superior assets of a firm.

The second dimension in dealing with firm differences among firms is the uniqueness of the growth path of an individual firm. Another related element is the balance between vertically integrated in house R&D capabilities and the procurement of necessary R&D services from outside. Pisano argues that “While in-house R&D has been traditionally an important source of technical know-how for firms, it is not the only possible sources, firms can tap the R&D capabilities of competitors’ suppliers and other organizations through such contractual arrangements as licenses, R&D agreements and joint ventures”. It has been argued that the evolution of corporate structure always simplifies a
compromise between incentive-compatibility and allocative efficiency requirements on the one hand and the imperative to learn, discover and adapt to unexpected circumstances on the other. The third element is the direction of expansion paths, the mode of diversification including vertical integration of forward and backward linkages. Horizontal cooperation such as strategic alliances and networking, including merger and acquisition among even tough rivals in the same product line, is also an emerging issue.

In addition, the continuity as opposed to the discontinuity of technology development paths, is an issue of no mean consequence. The expansion path is also well articulated by historical factors such as organizational routines and path-dependency. The fourth element is the incentives of expansion obtained through the balance between short term profit motivations and long term growth visions. There are strong advocates for the ratio of return on investment in short time, but there is also an increasing awareness of the importance of long-term growth objectives.

The third dimension in understanding differences across firms is to deal with the firm as an administrative body. It relates to the internal issues of a firm. It determines the distinctive identity of a firm. Related to this dimension is the quality of a firm’s managerial ability. Firm’s internal resources are the driving forces for its growth, and its quality of management is key force to its dynamic growth. The view, has been further confirmed by Chandler who tried to explain the evolutionary path of national economy especially focusing on American economy.

The second perspective is based on “bounded rationality”, a concept raised in a series of papers where it has been argued that all necessary information on both the alternative courses of actions and the consequences of those actions cannot be acquired and analyzed beforehand by organizations. Another aspects is the managerial ability which has to deal with complexities and uncertainty. The uncertainty, complexity and conflict in management activities have to be handled as efficiently as possible. The uncertainty emanates from external sources such as generalized uncertainty of cause-effect ambiguity and contingency in environment as well as from internal sources such as inter-dependence of components. It is caused by the behavior of the market the deliveries of suppliers, the attitudes of shareholders, the behavior of competitors and the actions of government agencies.

However, this managerial ability has to be cultivated within the firm. Demsetz mentions the worldly role of management, being to explore that uncertain possibilities and to control resources consciously, where owners of resources have a penchant for pursuing their own interests, are not easily analyzed in a model in which knowledge is full and free. Clearly our understanding of firm can be improved by recognizing that management is a scarce resource employed in a world in which knowledge is incomplete and costly to obtain. There are two sharply contrasting perspectives relating to the distinctiveness of a firm. The industrial position view, stresses the importance of external factors, in formulating firm capabilities and performances. On the basis of the above argument a firm could be conferred the status of the most important source of competence in innovation activities.

Techno-Management Capability

Techno-Management Capability (TMC) is a firm’s managerial capability of address issues arising out of strategic technology. TMC is the managerial capability of dynamic, turbulent, complex and uncertain path of technological progress.

The meaning of ‘dynamic’ in TMC has multi-dimensions. There are three categories in the concept of dynamic, all of which constitute TMC either alone or mixed together: (1) The first category is the long-run (longitudinal) case long-run technology development activities in a firm which take several years of sometimes even several decades. In this case both path-dependent and future oriented proactive activities are influential in technological progress. (2) The Second category refers to a vertical case of handling at the same time both the forward linkages with the suppliers of the equipment’s and raw materials and the backward linkages with customers during a period of firm’s launching its R&D projects. (3) The third category is the horizontal case. It is the case of simultaneous mobilization of cross-functional departments such as production, marketing, financing and human resources. An example is the concurrent development system in which R&D activities, the development of manufacturing technology, and the training of technical manpower are propelled in a parallel way. In other words, TMC is the managerial capability...
to handle the technology development systems in firms which are dynamic, complex, and uncertain.

Capabilities can be classified under three major groups, each characterised by its defining parameters. These are (1) Resource exploiting Capabilities - characterized by technological learning outside technological sourcing, human resource exploitation, and resource focusing for the target; (2) Managerial Integrating Capabilities - characterized by task force team (integration between R&D and production), concurrent development system (managing multi-faceted activities, production focused technology management, interfaces and consensus building among functional departments, and top management's leadership and involvement) (3) Path Navigating Capability - characterized by planned management, fitting into changes in environment, and joint R&D activities.

Related to the firm’s capabilities, Chandler(6) notes “For the history of industrial enterprises, learned routines are those involved in functional activities .... and ... developing new ones. Even more important are those routines acquired to coordinate these several functional activities. Essential, too, are those learned in the strategic activities of responding to moves by competitors, of carrying on the long costly and risky process of moving into new markets and adjusting to the constantly changing economic, political and social environment”. Here the first element can be analogous to the resource exploiting capability the second one to the managerial integrating capability and the third one to the path navigating capability. It has been noted in literature that organizational economic competence involves[7]: (1) allocative competence—deciding what to produce and how to price it; (2) transactional competence—deciding whether to make or buy, and whether to do so alone or in partnership; and (3) administrative competence—how to design organizational structures and policies to enable efficient performance. The allocative competence can be interpreted as the path navigating capability in this study, the transactional competence as the resource exploiting capability and administrative competence as the managerial capability.

Technology Development Path

When most other were closing down their R&D units or at least pruning them down, the company decided to expand it and “launch itself as a global provider of technology, services and products”, says Sridhar Mitra, vice president and chief technology officer, Wipro Ltd. “In-house R&D is an outdated concept; development units can be converted into profit centers (from cost centers) only if the global requirement are kept in mind,” adds Subroto Bagchi, vice president technology division, Wipro. The strategy has obviously paid off. Spin off in 1981 with 80 persons and globalised in 1990, the new look R&D has grown into 400-member division with cumulative earnings nearly touching Rs 1 billion. Its client list includes AT&T, Intel, Tandem, VLSI, UB Networks, Novell, Statacom, Chorus and Sunsoft.

The first break came in the early 1990 from Intel engineers who had gone for a specific project, came back with orders to design ABI/BCS2 tests suites for their end customers, major OEMs and ISVs. Tandem projects for Japan to port OS on R300 platform and Sun's project for setting up an interface between their engineering team and OEMs/ISVs followed, Odyssey 2001, and extension of Wipro’s global R&D in the US has crossed the $1 million mark within five months of its inception. Wipro Infotech Research and Development Division has designed a new range of mother boards based on Intel's PS4C the latest Pentium processor or that hit the market. This is the first time an Indian company has underwritten the entire development costs of design, running into few hundred thousands dollars — and borne the accompanying risk. This was a significant development, considering that it marks a radical departure from the trend prevailing in the Indian hardware industry.

Typically Indian companies which undertake design work share the upfront cost of design development with
an international vendor and get a percentage of royalties when the product hits the market. This ensures that the risk is shared between the parties. Cost sharing is de rigger because the front-end investment that is required to undertake such design development in India is rather high in terms of capital as well as manpower requirements. This course was followed by Wipro Infotech till recently. However, Wipro Infotech has now borne the entire cost in designing motherboards based on Intel's Pentium 100 Mhz chips. Wipro Infotech has designed a range of PS4C based motherboards with varying price and performance levels. The boards are integrated by the Original Equipment Manufacturers (OEM) into their systems. The company offered designs with rights to manufacture the boards themselves. The Wipro Infotech was quick to get the range off the ground. The engineers at Wipro Infotech had started work on the project, codenamed 'Pluto' in February, 1994 a few weeks before the PS4C was officially announced. The risk involved in the Pluto project were high. But the returns were also considerable if the product finds wide acceptance, as Wipro Infotech would get 100% of the royalties on this product. The focus of the Wipro Infotech R&D efforts have changed substantially since 1990. Earlier, it used to lay emphasis on designing products for the Indian market as there were barriers to entry for making forays into Indian market as well as for exporting from here.

R&D at Wipro Infotech has changed from being a overhead function to a regular business division and the majority of the work done was for the global market. Now the focus for designing and manufacturing locally for the international markets. The core competence of this division has been identified in hardware design, operating system and networking technology. The identified products are those where the software and design contents are high and the volumes low by international standards. One such product is LAN terminal server (LTS), which Wipro Infotech is selling in 20 countries. The company developed this product with Nupon a start-up in terminal servers. Wipro Infotech has exclusive rights for LTS in India while Nupon holds the rights in the US. The mission of the Wipro's R&D is to be a global provider of services, technology and products while positioning itself as an intelligent interface between the technology provider and technology packagers.

Wipro's Chairman Introspection

Azim H Premji, chairman, Wipro Corporation says that in the next 15 years the Indian companies will have to recognize, understand and overcome four major vulnerabilities—brand, quality, innovation and integrity. He feels that Wipro have not fully understood the alchemy, the power, and the vulnerability of brand as a corporate strategy. Brands, according to the chairman, are fortresses. If Indians do not have a strong and ongoing brand strategy, the customers will not know how to differentiate between Indian and its competitors. Internationally, people have grasped the importance of brand building so well that they may be prepared to put a company up for sale, but not its brand.

Brands are not about pouring bottomless budgets into media advertising. Nor are they about creating hype for an organization and deliver this value day after day. The brand has become a science and a corporate art that takes a lot of understanding, research and top management’s time. The chairman said that at Wipro, currently they are researching the Wipro brand and corporate identity. This study has led to the discovery of several interesting insights on what this company stands for and the status it could potentially occupy in the Indian and global marketplace. Facing international competition with unbranded products and services will be disastrous.

Quality

In the early nineties, Wipro became pioneer in introducing quality when our manufacturing and service businesses went through ISO certification. But it was soon realized that ISO 9000 was not the last benchmark of quality. The chairman himself spends more than 20 percent of his time meeting customers, many of whom are world leaders. Decision was taken to turn Wipro into an entity belonging to the league of world class or organizations, and for attaining that, a compliance-driven quality culture like ISO 9000 alone would prove woefully inadequate. Questions were asked as to who did it better, and time and money was spent in getting a first hand feel of how companies like GE, Xerox, Matsushita, Motorola, Texas Instruments and Samsung had gone about managing quality. Differences in both the rigor and level of contextual understanding were identified as the major roadblocks. Soon Wipro
signed up the Motorola University in Chicago, bought the intellectual property rights of Motorola's Six Sigma approach to Total Quality Management and created a six-year rollout that would take Wipro's five businesses to Six Sigma level by the year 2002. A project-based approach was chosen. Three things were found important—defects, cycle-time and team. Accordingly quality drive was situated on reduction of defects and of cycle-time, and in making a good team.

Innovation

The chairman things that although by Indian standards, Wipro is quite innovative, it still have to undertake long strides to achieve international standards. The major thrust of innovation has been on the customer care business, where it competes with MNCs and enjoys leadership in select product segments. So what helped Wipro grow in non-organic areas? The chairman thinks however, that what made this company bring out one great product after another is a closed economy. Strategic thrust given to innovation and to the techno-management capability enabled it to create the most successful R&D that runs as a profit center with a thousand people; and innovation is the key to making it the second largest software exporter in India. At Wipro, management of innovation is encouraged through enabling the organisational space conducive to "insight". The future will increasingly demand, argues the executives at Wipro, that innovation ought to be managed as a science, and there are companies that do it. Management of Toyota, Samsung, HP, Xerox, and 3M companies work hard to create conditions in which people deliver innovation and get rewarded for it.

Integrity

Brand quality and innovation are critical, and so is integrity to the long term success. At Wipro, it is regarded as the bedrock. Integrity is completely internalized through institutionalisation of the processes of innovation and quality-attainment. The chairman argues from his personal experience that value based business is profitable. It is possible to combine values and business leadership even in the trying times of today. The need to continually articulate the importance of values and audit at and through the company as a team, and teams individually, have been the abiding attitude and this has been achieved through formal, periodic surveys.

Conclusions

Wipro's technological development paths have been evolutionary processes. Although the performance has improved very sharply, this impressive improvement have resulted from numerous incremental improvements which have materialized in short time. This better performance has come from sustained vigorous hard work rather than a one-shot technological breakthrough. Particularly those processes revived have been a kind of heuristic developmental path rather than an automatic. The paper defines the theoretical framework of Techno-management capability, and its indicators. It shows how through securing higher values of indicators of techno-management capability Indian electronics companies in general grow over the last few years and specifically how Wipro Information Technology, a large domestic firm, adopted technological development and managerial path towards a success that is rather uncommon. These indicators of TMC, as the experience of a rather successful Indian company shows, are based on the four concepts of brand, quality, innovation and integrity. Attaining higher values of indicators is not dramatic, but is instead evolutionary. A firm’s attaining higher value must, as we argue, be in tandem with the society's attaining higher states in infrastructure and in culture.

The Indian case illustrated the potential “comparative institutional advantage” of state-connected organisations in promoting informatics infrastructure. Large projects customised to the local cultural and organisational environment may be extremely valuable in making sure that the local society as a whole realises the potential returns from global changes in information technology, and technologically entrepreneurial state organisations may have a comparative institutional advantage in realising such projects. Whether the focus is on informatics infrastructure or more strictly on strategies for building the greenhouse itself, the success of any policy is contingent on the institutional context in which it is attempted.

References


Appendix

Wipro Infotech Ltd
- In Information technology business, since 1981
- India's most respected computer company
- 1994-95 revenues at $135 million
- Consistent growth in revenue and profits since its inception
- Successive winner of "National Awards of Excellence"
- Organized into independent Business Divisions addressing various IT market needs

Business Solutions Divisions
- Manufactures, markets and support notebooks, Desktops and Servers
- Markets Landmarks and Wipro fusion range of Servers and Super Genius range of Personal Computers

Network Systems Division
- Strategic Alliance with Sun Microsystems, USA
- Has No.1 market share in Workstation business
- Delivers direct/ through channel
- Expertise in industry segment like finance, telecom, manufacturing and earth resources
- Thrust in commercial RISC/UNIX & EWS engineering workstations

Research & Development
- Driving force behind Wipro Corporation's successes in IT. Has seeded start up teams in Wipro Systems, Wipro GE Medical Systems
- Has 500 engineers, organized into:
  - Hardware design and ASIC
  - Operating Systems
  - Networking Technology
  - Undertakes projects and design products for Global partners
- ISO 9000 compliant for Systems and Communications Software Systems Engineering Divisions
- Provides customized solutions for India's strategic needs in space & defense areas
- Satellite tracking systems
- Fiber-optic network
- Ground check-out system
- Rugged onboard computers
- Currently refocused to enter systems integration business in specialized area
- Strategic alliance with Intermec, USA to provide barcode solutions
- Leader in Industrial Grade computers/terminals