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Focus : Small and Medium Enterprises

The Challenges for SMEs

Green Productivity & SMEs

Innovative Financing of SMEs

IT Applications in SMEs

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Managing Inter-organisational Alliances: The Challenge for SMEs

S. Raghunath

The world of business is changing rapidly. The winds of globalization have pushed SMEs to grapple with the changing needs of their customers. Large enterprises view SMEs as surrogates or satellites that would rotate around them seeking revenue and possible profit. The SME story of maintaining few customers and depending on them for major chunk of business is gradually undergoing an overall perspective change, states the author.

S. Raghunath is Professor, Indian Institute of Management, Bangalore. Paper presented at the International Forum for SMEs, New Delhi, 10-12 April 2001, (Organised by NPC, India & APO).

SMEs – The Challenges Ahead

SMEs are forever balancing the demands of keeping their working capital cycle under manageable limits and satisfying the quality and delivery criteria of their customers. In the process SMEs juggle between handling employee productivity, capital cost and product cost while meeting the expectations of the customer. It has always been a challenge to curtail and drive down costs while enhancing quality and customer service. SMEs are also facing a turbulent environment as the needs change rapidly and they are expected to develop a mechanism to take on the demands of the market place and offer suitable customized products with sufficient speed to convert the market opportunity into realizable revenue.

Obviously this calls for speed, ability to innovate, energy to monitor the changing expectations of customers and an organisation that delivers flexibility and required quality. As speed is of essence, the SMEs should possess not just the ability to monitor changing customer expectations but also the ability to get the organisation to innovate quickly and produce an acceptable product and service to capture the business opportunity. The competence to innovate stems from several factors – notable among them are:

- Technology upgradation
- A link with the lead users who generate ideas for new product development

SMEs should possess the ability to get the organisation to innovate quickly and produce an acceptable product and service to capture upcoming business opportunity.

- Downstream products to link with upstream products
- A mechanism to deliver the product concept and functionality through an organisation that is able to consistently service customer needs and after sales needs.

Managing Innovation

In the current business world, a new product idea and its offering today is called an innovation, next week it becomes an imitation and a month later it becomes a commodity that is available everywhere. Therefore, SMEs have to think of multiple innovations to keep ahead of the game. Any questioning of the possibility of making this happen will obviously meet with a host of road blocks as the company, its resources and its competencies are limited and therefore not quite capable of continuous innovations. This is where the role of strategic alliances and joint ventures appears to be relevant. Strategic alliances and joint ventures bring together complementary competencies and market focus. SMEs have found this route to be attractive while meeting the challenge of innovation and market penetration.

In recent times SMEs have attracted phenomenal funding for innovative products and services. The recent binge of financing hi-tech companies has led to many startups in the last 24 months. There are four trends that are deforming the business landscape and creating opportunities: Reverse markets, where power moves to buyers; unbundling and rebundling such as contract manufacturing; eroding industry boundaries and asset arbitrage. These are often knowledge assets locked in by brick and mortar such as traditional companies developing their service wing to attract better revenue and higher margins.

While it is important to pursue innovative products and service, it is equally important that a revenue model takes care of the costs of the innovation. Technological innovations get paid well because they create the backbone of the new economy. However, market innovations that create new distribution channels for various services find it tough to create revenues to take care of innovation costs.

Value Creation vs. Value Capture

The cult of innovation may suffer from the difficulty of distinguishing deeper impact innovation from peripheral impact innovation. Therefore, it is very important to focus far more on value capture rather than just

value creation. SMEs have to find ways to monetize the work their companies have done. In other words, SME owners need to look for new ways to make money rather than for new ways to make just products and services. Producing tech innovations has become orders of magnitude easier than making money. As far as the market is concerned, business model innovation matters more than product and service innovation.

SMEs need to carefully look at the return on their capital and the possibility of raising capital to prove their innovative ideas. It is easier to enter into a joint venture or an alliance to get the most innovative ideas to see the light of the day. Generally SMEs go by the view that creating value has to be followed by capturing value on a stand alone basis. These are difficult times confronted by a disruptive technology assaulting industries. The good news is that SMEs have been attuned to the threat of technological innovation and the need to be an innovator. The bad news is that all this innovation in the market place has destroyed the ability of most companies to command a premium for innovation. The challenge now is to find a balance between promoting innovation and building a sustainable business.

The challenge now is to find a balance between promoting innovation and building a sustainable business.

This is where joint ventures and strategic alliances have a major role to play. The ability to withstand any market shakeup and the ability to penetrate markets in a short span of time is fortified and facilitated by alliances and joint ventures.

In the rapidly digitizing global economy, the role of joint ventures and alliances is gradually undergoing change. There is no more the concept of an enterprise in the operational sense. In the legal sense there is an entity called the firm but on the ground it is an extended enterprise. This has happened primarily due to the advent of innovation in telecommunication. Instant access and real time response have become a reality these days. Networked communication, particularly in the form of electronic data interchange (EDI) allows the firm's external constituencies including suppliers, retailers, distributors, government, local communities, and even competitors to link their operations and perform their transactions instantaneously as the computers can talk to each other instantaneously.

The drive to be responsive and flexible to the needs of customers brings forth even more exciting oppor-

tunities for alliances. Mail order houses are teaming up with overnight couriers by running their warehousing operations at the courier distribution centres. The earlier delivery time of six to eight weeks has collapsed due to this development. By pooling resources, primarily in research and development, competing organisations in most industries have recognized that they can benefit from the results of better products and new markets.

SMEs & The Virtual Corporation

Concentrating on what a company does best and leaving the rest to partners has led to the emergence of the virtual corporation. This is an adhoc alliance of organisations, most of them being SMEs, taking advantage of dynamic business opportunities in e-commerce. The key physical linkages are provided by information technology, which is removing most of the limitations imposed by time and distance. While the lack of distinct physical boundaries may give an image of a computer-generated entity, its name is not derived from virtual reality. Rather it refers to an older technique of making computers act as if they have more internal memory than they do by the use of external virtual memory.

By drawing on the strengths of all its partners, a virtual corporation can in principle, outperform what is suggested by its physical characteristics. By pooling partners' strengths and expertise, a virtual corporation can gain scale without the size. Overhead costs are minimized with each partner focusing on his core competency. This means better return on investment. The ideal analogy is that of the football team. The goal of winning is clearly defined. The window of opportunity is extremely narrow but well known to facilitate precise planning.

This vision of business enterprise is as in the case of film industry. Teams of producers, screenplay writers, director, actors, actresses and film crew are brought together to make a movie. A close alliance among the partners is essential for the project. However, when it is over, whether any of the collaborations will be repeated depends largely on the needs of the future projects.

This is similar to the basic structure of the virtual corporation but not quite the same because of the nature of the stakes involved. The conventional approach is essentially a system of contractors and sub-contractors. There are the principals, typically the producers who may be backed financially by banks or venture capitalists. The other partners mostly under contract even if they get a share of the profits are part of the arrangement. As providers of service, they can atleast in

principle expect to be paid irrespective of the success of the project. This is not the case with corporations. For all practical purposes, this company can be located anywhere on earth as long as it has a satellite or computer network link. However, all partners to the project gain or lose together depending on how well the product sells. For such a network of companies to work, knowledge of each other's competency and a great deal of trust are essential. Every one must be committed to customer focus so that the company can benefit from all the individual contributions with responsiveness and flexibility. An entrepreneurial spirit to make what one can sell and not just to sell what one can make, is a critical success factor for the SMEs in a virtual corporation.

Alliance Management – Brick and Mortar SMEs

Let us turn to brick and mortar SMEs. Companies in vulnerable strategic positions caused by difficult market situations or risky strategies find strategic alliances useful in sharing risks, paring costs and regaining market power. However, a question that remains to be answered is – is managing alliances an area of expertise to be carefully nurtured in SMEs? The answer is pretty obvious. SMEs have structured many alliances but have managed only a few successfully.

Alliances are notoriously difficult to manage. Companies with top management from two or more parent companies, do not take kindly to interference from the head office of parent companies. Each alliance is unique, to be experienced and built on mutual respect and shared interest rather than on legal documents and tight controls. In these circumstances, power has to be shared, autonomy granted and the alliance held together by trust and common goals.

Power has to be shared, autonomy granted and the alliance held together by trust and common goals.

Close cooperation between alliance partners imposes a distinct set of requirements on the participating companies. Foremost among these requirements is the need for substantial delegation while maintaining a collaborative and participatory management style. A strong emphasis on environmental and organisational learning is demanded of all alliance partners. The proliferation of equity and non-equity based alliances in the stables of SMEs carries many challenges for the manager. Unfamiliarity with a hybrid organisational culture, limited delegation, compensation gaps, split loyalties, exile

syndrome and re-entry difficulties combined with staffing friction: at the forefront of these problem areas is lack of or inadequate preparation of managers for their new roles and relationships. An equity or a non-equity based alliance is a marriage of distinct corporate cultures. Through the merging of organisations, employee attitudes, values, behavioural norms and expectations shared by each partnering entity must be assimilated into the greater business alliance or joint venture organisational culture.

A priority for senior management training must be to build the behaviours, expectations and shared values that bring about high commitment to the new hybrid organisation. Executive education can be a means by which formal and informal rules governing behaviour which apply to all aspects of the organisation's practices can be assimilated and further developed. Training sessions can be used to encourage executives to think in ways consistent with the cultures, objectives and interests of all partners. This process can serve as a mechanism for developing and perpetuating a unique alliance culture.

The intensity and complexity of interpersonal skill training would depend on the nature of the alliance—whether it is non-equity, minority stake oriented or equal/majority equity joint venture. Management style flexibility, team building skills and communication skills would rank high on the list of skill requirements of alliance managers. A mismatch is often observed between business strategy and executive development programmes because differences in executive group interpersonal interactions and in types of alliances are not assessed. Negotiation, although of importance in all types of organisations, ranks high in alliance oriented organisations.

New Roles for SME Managers

A much more serious challenge for SME managers arises because of a traditional hierarchy-based organisation experimenting with horizontal linkages requiring less hierarchical practices. The role of senior executives is becoming more that of a team player and broker of others' efforts, than that of a dictatorial boss. Executives at the interface of their parent company and alliance company have a new role to teach, train, cajole and comfort employees involved in alliance based initiatives. In the emerging alliance based organisations, managers add value by deal making, by brokering at interfaces rather than presiding over individual fiefdoms. Managers and professionals at the corporate headquarters of alliance oriented companies have a strategic and collaborative role of serving as integrators and facilitators rather than as watchdogs and intervention-

ists. Business alliances and joint ventures serve to change impersonal, arms length contracts into relationships involving joint planning and joint decision-making. In the collaborative tasks that result, managers are more personally exposed. It is trust that makes alliances work.

Managers of alliance oriented companies have a strategic and collaborative role of serving as integrators and facilitators rather than as watchdogs and interventionists.

The search for internal synergies and the development of strategic alliances, emphasise the political side of a manager's work. Managers must be able to juggle a set of constituencies, rather than control a set of subordinates. They have to negotiate and persuade instead of making unilateral decisions and issuing commands.

Alliances that put lower level people in direct contact with each other across departmental and company boundaries, cut heavily into the managerial monopoly of information. Above all, there is a clear opportunity in such a dispensation for executives to learn new skills or apply them in new areas. It is possible that this might become an important motivator, as real time skill development ensures employability in the emerging future. The attractiveness of domestic companies who become a hub for alliance based growth often lies in their capacity to provide unique experience and learning through alliances. By this calculation, access to training, new mentors and challenging projects and milestones become more important than mere pay or benefits.

A difficult but possible change that the top management of SMEs participating in alliance based growth need to accept, is to see their company as a cluster of activity sets and not as a rigid structure. The work of top management in such companies will be to organise both sequential and synchronous projects of varying length and learning, through which varying combinations of people will participate, depending on the tasks, challenges and opportunities facing them and their alliance partners at any given moment.

Importance of Knowledge Creation and Learning

Another important question that needs to be addressed is whether SMEs really benefit in the long run from alliance based growth. The short answer to a long deliberation is that it pretty much depends on what the domestic partner acquires in terms of competitive

positioning, organisational excellence and knowledge through a process of knowledge management and creation. When an equity or non equity based alliance is created, organisational boundaries become porous. This provides partnering companies with a window on their partners' broad capabilities. Consequently, knowledge creation and learning should be viewed as a potential strategic benefit of alliance based growth. Such knowledge has the potential to be shared and distributed within domestic companies.

The translation of new knowledge into independent organisational action by the parent domestic company is the basis for creating new skills that support a company's competitive advantage. Some factors that require due consideration are:

- Even if domestic partners in alliances have access to the foreign partner's skills, the knowledge required to eliminate foreign dependency is usually more difficult to acquire for the domestic partner than for the foreign partner. A foreign partner can easily acquire local knowledge such as investment regulations, business culture, supplier practices and labour laws but a domestic partner may not quickly absorb the skills of manufacturing high precision products. For gaining a degree of parity on the rate of knowledge transfer on both sides of the strategic alliance, the domestic partner can discourage the foreign partner from sending a large number of managers to the hybrid company. Knowledge creation in organisations begins with individuals. The greater the number of foreign managers in the alliance, the greater the foreign partner's access to local knowledge.
- Another point of action for the domestic partnering company is that it should continuously upgrade the value of the knowledge it provides to the foreign partner by continually actively investing in local knowledge. The domestic counterpart can negotiate for greater responsibility in managing the strategic alliance and in effect increase the importance of its role in the venture's success.
- While the domestic company in the alliance context may strive to upgrade its value contribution to the foreign partner, it needs to constantly update itself through internalisation of knowledge acquired through the alliance route. To internalise knowledge, the domestic alliance partner must be willing to acknowledge that learning from the foreign partner is an important strategic task.

- Making a transition from a home grown domestic company to a company enlisting a foreign partner in an alliance introduces a learning challenge. Learning to adapt to the foreign partner entails suspension of existing beliefs. It also means giving similar weightage to survival and advancement activities. The overall goal of survival activities of domestic companies is to focus on product market positioning, planning, organising and controlling—managing the input output relationship between the company and the environment through the alliance.
- However, if SMEs have to consider the advancement of their existence in business, activities such as documenting knowledge and ensuring knowledge connectivity must be actively encouraged and factored into performance management systems. SMEs may like to provide periodical forums for organisational members to introduce new ideas, new concepts, and new experiences based on their alliance interaction. The key question would be to what extent new understanding and new distinctions in the existing spheres of knowledge are languaged in the organisation and how long they are sustained. New understanding and distinctions often vanish simply because they are neither understood nor further debated.

The SMEs striving to take on foreign competition need to expand their mindset and culture to team up with foreigners and to acquire and retain intellectual assets with a near religious focus on the customer and progressive human resource policies. The rules of competition in the domestic industry as they emerge in the new millennium will demand organisations built

The rules of competition in the domestic industry will demand organisations built on change, not stability; organised around a network of alliances, not a rigid internal hierarchy, and built on technological advantage, not on land and buildings.

on change, not stability; organised around a network of alliances, not a rigid internal hierarchy, based on interdependencies of partners, not self sufficiency; and built on technological advantage, not on land and buildings. □

Entrepreneurship Development for SMEs in the 21st Century

Gopal Joshi

The prevailing dynamic business scenario demands a relook at the categorisation of SMEs. The article analyses the job creation potential, growth orientation and the likely scenario in the coming years, of SMEs in the changed context.

Gopal Joshi is Senior Enterprise Specialist, ILO. This article represents author's personal views and does not necessarily subscribe to the ILO's official views. The paper presented at the International Forum for SMEs, New Delhi, 10-12 April 2001, (Organised by NPC India & APO).

How small is small?

An enterprise could be called small, yet could be highly productive and profitable to rapidly expand as a world class enterprise. Dynamism and growth of small enterprises accompanied by their access to modern information and communication technology (ICT) and global value chain linkage could render them more competitive than many of the larger enterprises around the world. Such scenario in the developing economies has caused quite a bit of confusion in terms of what can be termed as small enterprises.

The basis of definition of small enterprises has varied depending on the countries of reference; for instance, while in some countries, small enterprises are defined on the basis of capital investment, many countries find it convenient to utilize the number of workers as a standard basis for distinguishing small from medium and large enterprises. However, even the yardstick relating to capital investment and number of workers changes among the countries. Sri Lanka considers enterprises with up to 25 workers as small, whereas Bangladesh considers enterprises with power, with up to 150 workers as small (Gopal Joshi, Unpublished). Even within a country, different government agencies may use different basis for defining small enterprises. Such as in Pakistan, Punjab Directorate of Industries considers Rs. 10 million in fixed assets as small enterprises. The emergence of ICT application in small enterprises has further compounded the scenario. The problems of definition present the difficulty in assessing the situation faced by the small enterprises and in projecting the likely scenario in the future.

Thus, the nature of today's small enterprises is increasingly determined by their:

- Dynamism and growth
- Access and integration to ICT

- Linkages to value chain

Due to rapidly changing technological scenario in information and communication technology (ICT), the ability of the small enterprises to reach markets beyond their own geographical proximity and the ability to source information and input from large number of people and organisations through worldwide connectivity have transformed what used to be traditionally considered small. Due to the use of ICT, productivity and transaction costs of small enterprises have been drastically altered. Although one could make a distinction between ICT related small enterprises and non-ICT enterprises, it can be surmised that the distinction will be increasingly blurred, as many non-ICT enterprises incorporate the technology for their activities with increasing link up in the value chain, as is already happening in the movie industry, publishing business, and automobile manufacturing.

Due to ICT, the ability of small enterprises to reach the markets beyond their own geographical proximity and the ability to source information and inputs have transformed what used to be traditionally considered small.

Today's small enterprise may be so thoroughly linked to value chain with global suppliers and marketing organisations that it may be able to multiply its business capabilities several fold than what outwardly may seem as a small business. A small enterprise may only be small in name since it will have far greater access to resources and global reach to the market. By the same token, it cannot remain immune from the risks and challenges faced by the entire value chain as well.

But are the above scenarios true for all countries around the world? Most certainly not. There is the so called 'digital divide' among countries as well as within countries. There are countries that have advanced in business computer usage and internet connectivity far beyond the imagination of many developing countries. Many of the developing countries are facing illiteracy, poor infrastructure and stagnant economies based on basic commodities or agriculture. Then, there are countries within which there exists wide variance among regions in terms of advancement in ICT and its application in small enterprises, such as in India. In India, small enterprises catering to limited local market, those linked to the supply chain of the old economy and ICT enabled ones coexist in anomalous and paradoxical situation.

In India, small enterprises catering to limited local market, those linked to the supply chain of the old economy and ICT enabled ones coexist in anomalous and paradoxical situation.

Do small enterprises create jobs?

Many developing countries have pinned their hopes on solving the problems of unemployment by rapidly creating jobs in micro and small enterprises. Such hopes are not unfounded given the fact that small and medium enterprises (SMEs) create many jobs invariably in both developed and developing countries. In India, 80 per cent of the manufacturing jobs are created in the SMEs, whereas in the OECD area, small and medium enterprises account for over 95 per cent of all firms, 60 to 70 per cent of all jobs, and generate the majority of new job growth. Developed East Asian countries, like Japan, rely on the flexibility and innovativeness of the SMEs to keep the large enterprises competitive worldwide (OECD, 2000).

However, the myth that remunerative, productive jobs can be created rapidly in micro and small enterprises without macro economic and policy environment along with the requisite human resource development conducive to the growth of small enterprises has perpetuated in many countries. Entrepreneurship training programmes are conducted in the hopes of turning today's unemployed into tomorrow's entrepreneurs. New micro and small enterprises cut into the small market pie of lower or lower middle income population by slicing the share ever thinner thus driving the existing micro and small enterprises into further smaller income category and perhaps even poverty. Many micro and small enterprises are promoted without considering the need for enlarging the market pie, thus entrapping these enterprises in small scales of operations. Particularly when reservations are made for small enterprises, the scope for their modernization and growth is hindered. This is the situation faced by small enterprises in India, where the uncompetitive, traditional-technology bound micro and small enterprises are suddenly faced with global competition in the wake of trade liberalization.

Creation of a larger market pie requires that each small enterprise created provides the multiplier effect of spurring a host of economic activities through creation of productive jobs and enhanced economic activities. This may not always be the case if engaging in micro and small enterprises is more a survival activity. While certain section of the modern economy may en-

Creation of a larger market pie requires that each small enterprise created provides the multiplier effect of spurring a host of economic activities.

courage small enterprises with ICT applications, many other sectors may remain stagnant without dynamism and wealth creation. On the other hand, the job creation that may take place in expanding productive activities without market for products may end in bankruptcies and recession unless the market is protected and isolated from foreign competition. Product innovation, aggressive marketing, and productivity improvement can come about only if the complacency caused by protected market is removed.

Product innovation, aggressive marketing, and productivity improvement can come about only if the complacency caused by protected market is removed.

Can entrepreneurship development be growth oriented?

The developing economies in East Asia have gained competitive advantage due to the important role played by small enterprises in providing components and services in a cost-effective, flexible way to larger enterprises. How can the promotion of small enterprises result in faster economic growth if the anomalies of limited market and stagnation exist in the developing economies in South Asia? In order for small enterprises to be growth oriented, following conditions are required to exist:

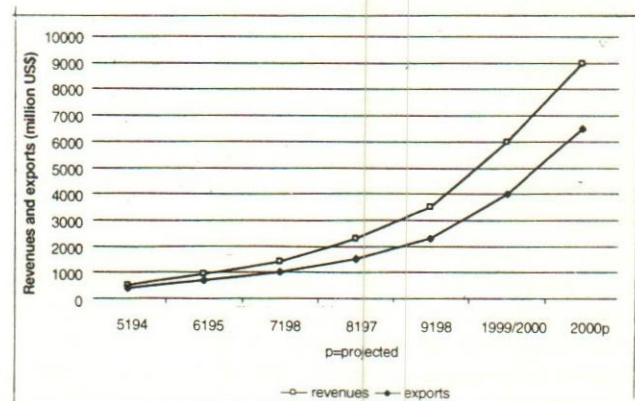
- Conducive policy and legal environment
- Adequate infrastructure
- Linkages to value chain
- Access to productive resources including credit
- Human resources development

It is very much essential that conducive policy and regulatory environment exists, wherein the small enterprises are allowed to grow larger and graduate to medium or larger enterprise. Such environment requires that there is no artificial imposition that the small enterprises, if successful, cannot grow larger and remain in the same sector. Therefore, the first requirement is that the reservations of certain sectors for so

called cottage and small industries have to cease to exist in South Asia. As the reservation is removed and small enterprises are allowed to grow and compete, many inefficient small enterprises are bound to close down. The aim of promoting small enterprises should not be to maintain at any cost unsustainable technology, uncompetitive business practices and economically unviable jobs. If the enterprises are no longer viable, they should be allowed to be bought out, merged or even closed under an exit policy. Such transition does need to take into account the social costs, and does need to be humane.

Other factors inhibiting growth of small enterprises are transaction costs in carrying out genuine business, whether such costs are in terms of the delays and fees or corruption. Unlike larger enterprises, which are often able to shoulder the transaction costs, smaller enterprises further downsize their operations as their transaction costs make them economically unviable. Absence of efficient infrastructure or the state monopoly on important inputs has debilitating effects on the functioning of small enterprises. Non-availability of continued power supply or bottlenecks in transport are bound to have negative effect on the productivity and efficiency of small enterprises. Access to information and communication technology (ICT) can be part of the availability of infrastructure. The technology itself has spawned many fast growing small enterprises while also providing the impetus for the growth of other small enterprises, which have been able to access it.

The rise of India's software industry over the 1990s represents one of its most spectacular achievements. As shown in Fig. 1, the Indian software industry has grown at a phenomenal annual rate of over 50 per cent over the 1990s, increasing total revenue from US\$ 175 million in 1989-90 to US\$ 5.7 billion in 1999-2000 (World Employment Report, 2001).



Source: World Employment Report, 2001, ILO Geneva.

Fig. 1. India: Software industry, revenues and exports, 1994-2000

However, the dichotomy between the small enterprises with access to ICT and without access to ICT is creating further complexity in the environment in which these enterprises are required to operate. It is therefore very important to create an environment in which small enterprises can access the benefits of ICT. Expansion of access to telecommunication provide the linkages essential for small enterprises to expand and access the information necessary to running an enterprise in the present complex, competitive environment.

It is very important to create an environment in which small enterprises can access the benefits of ICT.

In comparison to the small enterprises operating as an isolated entity, a small enterprise linked to a value chain has a great deal of potential to magnify its reach in accessing markets and productive inputs. The small enterprise could be a part of the local or global value chain with other enterprises, receiving design, technology and raw materials while providing the required processing for the final product and service being marketed in a geographical area far away from the location of the small enterprise. Thus, expansion of the market pie becomes possible by not confining itself to a geographical location. Garments industries receiving design and materials from the overseas principals and marketing the final products through large department stores abroad is an example of such value chain. Similarly, tele transcribing of the U.S. medical transcripts in India is another example of the enterprise based in one country providing service in another country.

In many countries, accessibility to productive inputs (i.e., skills, technology, raw materials and capital) is biased in favour of larger enterprises due to scale of economy as well as procedural requirements established by the government and the market. Nonetheless, the governments, donors and NGOs have made various kinds of attempts in making these inputs available to small enterprises. Government or semi-government training centres and industrial districts have been providing entrepreneurship and skills training. However, very small minority of small enterprises has been able to access such productive resources. For instance, only 3 out of 71 micro and small enterprises surveyed indicated that they had ever received any assistance from the government run training centres in Pakistan, (ILO, 1996). Even in the instances when the support was provided successfully, sustainability of such support has been in doubt. Therefore, it has become essential to

promote commercially viable business development services (BDS). A Donor Committee has prepared a guideline regarding how a sustainable non- financial BDS can be provided to the small enterprises.

Ultimately, the long-term growth of small enterprises would depend on the country's emphasis on human resource development. Mass literacy and availability of skills determine the availability of human resources and the market for the vibrancy and growth of small enterprises. It has been observed that improvement in productivity of East Asian countries has been correlated to the early drive towards mass literacy whereas emphasis on higher education for a smaller segment of the population has been viewed as insufficient to transform the domestic market and supply of readily trainable manpower (Joshi, 1998).

What is the likely scenario of entrepreneurship development in the 21st Century?

Entrepreneurship development in the 21st century would be influenced by the growing concern towards business ethics among domestic as well as multi-national corporations. Public concern regarding environment, working conditions and workers' rights as well as child labour would increasingly require the sourcing and supplying enterprises to observe business ethics. Small enterprises as a part of the global value chain would be affected by the concern of the sourcing and marketing enterprises with regard to the production processes and job quality of these small enterprises.

Public concern regarding environment, working conditions and workers' rights as well as child labour would require the sourcing and supplying enterprises to observe business ethics.

The likely scenario of entrepreneurship development in the current century would be dominated by growth in ICT, commercial BDS providers and global value chain linkage as increasing liberalization of trade and globalization continue. While the small enterprises would provide innovative and competitive advantages in such liberalized environment, these enterprises would also need to be far more efficient, productive and versatile to survive in such a competitive environment. Promotion of modern small enterprises would require facilitation of their access to ICT and improved connectivity. Increasing usage of ICT also assumes improved human resource development with mass literacy and availability of skill development opportunities. In India,

there are good examples of commercial institutions, such as NIIT, providing computer education.

Entrepreneurship and skills development along with other productive resources would have to be increasingly provided on a commercial basis since the governments would have less and less role to play in running commercial enterprises. The government's role will be in facilitating and regulating the business activities. How BDS providers evolve in a commercially sustainable way and whether they would still need to be steered by the government would define the extent to which small enterprises would form the part of the globalized business environment.

Global value chain linkage would require that the improvement in technology, productivity and business management skills of small enterprises would be in the interest of the sourcing companies. It is expected that larger sourcing enterprises would increasingly play such a role. However, the question remains as to what would be the fate of the small enterprises in the event the sourcing companies are not able to compete in the market and face bankruptcies. Therefore, those small enterprises that have diversified their own sourcing and marketing would have a greater chance of survival in the competitive market.

Size or costs will no longer count; instead, creativity and flexibility will be crucial. If it was once the large firms that ate up the small fry, the future will see fast companies overtaking their slower rivals. The key indicator will be time- to-market. Sometimes just a few weeks can make a difference between a resounding success and a dismal failure. Consequently, it is not unusual for the creators of digital products to endure phases with 100-hour working weeks. Since software now plays a key role in all segments of the value-added chain, even in "old" industries such as car manufacturing, it is becoming more common for development work to go on round-the-clock and around the globe (U. Koltz, 1999).

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Productivity is the application of clear and energy efficient technologies and sound management principles to deliver environmentally friendly products that improve quality of life and competitiveness at the same time.

– Managing Enterprise Productivity and Competitiveness – ILO

SMEs: Changing Paradigm of Performance Measures

G.D. Sardana

Economic reforms and globalisation have created enormous ramifications on economic policies. The pre-liberalisation economic policies practiced bureaucratic controls, licensing, regulated monopolistic controls and provided protection to industry in general and SMEs in particular against competition. The new economic policies have attempted to integrate the Indian economy with the world economy and in the process thrown new challenges before the SMEs. This paper examines the changing paradigm of challenges and the new dimensions which have a large bearing on the performance of enterprises. It proposes a methodology of constructing a metrics under broad categorisation measures of economic Performance (P), Quality (Q), and Recipient satisfaction (R). The model can provide an index of performance for a corporation.

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The policies of economic reforms and liberalisation ushered in a decade ago were expected to bring a welcome turnaround in the health of the economy, increase investment and help create millions of jobs. SMEs were considered a prime vehicle to create impact in these directions. However, for the past couple of years economic slowdown is visible, there is an endemic reluctance to invest and recent press reports claim closure of SMEs in thousands. The process of globalisation or free trade without quantitative restrictions has brought foreign goods, generally in the manufacturing domain of SMEs, within the easy reach of consumers. This has resulted in further increasing the woes of the SMEs. The changed economic and industrial scenario has created new challenges for management, new goals for achievement and new compulsions for success. Devoid of basic strengths and advantages as enjoyed by large corporations, SMEs need to adopt new norms, understanding the changed meaning and interpretation of performance and develop methodologies to evaluate the same. Whatever may be the merits or demerits of the economic reforms, its suitability or otherwise to the ill-developed Indian economy with its singularly unique problems of teeming unemployment, extreme poverty and lack of education, the changed scenario has come to stay. Bound by international conventions and trade agreements, the national economy is hooked to competitive global economy and trends. In this type of irreversible one way traffic, the only course of action is in the direction of understanding the changed paradigm of economic development and taking steps to align with the same.

Features of SMEs

As against the normal perception that SMEs have no place in developed economies, SMEs not only predominate but are the backbone for large corporations in supply of parts, components, finished products in several cases and services at a cost which large cor-

porations are not in a position to match if produced in-house. In this respect SMEs become the ancillaries or exclusive vendors to larger firms. However, this does not preclude SMEs from enjoying the status of firms carrying out production and marketing processes independent of the control of large firms. Larger number of SMEs operate independently and many have become success stories.

SMEs are the backbone for large corporations in supply of parts, components and services.

Indian laws designate a firm as small if its investment is limited to a specified figure. This is a legacy of the permit-quota-license days when subsidies and doles had to be extended on investment or turnover criteria. However, there are other more rational ways to understand a small undertaking. Prem Vrat et al (1998) quote. The Small Business Act (1953) of the USA, defining a small business as: 'One which is independently owned and operated and not dominant in its field of operations'. The Committee for Economic Development (of the US) considers any two of the following criteria to designate a business as small:

- Independent management, usually owner managed
- Capital as supplied by the owner
- Local area of operation
- Relatively small size within the industry

Murdick et al., (1972) also point out a similar concept of small business with the following features:

- Owners are the managers
- There are no separate managers with independent authority for functional areas
- Investment and expense decisions are controlled by the owner
- The area of operations is restricted and localized.
- The marketing operations are confined to restricted areas or through direct sales to customers. There is only a thin line of demarcation between a small and a medium sized enterprise. A medium sized firm is likely to have a larger base of operations and marketing.

Ownership as well as decision making in areas of functional management such as Production (process engineering, product diversification, capacity planning, expansion, modernization), Technology (Quality management, development of technology, selection of machines) Marketing (new territories, pricing of products) etc. are confined to owners. Investment and controls on all financial matters (including expenses) are invariably in the hands of the owners.

Strengths & Weaknesses of SMEs

SMEs are started by an individual either alone or in partnership usually with siblings or other members of the family or close friends out of desire to be independent, to become prosperous, to increase family income or to have economic security. Availability of economic resources determines the size. The firm gets located near the owner's residence.

Strengths

An SME has strengths not shared by large corporations. These strengths if properly exploited can deliver rich dividends.

High degree of motivation: The owner possesses clear motives behind establishment of an SME. He is uninfluenced by functional managers or other professional experts as are present in a large organisation. His zeal and smallness of enterprise size bring him close to the employees with deep knowledge of their ambitions, desires, needs and necessities. The employees accept him as head of a large extended family and accept his objectives unquestioned. In return the owner uses rewards/punishments to further this cause.

High performance: If performance is the limited accomplishment of objectives as perceived by the owner, a high degree of achievement can be expected as all the employees are motivated to work for the same. The owner is able to draw out the best of performance from his men. Absence of restrictions in the form of rules, layered permissions, regulations and formalities increases efficiency. The performance achieved by an individual never gets unnoticed or lost in the crowd of files. Recognition further boosts the performance to greater heights.

Absence of restrictions in the form of rules, layered permissions, regulations and formalities increases efficiency.

Strong focus: Smallness of the firm creates an opportunity to have a strong focus on a desired aspect of operations, such as quality of the product/service, engineering precision (as in a tool room), customer service, skill generation in specific technology or a process. Many SMEs have scored successes over large corporations as these have concentrated on a category of chosen customers and cultivated them with customised products and personalized service. These constitute niche markets.

Low overheads: Absence of executives, managers, professional experts brings down the overheads. SMEs are also low in infrastructure and operational cost. Smallness of size helps to control indirect expenses as well.

Weaknesses

An SME has a large share of weaknesses. Some of these are inherent in the structure of the organisation. But many of these are on account of lack of knowledge or foresight.

Lack of professional expertise: Smallness of the size coupled with financial constraints prohibits the firm to hire professional experts in various functional areas. The owner therefore, fails to get insights on views held by him. In a fast changing world of technology where management strategy has been developed as a well conceptualised science, the owner loses a major advantage enjoyed by a large organisation. SMEs in a large number of cases, are ignorant of latest production processes, marketing concepts, new products, developing technologies, materials sciences, skill development and management practices.

Lack of finances: This problem is acute in SMEs. Because of organisational constraints, only limited finance from specified few sources is available. An SME is heavily restricted in investing in new technologies, new plant and machinery. Allocating resources to industrial research, R&D, product development also takes a back seat as SMEs cannot afford to invest in infrastructure of test laboratories and test equipment with uncertain long term return. Limitation of financial

Allocating resources to industrial research, R&D, product development also takes a back seat as SMEs cannot afford to invest in infrastructure.

resources also prohibits the owner from recruiting professional experts, technologists and scientists. For the same reasons an SME is not in a position to explore wider markets.

Weak performance alignment: Employees are the greatest asset to an organisation. However, it requires strong management systems, development of a systematic organized and comprehensive approach and a commitment towards human resource development to make employees become effective assets. Gilley et al., (1999) advocate that an organisation must design, develop and implement a performance alignment process to improve its competitiveness. This process comprises several steps: establishment of cohesive performance objectives aligned to business goals, client needs and expectations; improvement of work/job design; training and development of human resource; development of performance oriented work culture; performance measurement and evaluation and a process which links performance to compensation. Unfortunately an SME lacks organisational strength necessary to create the alignment process. The owner manager, in the absence of a professional manager, is influenced by employees who cater to his whims as against performance. There is also a tendency to believe that employees can be easily replaced because of high unemployment and therefore he adopts a hire and fire philosophy. Gilley et al (1999) rightly point out that when this approach predominates, treatment of employees lacks dignity and the 'asset' comes to be considered as disposable. Commitment, sincerity, innovativeness become casualties. Owner manager has a strong belief that he knows everything. When this attitude prevails, there is no room for dissent, suggestions for improvement and ideas for growth. An environment of indifference develops. This kills the morale, loyalty and commitment of employees.

SMEs controlled as these are by owner-managers or family, tend to keep the performance or achievements secretive for fear of demands from the employees for rewards. Often a diluted picture of achievement or exaggerated version of failures is presented. This philosophy sows the seeds of mistrust, non involvement of employees, secretive working and lack of transparency.

Lack of strategic vision: Lack of a clear direction for growth, product diversification, selection of technology and lack of understanding the future environment leads to aimless drift when huge amounts get spent on training of employees, hiring of experts, purchase of machines, advertisement and publicity. This drains scarce resources and energies. At SMEs this often hap-

pens as the owner-manager carries faulty presumptions unaided as he is from professionals.

Singular objectives of the owner-manager become the goals of an SME. There is thus no attempt to either list down both the short term or long term objectives nor to formulate a policy on performance measurement or evaluation. An organisation has multi objectives and the performance against these goes unaccounted.

Changing paradigm of challenges

Over the past decade, since the process of liberalisation and globalisation started, there has been a tremendous change in the industrial scenario. SMEs have had to face new challenges. New products, new technologies, new customer expectations have surfaced. The industrial paradigm has changed generating new issues. A new agenda has emerged and companies require to redesign performance measures.

Status before the change: Earlier, the small industry existed in a safe heaven of protections enjoying a number of privileges. The law of the land, rules and regulations extended a variety of safeguards for its operations.

Protection & Subsidies: Reservation of a large number of products/industry for SMEs eliminated competition from large enterprises; quotas of scarce raw materials at controlled prices; exemption or reduced rates of excise duty; subsidies on sale to public departments; subsidies and tax concessions on exports; purchase preference to products; protection from imports either through bans, restrictions or high custom duties; low rates of interest on funds from banks/institutions; easy/relaxed procedures to obtain credit limits; institutional help to obtain credit limits and payments; subsidies to obtain ISI/ISO certifications, modernisation, relaxation of rules/provisions in areas such as pollution control etc. constituted some major protections.

Limited competition: SME faced only a limited competition in the market. Sale of products manufactured became fully assured. It became a seller's market. Assured market left no compelling room to innovate in product styles or performance, leave aside incorporation of customer specific needs.

Poor quality: Assured market and a price advantage brought complacency in operations. Quality of products and services suffered. SME products came to be branded as sub-standard and discerning domestic customers avoided the same. SMEs could never make a headway in exports. The image stuck.

Outdated technology: Similar reasons did not encourage SMEs to update technology. Manual operations and use of outdated models, reconditioned second hand machines dominated. High margins prevented any exercise on saving of materials, value engineering or revision of product standards in line with new developments. Many SMEs took pride in offering old specifications with bulkier configurations on the pretext that these were safe and reliable. The work force could never get any opportunity to get trained on new technologies, test equipment and instruments.

Lack of vision: SMEs felt so secure in the business and the business environment that the organisations started ignoring the winds of change and the WTO imperatives. Maximisation of profits constituted the single goal to the detriment of other goals which should prepare and organisation for future. Lack of vision prevented SMEs from taking any steps for either changing technology or for making the products competitive. SMEs never visualised that protections will have to be withdrawn once the country signed WTO conventions.

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Changed Paradigm: Last decade has brought a sea change in the paradigm of industrial development. Competition, new technology, IT, and customer expectations have added new dimensions to the philosophy of management. Major changes are as follows:

Customer focus: Liberalised imports and entry of large houses to manufacture items reserved for small scale sector have opened up flood gates of expectations from customers. For the first time customers have a choice on product design, quality and price. Service has acquired new dimensions. Spread of IT has made the customer knowledgeable about the latest developments. It has become a customer focussed, market driven economy. Success of an organisation is dependent upon how an organisation is able to translate the voice of the customer in development of new products and services and how each component of the internal chain is mapped to work for customer satisfaction. Customer satisfaction management has been developed as a business function. Study of consumer's buying habits, his preferences and needs have become an important agenda for corporate policy. A performance oriented firm organises its processes to provide the best of services. The systems are organised such that there is a

flexibility and adaptability to implement change at a short notice as customer needs are recognised.

Technology: Technology has always been considered a major factor in improving productivity. Economic growth and prosperity of industrialized economies is largely attributed to the capability to generate technologies and use the same in industrial production. Thus, modernisation or enhancing the process technology count as significant factors toward the performance of an organisation. In the context of SMEs new technologies and their impact can be studied in three areas:

New technologies are complex; they have more automation and programmable facilities. They are capable of generating high precision, close tolerances, high consistency and less rejections. They are also user friendly and have reduced requirement of skill in operations. The new technologies are engineered to increase the flexibility of production and to respond to change. Mass production and technology including automated assembly lines are giving way to small batch production which is more customer oriented. This has impact on labour skills—labour has to be computer literate and more knowledgeable about technology. More of supervisory and maintenance skills are needed. Change in technology is also evident in product design. Products with variation in features or styles or with add on characteristics are getting introduced more frequently so that customer interests are kept alive. There is a trend for products to be user friendly and less material intensive in construction. Lower energy consumption, high reliability and low failure rates are other attributes.

There is a trend for products to be user friendly and less material intensive in construction. Lower energy consumption, high reliability and low failure rates are other attributes.

Information technology is the second dominant area where technology has had a major impact. IT has redefined the entire gamut of production processes and infrastructure, distribution and marketing. The demand from customers, availabilities of stocks and manufacturing requirements can now be assessed faster and more accurately. IT has to be seen as a process facilitator and an instrument to improve efficiency. IT as a means to provide information to customers will continuously raise the expectations of customers. This will further create an impact on industry to be more customer focussed.

The third area is in the domain of management systems. Production systems do not require to be organised on large inventories of stocks as the technologies can help in rapid changes. Small batch production helps organisation to reduce hierarchical levels and make operational levels more responsible. As new technologies are more productive, organisations require reduced labour but with better knowledge. They need different strategies to motivate and develop. The development of technologies and technological capabilities is a complex task in itself which requires skills to be acquired in all operations.

Focus on HRD: SMEs had hitherto relied on repetitive routine and mechanistic type of work. This type of activity called for extensive use of unskilled/semiskilled labour so easily available and often referred to as 'cheap labour'. This scenario was exploited to maximum advantage. With the introduction of new technologies, many of the tasks can be performed by machines which have embedded skills. Simultaneously, the new worker requires higher conceptual and behavioural skills to understand the inherent technology, processes and techniques better and also possess capabilities of reasoning, inter-personal skills and communication. Concern for higher organisational efficiency, productivity and quality demands that the workers possess a good understanding of the system in operation, technical process, importance of specifications, nature of materials used, implications of usage of parts not conforming to designs and the importance of keeping to schedules, costs and co-ordinated work.

New occupational trends and patterns of employment have emerged. Cognitive and judgement skills are replacing the unskilled workmen and operations. More workmen are needed with multiple skills or flexible grouping of skills who can understand and carry out more than one trade. The proportion of technicians, supervisors, engineers and managers has tended to increase, simultaneously reducing the demand for clerical and administrative staff.

As the new pattern lays stress on attitudes, behaviour and attributes such as commitment to the goals, loyalty and working with customer focus, employees require a high degree of motivation and a work culture conducive to creativity, innovation and harmonious relationship. Lack of transparency in performance evaluation, disregard of merit, hire and fire policy are detriment to the same. SMEs will require to adopt more positive approaches such as participation, transparency, training and development and encouragement to performance. The old philosophy that a worker is to only carry out a task instructed has progressively given place to new imperatives: participation in decision

The old philosophy that a worker is to only carry out a task instructed has given place to new imperatives: participation in decision making; sharing responsibilities, resolving problems and demonstrating creativity.

making; sharing responsibilities, resolving problems and demonstrating creativity. Loss of a customer order or failure of a product supplied to a consumer also becomes the concern of workmen. The technologies are changing at a fast rate. This calls for continuous programmes of training and retaining and exposure to new skills.

Competitive market conditions: Post liberalization era has ushered in intense competition in the market particularly for SMEs. At the domestic front, the reservation list of products and industries for small industries has been pruned progressively and doors opened to large sector. Besides, many of the protections have been withdrawn. Large sector with its advantages of better technology and systems provides tough competition. Brand image of large firms has further affected SMEs share. Liberalised imports along with reduced tariffs has opened the market to MNCs whose products enjoy benefits of superior technologies. As a result of mass production and low materials designs, many of these are also cheaper in price.

IT has made information easily accessible to consumers and product specifications and prices can be compared. Winning of customers is now getting determined by the promptness in providing service. In this respect also, large corporations prove to be more resourceful because of large network and variety of products and service, which help to even out overheads.

Winning of customers is now getting determined by the promptness in providing service.

Competition related to prices, quality and services has indeed been one of the major challenges faced by SMEs.

Emergence of service sector: As the economy passes through various stages of development, there is a shift of activity from agriculture to manufacturing and to

the service sector. Latest estimates point out that the contribution to GDP from agriculture, industry and service sector stands at 26 per cent, 22 per cent and 52 per cent respectively as against figures of 32, 25, 40 per cent, ten years ago. There is a rationality in this development. As the individual income rises, there is a tendency to spend more on facilities and conveniences. People look beyond bare necessities and want 'goods' to make lives fuller and enjoyable. The new development has created opportunities for the entrepreneur to shift from manufacturing base to the services.

A number of such opportunities are available and their growth is on rise. Most of these fit the budgets of small business. The new areas cover entertainment, including films, TV, software, Cable TV, music, event management; retailing; hospitality, including hotels, restaurants, coffee bars, fast food counters, tourism, health-care and recreation. IT has already created a revolution and generated infotech-enabled services. Human Genome projects and bio-informatics, bio-technology are the new horizons.

Liberalisation, reforms and globalisation have compelled the government to redefine its role. A large variety of service section function jobs as power generation and distribution, water supply, road building, operation and maintenance operation of airports, telephones, communications, sanitation etc. are getting privatised. This list will get surely extended to include banks, financial institutions, insurance, railways, post offices, revenue collection, hospitals, education and many more. A discerning SME can see the writing on the wall and grab new opportunities.

Balancing business needs with family priorities: Most SMEs are family owned business enterprises. The members of the family, usually siblings are not only owners but also occupy sensitive positions and exercise all executive powers. Most often family priorities get a precedence over business needs. Profit alone, preferably generated in the shortest run, becomes the only objective. They lose focus on long term objectives and are at a loss to adjust rapidly to market forces. As per one estimate, 70% of family business in India does not survive the first generation. This scenario has added urgency to problems of balancing business needs with family priorities. In particular the problems which require attention include:

- Separation of ownership/family needs with business goals.
- Introduction of professionalism in business
- Identification of distinctive elements of governance

- Issues of delegation of authority and controls in case professional executives are inducted.
- Competence vs ownership priorities.
- Relationship with employees
- Succession planning

The Rationale of Performance Measurement

There are differing perceptions about performance measurement. Many consider it as an exercise of financial metrics and therefore functional executives from disciplines such as production or marketing or materials management or HRD shy away from the same as being too technical in nature carrying too little relationship with their disciplines. The financial analysts invariably refer to the audited balance sheet as representing the performance, precluding any other specific need or methodology for performance management. Traditionally, for an SME owner, profit alone represented performance. There has hardly been the necessity or urge of another measure.

Traditionally, for an SME owner, profit alone represented performance.

One comprehensive definition of Performance Measurement is provided by Tesoro and Tootson (2000) as quoted from "Performance Measurement" 1977, May 10—"Performance measurement is a process of developing indicators that report on the accomplishments and progress of an organisation". This definition foresees a number of steps:

- Selecting suitable indicators of performance
- Evaluation of status of performance
- Evaluation of progress against benchmarks or targets

The exercise calls for an understanding and agreement on what counts as performance and for what purposes the performance is going to be used; who constitute the beneficiaries and how do they benefit from the exercise.

Measurement refers to the process of obtaining quantitative and qualitative attributes and establishing a co-relationship to represent the property of an object. Mason and Burton-Swanson (1981) explain that measurement is the process of obtaining symbols to repre-

sent the proper ties of objects, events or states. This aspect implies that the objects, events or states to be measured must be identified. It is easy to identify if the objects happen to possess physical dimensions. However very often objects such as quality, customer satisfaction do not carry physical dimensions and yet are important performance objects requiring measurement. Identification of the objects is closely inter-linked to basic goals of an organisation. March and Simon (1992) point out that the identification of object/event must lead to the replies against issues;

- What problems shall I look into?
- What course of action is better?
- How well am I doing?

The start of the exercise therefore comprises establishing goals/objectives for the organisation. Many of these such as economic performance are in quantifiable terms but some can be of qualitative types. The goals will provide measures for evaluation. The rationale of performance measurement can be summarised as:

Assessing the levels of achievement: Once the measures of performance significant to the organisation have been identified the organisation assesses the level of achievement by comparison with targets or benchmarks.

Evaluating operations: An organisation translates its plan through a large number of activities. An evaluation of operations provides detailed information of each activity to generate a feedback system. It helps in identification of performance measures which are critical for achievement of goals.

Diagnosing and redeploying resources: An organisation is a dynamic system. It has to innovate, improve and move forward on continuous basis. It has therefore to be alert and carry out a diagnosis of its success and failures so that resources can be deployed more judiciously.

Fixing new performance objectives: An organisation has to plan for growth and survival. With new technologies, many processes and products require to be dropped and new ones to be added. Performance measurement system provides a rational system to take decisions.

Rewards/motivation: Performance measurement brings transparency in the organisation. A successful organisation creates a sense of pride and motivates employees to scale new heights. A failure on the other hand also brings out the seriousness of the situation so

that employees put in extra efforts. Besides, performance measurement can be used to reward performing employees in a visible and transparent manner.

Performance measurement brings transparency in the organisation.

PQR: A Performance Metrics: Performance of an organisation has focus on several areas. Aggarwal (1981) points out the following: Investor satisfaction Employee satisfaction Customer satisfaction Supplier satisfaction. EIU and KPMG (2000) refer to the goals of quality customer services and financial efficiency and that only agile, entrepreneurial and customer oriented companies will survive. Kaplan and Norton (1992) have enlarged the concept and presented a balanced score-board comprising a family of measures in areas of profitability, productivity, customer quality, process quality, workforce and partnering.

EIU and KPMG (2000) point out that as against the present focus on operational controls and the support of external financial reporting, new performance measures should provide operational control, support strategy formulation and reinforce overall corporate goals. One has to start from understanding the goals of the company. PQR Performance Metrics as developed by Sardana (2000) considers organisational performance to encompass outcome as (economic) Performance, Quality and Recipient satisfaction.

Sub-systems and Key Performance Areas (KPA) under Performance (P)

These entail the conventional financial performance area of profitability, liquidity and turnover. Management preparedness for the future in terms of long term goals as well as the desirability for good governance have been included in the all important management sub-system. The following sub-systems (Table 1) are considered.

Financial Efficiency: This covers evaluation of financial outcomes such as returns on capital employed, turnover, liquidity and growth achieved in market share, market generation, winning over new business, introduction of new products or services.

Financial Effectiveness: This sub-system deals with the 'hows' of achievements. Growth in profit can be achieved through several ways: but it is better if achieved through organisational efficiency by control-

ling expenses on inventories, losses, direct and indirect costs and through better management of one's own funds.

Table 1: Sub-systems and KPAs under 'P'

Weight: 0.40

Sub-systems	Weight	Measures/ KPAs	Performance +2 +1 0 -1 -2 [[[]][[]][[]]	Weight
Financial Efficiency	0.30	Return on turnover (Profitability)		0.25
		Return on capital employed		0.25
		Receivables		0.25
		Growth (in turnover)		0.25
Financial Effectiveness	0.25	Control on inventories		0.30
		Control on variable expense		0.25
		Control on fixed expense		0.20
		Control on interest payments		0.25
Assets Utilization	0.20	Return on assets		0.25
		Capacity utilization		0.25
		Growth in assets		0.25
		Employee productivity		0.25
Management Sub-system	0.25	Short term business goals and prioritisation		0.25
		Long term goals and planning		0.30
		HRD practices		0.25
		Values/ethics practiced		0.20

Assets Utilization: The sub-system is again akin to financial effectiveness in objectives. A fuller and effective use of assets is important. Human resource is another important asset. Productivity of employees arrived as turnover per employee is included as key performance area (KPA).

Management sub-system: This encompasses management functions of providing clear business goals and their priorities for achievement. The values

and work practices go a long way to motivate and provide a proper work ambience. Training and development of employees is one more significant area.

Sub-systems and KPAs under Quality (Q)

Quality has several dimensions. The product or service quality has origins in design and specifications, materials, processing and other in-house treatments. Besides, quality also implies high reliability, low failure rate, consumer friendly usage, ease of repair and maintenance, durability and safety in usage. These aspects have been incorporated in the following sub-systems (Table 2):

Table 2: Sub-systems and KPAs under 'Q'

Weight: 0.30

Sub-systems	Weight	Measures/ KPAs	Performance					Weight
			+2	+1	0	-1	-2	
			[]	[]	[]	[]	[]	
Technology	0.30	Product Technology					0.30	
		Process Technology					0.20	
		IT					0.25	
		R & D/ Development					0.25	
Technical Quality	0.20	Conformance to specifications					0.30	
		Conformance to cost specified					0.30	
		Conformance to process time specified					0.20	
		Materials Productivity					0.20	
Functional Quality	0.25	Comparison with competition					0.25	
		Customer acceptance					0.35	
		Safety and security in operation					0.20	
		Consumer friendly usage					0.20	
Process Quality	0.25	Quality of inputs					0.35	
		Quality of machine/tools					0.20	
		Procedures and systems					0.20	
		Quality control systems					0.25	

Technology: It is a wide term and encompasses KPAs of product technology, process technology and R & D. IT has been considered an important KPA for SMEs as it is going to play a significant role.

Technical Quality: Design lays specifications for performance, costs of manufacturing, process time and norms on material consumption. Technical quality is evaluation of conformance to these pre-determined parameters. Materials productivity as cost of materials per unit of product manufactured is an important measure to know the extent of materials consumption.

Functional Quality: This is related to what consumers expect from the product. Important KPAs include comparison with other market brands, field failures, product capabilities, aspects such as reliability in service, durability and life of the product. Other areas of performance included are the ease and safety in usage.

Process Quality: The quality of the product after design considerations is dependent on the quality of raw materials used and the quality of processing tools, machinery and plant installed. Detailed process instructions and quality control procedures ensure systematic work to generate quality products.

Sub-systems and KPAs under Recipient Satisfaction (R)

An SME deals with four major categories of stakeholders which carry expectations of receiving satisfaction from the organisation (Table 3). The four classes considered are customers, owners (or shareholders/partners), employees and suppliers.

Table 3: Sub-systems and KPAs under 'R'

Weight: 0.30

Sub-systems	Weight	Measures/ KPAs	Performance					Weight
			+2	+1	0	-1	-2	
			[]	[]	[]	[]	[]	
Customer satisfaction	0.40	Credibility					0.25	
		Availability					0.25	
		Responsiveness					0.25	
		Empathy					0.25	
Owner satisfaction	0.25	Business returns					0.40	
		Organisational Efficiency					0.20	
		Growth					0.25	
		Image in society					0.15	
Employee satisfaction	0.20	Job satisfaction					0.30	
		Salary satisfaction					0.30	
		Growth opportunities					0.20	
		Work practices					0.20	
Supplier satisfaction	0.15	Payments					0.40	
		Fair trade practices					0.20	
		Dispute resolution					0.20	
		Interaction					0.20	

Customer satisfaction: Besides qualitative requirements as covered under 'Q', a customer expects credibility, that he will be delivered product/service as per performance and quality and service as is claimed by the firm. It is also expected that the product will be made available in reasonable time; the company will respond in case of complaints and other needs and the customer will receive a patient hearing.

Owner satisfaction: Four areas dear to owner include overall business performance generally in the form of profits or returns, growth in sales over previous year; efficiency of the organisation generally in terms of execution of orders (time to market) and an image of the firm in society.

Employee satisfaction: An employee looks forward to job satisfaction, good salary and perks and opportunities for growth. Work practices which provide fair dealings, dignity at work, reward and recognition for performance and a congenial ambience are other KPAs.

Supplier satisfaction: Supplier expects timely payment on supplies, fair trade practices, satisfactory dispute resolution and a cordial interaction with the firm.

All the categories (P, Q, R) and sub-systems or their KPAs are not equal in priorities and ranks. These are therefore required to be ranked and weightages assigned in proportion to the importance assessed. Evaluation of each of the KPA is carried out by comparing the level of achievement to the benchmark. This benchmark, as predetermined, has to be the potential value of achievement of a better performing competition or an achievement already attained by the company.

The evaluation can be carried by grading the performance on a five-step point grading system with +2 standing for the highest and -2 for the lowest achievements. The point grades are aggregated and multiplied with the weightage factor.

A composite index of performance can be build up by applying weightages to the sub-systems and aggregating the points scored. This represents achievement against a maximum score of 100. The performance index so arrived against sub-systems provides an assessment of performance against the benchmark and enables the firm to take up corrective steps. An overall index of performance can similarly be built up by using weightages factors of P, Q and R.

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The simple act of paying positive attention to people has a great deal to do with productivity.

— Tom Peters

SWOT Analysis of Small & Medium Scale Industry: A Case Study

R.S. Dalu & S.G. Deshmukh

Small and medium scale enterprises (SMEs) play a critical role in the economy of India. In all the states of India, SMEs are increasing in number. In spite of their success stories, it is also observed that, sickness in SMEs is increasing at rapid rate. In this paper, authors present a study on the problems of SMEs of Vidarbha region of Maharashtra. SWOT Analysis and Situational Analysis are used as tools for the study.

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Generally economies are to a large extent, dependent on the success of the small business sector. For example, in UK more than 70 per cent of all business employ under 100 people (Huxtable, 1995). Also 18 per cent of UK gross output (Manufacturing) is generated by businesses with fewer than 100 employees (Ghobadian & Galleary, 1996). In India, small scale sector has emerged as the most vital and dynamic sector of the economy. It has helped significantly in strengthening the entrepreneurial base of the country giving its economy diversity and depth. In spite of several shortcomings and limitations, the role played by the sector in the country's development is too significant to escape notice. The functional vibrance of the sector is visible from its contribution of 40 per cent in industrial production, 30 per cent in country's total exports and providing employment to 167 lakh persons in over 30 lakh small scale industries, (SSI), which is next only to agriculture (Laghu Udyog Samachar, 1998). Section 11-B of the Industries Act, 1951, provides a definition of industries in terms of investment of units in fixed assets. For SSI the limit is 1 crore. Industries with investment between 1 crores to 100 crores are termed medium scale (MSI) (Karandikar, 1999).

Study reports (Chadha, 1995; Sandesara, 1992) show that in India, number of SMEs is increasing every year. It is also observed that many SMEs are sick and some are closed down, the main problems being low product quality and rise in market competition. It is necessary for SMEs to face new challenges by adopting proper strategy.

Sickness in SMEs

One of the dissatisfying features of small and medium sector is the presence of a large number of sick units, with little scope for improvement in the near future. A unit is defined as sick if any one of the borrowal accounts of the unit remains substandard for six months

Table 5: Details of SMEs Considered for Study

Name of Plant	Products	Turnover (Crores)	Type (SSI/MSI)
Maloo Electrodes Ltd. Nagpur.	Mild Steel 6013	0.75	SSI
Conventry Spring and Engine Component, Nagpur.	Helical Coil Springs and Washer	0.90	SSI
Shichit Shetmal Prakriya Sahakar, Wardha	Cotton Ginning and Pressing	0.40	SSI
Shree Krishana Oil Industries, Wardha.	Cotton Seeds Oil and Cake	0.40	SSI
Tekade Industries, Amaravati.	Tractor Trolley	0.8	SSI
AIR Engg. Co. Ltd., Nagpur	Ball bearing and Spring Coil	0.9	SSI
Vidarbha Pneumatic and Mining Equipment	Pneumatic Ckt.	0.6	SSI
Urvi Transformer, Wardha	Toridal Transformer	0.4	SSI
Alvin Medicot, Wardha.	Medicot	0.6	SSI
Star Plastic, Wardha.	Plastic Products	0.5	SSI
Anup Textile, Hinganghat.	Great Cloth	0.9	SSI
Harshneel Industry Umari, Wardha.	Steel Furniture and Cooler	0.4	SSI
Venkatesh Murmura Udyog, Arvi.	Murmura	0.4	SSI
Vainganga Spun-Pipe, Wardha.	Spun-pipe	0.7	SSI
Sham-Mohan Pulse	Pulses Processing	0.6	SSI
Kocher Packaging, Hinganghat.	Paper Cone and Plastic Bag.	0.4	SSI
Shetmal Prakiya Sauntha, Wardha.	Cotton Processing	0.4	SSI
Swastic Industry, Amaravati.	Pulses Processing	0.5	SSI
Kalpatqru Blow Plast, Akola	Plastic Articles.	0.6	SSI
Mazza-Bottling Plant, Nagpur.	Bottles	0.9	SSI
Kamdhenu Ahar, Wardha.	Dry food Products	0.4	SSI
Vinaya Espat, Wardha.	Stee Products	0.5	SSI
Anupam Extraction, Wardha.	Aluminium Products	0.4	SSI
Snehal Fabricators, Yavatmal.	Steel Furniture, Cooler.	0.4	SSI
Tirupati Industries, Yavatmal.	Tractor Trailors, Agriculture Implements	0.6	SSI
Hanuman Vitamin Foods, Ltd, Khamgaon.	Hard Fats	80	MSI
J.S. Corporation, Akola.	Thresher, Power Sprayer.	7	MSI
Duraweld Wearplates Pvt. Ltd., Nagpur.	Composite Wear Plates.	6	MSI
NOCIL, Akola	Plastic Products	90	MSI
Khandelwal Electricals, Akola.	Farm Equipment	5	MSI
Hindustan Lever Ltd., Khamgaon.	Soap	60	MSI
Bajaj Plastic Ltd., Nagpur.	Plastic Bags	90	MSI
Facor, Nagpur.	Ballets Angle	20	MSI
NECO group of Ind., Nagpur.	Iron Casting	25	MSI
Asha Industry, Wardha.	Trolley and Agricultural Products.	5	MSI
Wardha Agro Processor Ltd., Wardha	Agro Products	3	MSI
Padsons Industries Pvt. Ltd., Akola.	Agricultural Equipment.	3	MSI
Archana Industries Transformer Pvt. Ltd. Nagpur.	Transformer and its Products.	4	MSI
Conventry Spring and Enggs. Co. Ltd., Nagpur	Helical Coil Springs, Washer.	3	MSI
Padgilwar Agro Ind. Nagpur.	Hand Operated Sprays, Threshers.	7	MSI
Hindustan Lever Ltd., Yavatmal.	Synthetic Material.	40	MSI
VIP Industries Ltd., Nagpur.	Plastic Bag.	50	MSI
Nippon-Denro Ispat Ltd., Nagpur.	Steel Products	60	MSI
Laften Lab. Ltd., Akola.	Pharmaceutical Products.		SSI
Thakersy Exports Pvt. Ltd. Amravati.	Garments (Gents Shirts)	3	SSI
Jadhaos Gears, Amravati.	D.R. Ginning M/Cs		SSI

lack of industrial environment, lack of trained workers, lack of technological superiority, management deficiency, and high turnover of key personnel are found to be the main weaknesses (Table 7(b)). Main opportunities for development are export market, government support, excise relief and increased ceiling for SMEs (Table 7(c)). Immediate threats to SMEs are competition from large units and multinationals, financial stringency, technological obsolescence, negligence towards industrial training, and increase in the price of inputs (Table 7(d)).

Table 7(c): Opportunities

Opportunities	Points on the Scale of 0-100	Rank
Export market	78	1
Government support	70	2
Excise relief	65	3
Increase of ceiling for SSI/SMEs	48	4

Table 7(d): Rank of Threats

Threats	Points of the Scale of 0-100	Rank
Competition from large units and multinationals	70	1
Financial stringency	62	2
Technological obsolescence	50	3
Negligence towards industrial training	45	4
Increase in the price of inputs like power and raw material	40	5

<p>Strengths</p> <ul style="list-style-type: none"> • Flexibility. • Owner management. • Inexpensive labour. • Less overhead. • Favourable capital output ratio. 	<p>Weaknesses</p> <ul style="list-style-type: none"> • Lack of quality consciousness. • Underutilization of capacity. • Lack of financial strength. • High percentage of absenteeism • Lack of industrial environment • Lack of trained workers • Lack of technological superiority. • Management deficiency. • High turnover of key personnel.
<p>Opportunities</p> <ul style="list-style-type: none"> • Export market. • Government support. • Excise relief. • Increase of ceiling for SMEs. 	<p>Threats</p> <ul style="list-style-type: none"> • Competition from large and multinationals. • Financial stringency. • Technological obsolescence. • Negligence towards industrial training. • Increase in the price of inputs.

Fig. 1: SWOT Analysis of SMEs

Figure 1 shows the SWOT analysis of SMEs.

Strengths

Flexibility: Ability to make quick adjustment to changing economic and trading scenario. SMEs can easily absorb new technology, new design, new processes and the like. The cost of such switch over is minimal (Selvam, 1996; Mc Adam, & McKeown, 1999; Harrison, 1994).

Owner Management: In SMEs, owner management is a possibility, which ensures quicker decision-making. There is no passing the buck, no red-tape and no committee sitting on decision issues. Personal commitment gets transformed into economic dynamism interfacing local, national and global economics (Selvam, 1996; Arun, 1999).

Inexpensive labour: The bulk of problems of large businesses can be traced to the huge and escalating wage bill. Allowances, complete neutralisation of rise in cost of living, etc. make many industries sick. SMEs can build on its strength taking advantage of cheap labour (Selvam, 1996).

Less overhead: No expensive investment in land and building, less capital-intensive production process and the like can reduce overhead. This means low break-even level of sales. Though SMEs suffer from lack of scale advantages, they gain from low break-even point (Selvam, 1996; Eilon, 1981).

Favourable capital output ratio: SMEs are labour intensive. By properly utilizing the local reserves i.e. raw material, labour etc, SMEs can keep low level of capital investment per unit of output (Gowda & Krishnamurthy, 1997).

Weaknesses

Lack of Quality Consciousness: Design quality, performance quality and aesthetic quality are major aspects quality conscious consumers look for in products (Selvam, 1996; Derrick, 1989). SMEs neither organize quality awareness programmes nor involve their employees in quality management process, so they do not understand the importance of quality products.

Underutilization of Capacity: Sadesara (1993) observes that overall capacity utilisation in small industry sector is merely 48 per cent. Study reports (Chadha, 1995; Swamy, 1995) show that level of productivity in SSI sector in India is very low.

potential of labour, capital, skills and equipment, resulting in low labour, and capital productivity and underutilised capacities. The most critical constraint on growth and modernisation of small industries, is the use of obsolete technology by this sector (Chadha, 1995).

Increase in the price of inputs: Prices of inputs like raw material, power are increasing at tremendous rate, leading to rise in production cost. It badly affects the marketing performance of SMEs.

Situational Analysis of SMEs

The SWOT analysis, a powerful tool (Wehrich, 1982), developed by the above procedure, was used for the situational analysis of SMEs. The statements were examined one against another on the lines suggested by Johnson and Scholes (1994). The analysis is shown in Table 8. The main strengths and weaknesses are in the left-hand column, and are examined in terms of the key environmental issues: a '+' or '-' or '0' was scored as follows:

Marking + if there was a benefit to SMEs, i.e. if:

- a strength enabled it to take advantage of or counteract a problem arising from an environmental change;
- a weakness was likely to be offset by the change.

Marking - if there was an adverse effect on SMEs, i.e. if:

- a strength was likely to be reduced by the change;
- a weakness prevented the organisation from overcoming the problems associated with the change, or was accentuated by that change.

Marking 0 if there was no effect on SMEs.

What this analysis yields is a much clearer view of the extent to which the environmental changes and influences provide opportunities or threats, given current strategies and organisational capabilities. Table 8 shows that major opportunities lie in the utilisation of financial and non-financial support extended by Government, and gaining the vast export market. Owner management and flexibility are some other areas which provide opportunities for growth. Likewise, major threats include competition from large industries and multinationals and rise in expectations of customers. In the light of these considerations, the need for quality initiatives in SMEs was felt.

Conclusion

The study shows that Competition and Rise in expectations of customers are the major external issues for SMEs of this region. Only 32 per cent of the SMEs from the sample use ISO certification as an approach for managing quality, TQM approach is not used at all (Table 9). Non-availability of trained workers, lack of work culture due to low industrial development, low level of quality awareness, lack of finance for developmental activities and high interest rate on loan are some of the common problems faced by SMEs. So, urgent recommendations for SMEs are to give more emphasis on training employees on various aspects like quality awareness, use of quality control tools and adoption of continuous improvement techniques.

Table 9: Approaches used for managing quality

Name of Approaches	Number of Industry
Traditional	40%
Statistical Quality Control	28%
ISO 9000	32%
Total Quality Control (TQC)	Nil
Total Quality Management (TQM)	Nil

It is also observed that SMEs of this region can not spend on staff training programme due to their financial limitations, so it is necessary for Government of Maharashtra to help SMEs in this regard. District Industrial Centres (DICS) and Institutions like National Productivity Council (NPC), Indian Institute of Industrial Engineering (IIIE), National Centre for Quality Management (NCQM) are already organising such training programmes (Table 10) but they may not be sufficient.

Table 10: Training Programmes Organised by MCED (since inception upto 31/3/98) in Vidarbha

Region	No. of Training Programmes	No. of Participants
Amravati	44	1125
Nagpur	44	1375
Vidarbha	88	2499
Maharashtra	376	10913

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Humanity has the ability to make development sustainable to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs.

— World Commission on Environment and Development

SMEs & Environment Protection

A.K. Ghose

SMEs with their labour intensive character and low technology dependence possess a huge pollution potential, because of their very nature. The author presents the problems confronting Indian SMEs on the environment issue and suggests a few recommendations to make them compliant to optimal ecological standards.

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Small and Medium Enterprises (SMEs) cover a wide spectrum of industries and play an important role in both developed and developing economies. India is no exception and SMEs occupy a prominent position in planned development of Indian economy. The SME sector accounts for 40 per cent of the industrial production, 35% of the total exports and provides about 80% of employment in the industrial sector in the country. Over the years, SMEs have shown a consistent growth rate, both during protected economy and open economy.

SME Sector: Definition Criteria

The definition of SMEs varies from country to country. All over the world, number of employees or capital investment or both have been used as the basis for defining SMEs. Table 1 shows the definition of SMEs in some of the developing and developed countries:

Table 1: Definition of SMEs

Country	Category of Industry	Criteria
Australia	Manufacturing	< 100 employees
	Services	< 20 employees
Germany	SME	< 500 employees
France	SME	10-499 employees
Japan	Manufacturing	< 200 employees
Canada	Manufacturing	< 200 employees
USA	Very Small	< 20 employees
	Small	20-99 employees
	Medium	100-499 employees
China	SME	Depends on product group. Usually 100 employees; investment ceiling US\$8 million
Indonesia	SME	< 100 employees
Malaysia	SMEs	< 175 full time workers Investment US\$1 million
Thailand	Labour intensive	< 200 employees
	Capital Intensive	< 100 employees

On the basis of environment criterion, the generally acceptable divisions are:

- Up to 19 workers – Micro or very small enterprises
- 20-100 workers – Small enterprises
- 101-500 workers – Medium enterprises

In India, capital investment in plant and machinery has been used as the criteria for definition. As per the prevailing definition, small scale industry (SSI) in India is defined as "An industrial undertaking in which the investment in fixed assets in plant and machinery, whether held on ownership terms or lease or on hire purchase does not exceed Rs 10 million (US\$ 0.21 million)." In view of the government policies and overall economic environment, the definition of SSI kept changing over the years. Table 2 shows the definitions prevalent in India during different periods:

Table 2: Definition of SMEs during different periods

Year	Investment Limits	Additional Condition
1950	Upto Rs 0.5 million in fixed assets	Less than 50/100 person with or without power
1960	Upto Rs 0.5 million in plant & machinery	No condition
1966	Upto Rs 0.75 million in plant & machinery	No condition
1975	Upto Rs 0.1 million in plant & machinery	No condition
1980	Upto Rs 0.2 million in plant & machinery	No condition
1985	Upto Rs 0.35 million in plant & machinery	No condition
1991	Upto Rs 0.6 million in plant & machinery	No condition
1997	Upto Rs 3.00 million in plant & machinery	No condition
1999	Upto Rs 1.00 million in plant & machinery	No condition

The employment potential criterion was dropped from SSI definition in India due to the following factors.

- Employment changes seasonally and from year to year. Hence, it is difficult to administer this condition.
- An employment limit acts as an incentive to limit employment to remain within SSI.
- Using employment criterion would discriminate against industries using simple and labour intensive technologies as against sophisticated and labour saving technologies.

There is no clear-cut definition for medium scale enterprises in India. However, units other than well

Using employment criterion in SSI would discriminate against industries using simple and labour intensive technologies as against sophisticated and labour saving technologies.

known industries like refinery, fertilizer, petrochemical, auto-mobiles, integrated textile mills, wood based pulp and paper mill can be categorised as medium scale enterprises.

SMEs have shown their presence in nearly every sector in this country. As per an estimate, approximately 7500 different products are manufactured by SMEs in India. Some of the SMEs are producing directly for consumer market while others are serving as suppliers to bigger industries. Based on products, SMEs in India can be broadly classified into following groups:

- Food Products
- Chemicals and Chemical products
- Basic Metal Industry
- Electrical Machinery and Parts
- Rubber and Plastic Products
- Machinery and Parts except Electrical goods
- Hosiery and Garments
- Wood Products
- Non-metallic Mineral Products
- Paper Products and Printing
- Transport Equipment and parts
- Leather and Leather Products
- Miscellaneous Manufacturing Industries
- Other services and Products
- Beverages, Tobacco and Tobacco Products
- Repair Services
- Cotton Textiles
- Wool, Silk, Synthetic Fiber Textiles
- Jute, Hemp and Mesta Textiles
- Other Services

The small industries have tended to concentrate in the vicinity of large industries or metropolises and big cities. Availability of ready market, social and infrastruc-

tural facilities and skilled labour contributed to such development. Geographically, though generally present all over the country, SSI are more numerous in the states of Maharashtra, Tamil Nadu, Karnataka, Gujarat, Punjab, UP and West Bengal.

Post Liberalisation Scenario for SMEs in India

The post liberalisation (1991) era has thrown up new challenges to the Indian SME sector. Being competitive in pricing, meeting quality standards and environmental compliance are foremost among them. Less capital requirements, low gestation period, operational flexibility, quick adaptability, labour intensive character without depending too much on skilled labour have been the strength of the SSIs in India. While protection, subsidies and incentives over the years helped SSIs to develop, at the same time these have made the sector vulnerable in post liberalisation era. Main reasons are technological obsolescence, adverse economy of scale and low product quality. Meanwhile, societal expectations from the industry have grown and demanding environmental compliance is one of the manifestations of the same. The SME sector, therefore, will not only have to improve product quality and be cost competitive but environmental compliant also, for their very survival. Though this paper deals with SMEs and Environment protection in the Indian context, much of it would be applicable to most of the developing economies.

SME sector will not only have to improve product quality and be cost competitive but environment friendly also.

Environment & SMEs

Any industrial activity is likely to have an adverse impact on the environment. The environmental impacts may be broadly classified in following four categories:

Water Pollution: Water pollution means alteration in physical, chemical or biological properties of water in such a way as to be harmful to receiving water body, flora, fauna and land. Discharge of wastewater, or liquid/gaseous/solid substances drained into streams/rivers contribute to water pollution. Physical and chemical treatment, biological treatment and incineration are some of the commonly used water pollution control systems in the industry.

Air Pollution: Air pollution means the presence in the outer atmosphere of one or more contaminants such as

dust, fumes, gas, mist, odour, smoke or vapour in such quantities as known to be injurious to human, plant or animal life or to property. In the SME context, emissions due to improper burning of fuel in industry or from processes primarily contribute to air pollution. Cyclones, scrubbers, bag filters and electrostatic precipitators are some of the air pollution control systems needed to minimise effects of industrial air pollution.

Noise Pollution: Noise is unwanted sound. Ambient noise is all encompassing noise associated with any given environment and is usually a composite of sounds from sources near and far. Any abnormal sound that irritates human beings is called noise pollution. The main sources of noise pollution in industries are: machines/equipment and leakages of steam or compressed air. Noise pollution control measures include sound proof enclosures, modified design of machines, green cover etc. Use of ear plugs or ear muffs reduce the impact of noise pollution on humans.

Solid Waste Pollution: Solid waste implies any waste in solid form which can not be reused for any productive purpose. It may include process wastes such as distillates, sludge or scrap. Solid waste is further classified as hazardous and non-hazardous solid waste. While disposal of non-hazardous solid wastes is comparatively easy, disposal of hazardous solid wastes requires special measures and is strictly governed by the provisions of relevant laws.

Applicable legislations

The Ministry of Environment and Forests (MOEF) in the Central Government is the apex body in India for preservation of environment and natural resources. While MOEF makes environmental laws applicable to the country through Acts of parliament, the Central Pollution Control Board (CPCB) is its technical wing framing rules under such laws. Most of the State Governments have their own Environment Ministries and State Pollution Control Boards (SPCBs) to implement the laws. Depending on their specific requirements, the State Governments may make the rules more stringent but can not relax them. Industrial activities in India are governed by the following main environmental laws, which are applicable to SMEs also.

The Water (Prevention and Control of Pollution) Act, 1974: Applies to all establishments discharging effluents into a water body, sewer system or on land. All operating industries need to meet the discharge norms specified in rules framed by the Central Government and obtain "Consent to Operate" from SPCBs at specified intervals. The effluents discharged have to be

managed at all times or else there are penalty provisions under the Act for violations.

The Air (Prevention and Control of Pollution) Act, 1981: Applies to all industries, which have to declare their air pollution control areas and install necessary equipment. General and industry specific standards have been specified for air emissions from industry. Like in the Water Act, an industry has to obtain "Consent to Operate" under the Air Act also at specified intervals. Discharges into the air are to be managed within such prescribed standards at all times failing which penalty provisions are applicable.

Environment (Protection) Act, 1986: EP Act is an umbrella Act covering all aspects of environment including abiotic and biotic environment. Under this Act, the Government has identified 17 categories of industry (vide Table 3) as highly polluting and has laid down detailed procedure for obtaining environmental clearance including preparing environment impact assessment, going through public hearing and assessment at both state and central levels. For other categories of industry which are comparatively less polluting, a proponent has to obtain a no objection certificate from the concerned SPCB prior to setting up the industry. The EP Act also authorises the state (or central) government to issue directions in writing with regard to: closure, prohibition or regulation of any industry, operation or process; and stoppage or regulation of the supply of electricity, water or any other services. Under the EP Act, MOEF has issued industry specific standards and general environmental standards of air and water pollutants. MOEF has also framed a number of other rules to be followed by industry including those for management and handling of hazardous wastes and for manufacture, storage and import of hazardous chemicals.

Table 3: Polluting Industrial Sector

1. Cement	10. Pulp & Paper
2. Thermal Power Plants	11. Pharmaceuticals
3. Iron & Steel	12. Dye & Dye Intermediates
4. Fertilizer	13. Pesticide
5. Zinc Smelters	14. Petro Chemicals
6. Copper Smelters	15. Tanneries
7. Aluminium Smelters	16. Sugar
8. Oil Refineries	17. Basic Drugs
9. Distilleries	

Environmental Pollution from SMEs

Generally speaking all industrial activities have adverse impacts on the environment, but few sectors of

SMEs have major impacts and the industry has found it difficult to mitigate these adverse impacts. Some the environmentally problematic sectors of SMEs and their pollution potential are presented in Table 4.

Table 4: Industries and Pollution Potential

Industry	Environmental Problem			
	Water	Air	Odour	Solid Waste
Tanneries	3	-	3	3
Pharmaceuticals	3	3	3	3
Chemical processing	3	3	3	-
Pulp and paper	3	-	3	3
Textile dyeing and printing	3	-	-	3
Dyes and dye intermediate	3	-	-	3
Metal finishing	3	-	-	3
Foundries with coupolas	-	3	-	3
Brick kilns	-	3	-	3
Lime kilns	-	3	-	3
Stone Crushers	-	3	-	3
Khandsari sugar	3	-	-	3
Food and fruit processing	3	-	3	3
Meat processing and slaughter house	3	-	3	3

Though the SMEs, particularly the small scale sectors, do not follow a definite pattern in regard to their locations, they mainly come up around the major cities and adjacent to large industries. Some of the critically polluted areas in the country are: Vapi - Gujarat; Ankaleshwar - Gujarat; Chembur - Maharashtra; Thane - Belapur; Manali - Tamilnadu; Korba - Madhya Pradesh; Ghaziabad - Uttar Pradesh; Dhanbad - Bihar; and Durgapur - West Bengal. Polluted river stretches are: Sabarmati, Subarnarekha, Krishna, Damodar, Ganga, Yamuna, Hindon, Kali and Gomti.

Impediments

The factors, which prove to be impediments in improving the environmental performance of SMEs are:

- Obsolete technology, which necessarily generates pollution from the processes.
- Preference for labour intensive technologies (because of comparatively lower cost of labour) in

place of more automated processes which are likely to be less polluting.

- Lack of awareness of *environmental* requirements and industry's obligations.
- Lack of guidance to identify the environmental problems and suitable mitigative measures.
- Lack of resources, managerial capabilities and skills even when the environmental shortcomings are identified.
- Lack of space for installing pollution control equipment.
- Absence of common treatment facilities which could provide an economic solution to the pollution problems.
- Lack of public/market pressures to improve environmental performance.

Approach for Improvement

A multipronged and pro-active approach is necessary to bring environmental issues into focus for the SME sector. Some of the measures, which are likely to bring results are as follows.

Awareness

It is important that SMEs are properly appraised of their environmental obligations. Generation of pollution not only means that they face threats from regulatory agencies/public/judiciary but it also means that they are inefficient. Over the years Government has developed a framework of institutions to help SMEs at Central, State and District levels vide Table 5. These institutes need to pro-actively communicate to SSIs on their environmental obligations as well as guide/provide information on their environmental needs. Since all these institutes are Government sponsored, the Ministry of Environment and Forests (MOEF) should take up with concerned ministries/state govt. on developing requisite expertise in these institutions.

Cleaner Production

Industrial pollution is caused, more often than not, by improper use of resources and raw material, generating wastes in the form of effluents, emissions or solid wastes. Unburnt hydro-carbons coming out of the stack of a furnace or from automobile due to improper combustion, dust emitted by lime kilns or cement plants being nothing other than their products, effluent from a chemical plant containing unwanted proportion of an input resource, high noise from an industry due to

steam or compressed air leakage are some of the examples of malutilisation of resources causing pollution. Thus, improving the efficiencies of the manufacturing processes would not only lead to cleaner production reducing pollution, but would also add to the bottom-line.

Improving the efficiencies of the manufacturing processes would not only lead to cleaner production reducing pollution, but would also add to the bottomline.

Table 5: Institutional Infrastructure for SSI in India

Institutions	Major Activity
Central Government	
Small Industries Development Organisation (SIDO)	Apex body for SSI promotion
National Small Industries Corporation	Marketing machinery on hire purchase
National Institute of Small Industries Extension Training	Research Training etc
National Institute for Entrepreneurship and Small Business Development	Entrepreneurship
Small industries Development Bank of India (SIDBI)	Finance
National Research Development	Commercialising indigenous research for SSI
State Government	
Directorate of Industries	State level apex body for SSI promotion
Small Industries Development Corporation	Promotion of SSI through Industrial Estates
Small Industries Marketing Corporation	Marketing
Entrepreneurship Development Institute	Entrepreneurship
State Financial Corporation	Finance
District Level	
District level Centre	Provision of multiple service and Support under single roof

Given the generally low level of technology of the SME sector in India, there exists tremendous scope and the incentive for most of these industries to go for cleaner production drive. Introducing Environment Management System (EMS) and carrying out regular waste minimisation and EMS audits, is probably the most effective tool to introduce cleaner production. Whichever industry carried out this exercise sincerely

was pleasantly surprised by the resultant reduction in wastages. It is also the experience of most of the industries that much of the results are obtained by tightening the operating practices by strictly enforcing the standard operating procedures (SOPs) or through simple and generally inexpensive modifications.

Introducing Environment Management System (EMS) and carrying out regular waste minimisation and EMS audits, is the most effective tool to introduce cleaner production.

Cleaner technologies for a product are generally capital intensive and may be difficult for SMEs to afford. Such industries need to first tune up their existing production lines to achieve cleaner production before they opt for the next generation 'Cleaner Technology'. The new industries coming up should, however, go for the clean technologies, because in longer term only clean-technologies will be able to survive. The main question is—from where will the SMEs get such guidance. The SSI institutions and the industry associations will have to come forward, if meaningful progress is to be made in this direction.

Zoning

One major problem with SMEs is their having come up in the areas not conducive for siting such industries from environmental angle. Taking into consideration the developmental needs of regions as well as their environmental sustenance or carrying capacities, a zoning atlas need to be developed for the entire country for siting of industries. This would contribute greatly towards environmentally sustainable development. Work in this direction is already on at the Central Pollution Control Board (CPCB). This needs to be expedited.

Industrial Estates & Common Facilities

Though the problem of air pollution needs to be solved by the industry concerned, common facilities may be developed for effluent treatment and waste disposal. Self-sustaining Industrial Estates with common effluent treatment plants (CETP) and waste disposal facilities is the answer for the polluting type of SMEs. Industries desirous of taking advantage of such common facilities contribute towards capital and operating costs in proportion to the quantities of their effluents or wastes. The participating industries may have to pre-treat their effluent/wastes to meet the input requirements of the common facilities. However since costs of such

pretreatment are not normally very high, many industries will be inclined to opt for it with increasing pressure from regulatory agencies, public and the society. The common facilities may include:

- CETPs for biologically degradable effluents
- Incinerators for difficult wastes
- Secured landfill sites for hazardous waste disposal.

Such common treatment facilities, if properly designed and built keeping economy of scale in mind, have potential to become good business propositions as have been the case in many developed countries and also in states like Gujarat in India.

Common treatment facilities, if properly designed and built keeping economy of scale in mind, have potential to become good business propositions.

Environmentally unviable processes for SMEs

Some of the processes in the chemical and allied sectors like pharma, pesticide, dye and dye intermediates and leather chemicals are such that they generally have to have their own treatment facilities and can not depend on common facilities. Since such treatments are generally high in capital as well as operational costs, economy of scale for the industry becomes important. It is understood that CPCB has carried out a study to arrive at a viable size of such industries depending on annual operating costs for suggested modes of waste treatment/waste minimisation and the annual turnover. This study ultimately aims to identify chemicals which require:

- Immediate banning for SSI sector
- Phase out
- Reduction or review

It would be helpful if CPCB could complete this study and the Govt. take necessary decisions so that environmentally unviable industries do not come up in the SME sector, and such existing industries could be identified for suitable future action.

Policy Initiatives

The Government has over the years taken a number of policy initiatives to encourage growth of SMEs. The result of such sustained efforts is reflected in the SMEs

contributing more than 40 per cent of industrial output of the country. However, some further initiatives as mentioned will help SMEs become environmentally sustainable:

Common Treatment facilities as Infrastructure Projects: In today's context CETPs, common incineration systems and secured landfills sites are emerging as basic back up facilities required to ensure environmentally sustainable operations of SMEs. These should be recognised as infrastructure projects with resultant fiscal incentives/benefits so that they become economically more viable and attract entrepreneurs.

Environmental Clearance for Industrial Estates: As mentioned for 17 categories of polluting industries (which cover major part of manufacturing industry) environmental clearance has to be obtained from the central government, irrespective of size of the industry, thus including the SMEs in that fold. Environmental clearances are quite long drawn and often tedious processes involving among other things, public hearing. SMEs generally find handling such situations quite expensive and difficult. Since locating SMEs in Industrial Estates appears to be an environmentally sensible solution, the Government may consider according common environmental clearance for such complexes. The proponents of Industrial Estates in turn will have to commit to keep the pollution load from member units within the set of projected figures given in their application.

This would save the small industries from hassles and encourage them to behave in environmentally responsible manner.

Environmental Appraisal of funding proposal: Almost all proponents of projects including those in SME sector depend on financial institutes (FIs)/banks for their funding. These agencies thus are in a unique position to ensure that the proposals put up to them meet the environmental requirements of the land. Many of the banks and FIs have built in such checks in their system. It would only be prudent on their part to be more rigorous in their assessment so that projects funded by them are environmentally compliant under increasing societal pressures.

Market Based Instruments: The command and control regime followed in this country for industrial pollution control has not been very successful. It depends very heavily on enforcement by regulatory agencies, which has not been effective and does not differentiate between average performer and one who excels. Detailed studies have already been carried out which have come out with recommendations in respect of proper pricing of resources which will enable industries to internalise environmental costs, application of polluter pays principle, tradable permits etc. The Government may consider introducing these instruments suitably in phased manner with industry specific or location specific approach. □

The earth has enough for everyone's need, but not for everyone's greed.

– Mahatma Gandhi

Green Productivity & SMEs – Singapore's Experience

Peck Thian Guan

Singapore is a small city-state. It occupies an area of 647 square kilometres. With a population of 3.5 million, its density of population is among one of the highest in the world. In the late 1960s when Singapore started its industrialisation programme, the government realised that as a small country, the effects of a polluted environment would be felt more acutely than in larger countries. At the same time, the government believed that a clean and green environment would support economic development. This was contrary to conventional wisdom at that point in time, that industrial development must always be at the expense of the environment. In accordance with the government's commitment to protecting the environment, the Anti-Pollution Unit (APU) was set up in 1970. It reported directly to the Prime Minister's Office. In 1972, the APU was upgraded to the Ministry of Environment.

The Government believed that a clean and green environment would support economic development—a concept much ahead of the times.

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Singapore's Environmental Performance

It is interesting to review Singapore's environmental performance 30 years thereafter. In January this year, within the space of a week, two environmental reports were released. The Greening of Industry Network, which is an international partnership of policy professionals, researchers and practitioners, focussing on issues of economic growth, industrial development, the environment and society and building a sustainable future, developed the GIN-DEX. This index measures the synergy between economic development and environmental improvement in each of the 36 countries ranked. Singapore emerged eighth in the

list (9th GIN Asia Conference in Bangkok, 22 Jan 2001).

At the World Economic Forum in Davos, a very different picture was painted of Singapore's environmental record. When measured against the Environmental Sustainability Index (ESI), which was developed by the Forum's Global Leaders of Tomorrow Environmental Task Force, Singapore was among the 10-worst performing countries (Newsweek, 29 Jan 2001). (After clarification with the researchers, Singapore's position rose to 65 among the 122 countries assessed.)

What is the reason for such wide disparity in the assessment of Singapore's environmental performance? The reason lies in the indicators. The GIN-DEX measures and ranks carbon and water pollutant emission and energy use per unit industrial output, i.e. the synergy between economic and environmental improvement. The ESI measures sustainability. Small countries with no natural resources within their territory to compensate for consumption of resources will naturally fare poorly. The two indices give a composite picture of Singapore's environmental performance – although the country is managing well, it is still not sustainable. More effort must be put in to ensure that our industrial development will not be hampered by an unsustainable consumption pattern. There is room for improvement by the industry.

Singapore's Economic Landscape

So, what then is the make up of Singapore's industry? Singapore has a dualistic economic structure, with a large number of SMEs co-existing with a small number of large, local enterprises and foreign MNCs. SMEs are an important part of Singapore's economy. They comprise 92 per cent of total establishment, employ 51 per cent of the workforce and generate 34 per cent of the total value added (SME21, Position SMEs for the 21st Century, published by Productivity and Standards Board, 2000). Hence, for Singapore to improve its environmental performance, this segment of the industry cannot be neglected.

Characteristics of SMEs

SMEs are generally slow in embracing best practices. They have insufficient management know-how, a shortage of professional and technical manpower, outmoded and unproductive methods of operations. They are locked in a "no-time-no-money" syndrome. When the economy is good, they have no time to put in place systems to ensure better performance; when times are bad, they claim not to have enough money to pursue these programmes.

SMEs are locked in a "no-time-no-money" syndrome.

Although global environmental problems are real and would require everyone to do their part to protect our planet, most SMEs would rather put their energies into activities and programmes that would bring about immediate benefits to themselves. They would leave it to the government or the multinational companies to deal with environmental issues. The link between environment and their business is not evident to them. Hence, if environmental protection is promoted separately from manufacturing needs (e.g. quality and productivity), these programmes will fail. The working relationship between pollution prevention and manufacturing competitiveness must be clear before businesses, especially those involving the SMEs, would consider taking steps to improve their environmental performance (US Office of Technology report to Congress, 1994).

Green Productivity

Green Productivity offers a different strategy. Environmental protection is promoted together with productivity improvement. The end goal of GP is having overall socio-economic development which is sustainable. GP uses both productivity and environmental management tools, techniques and technology to reduce an organisation's environmental impacts. For an organisation practising GP, raising productivity does not necessarily mean having to use more resources (thereby adding to the environmental burden) in order to get more output. It means using resources more effectively and efficiently, producing better products and producing less waste in the process.

Raising productivity does not necessarily mean having to use more resources. It means using resources more effectively and efficiently, producing better products and producing less waste in the process.

Four-step approach to promoting GP

A four-step approach is used to promote GP in Singapore. To begin with, there is a need to create awareness of GP amongst companies. With the help of Asian

Productivity Organisation (APO), numerous talks and seminars were organised. Realising that the commitment of the chief executive of the organisation is the most important, efforts were made to reach out to the top echelon of companies. Breakfast talks were held to minimise the time that a CEO needs to be away from his office. To make it more convenient for factory staff to attend these awareness seminars, talks were conducted within the industrial estate.

While talks by APO experts were useful in raising awareness, there was a need to educate the industry and to equip them with the necessary tools to carry out GP on their own. GP training workshops were conducted. In addition, more trainers were trained so that there would be consultants available to assist the companies. First GP Demonstration Project was started. The purpose of the demonstration project was to show that the GP methodology could be applied to Singapore companies, with tangible benefits to be realised.

Encouraging the companies to take action—by starting GP programme in their own organisation—was the next step. And lastly, for the programme to be self-sustaining, the industry must have a sense of ownership of the programme. Currently the Singapore Productivity Association is being encouraged to embrace GP and to promote GP to its members. The Environmental Committee of the Electronic Industry, which is a loose confederation of companies in the electronic sector, has already indicated interest in promoting GP to its members. They have registered themselves with the International GP Association.

Case studies

In the context of Introduction of GP, four case studies are described here. In some cases, simple adjustment to the process was sufficient to achieve waste reduction and cost savings. In other cases, certain technologies had to be used to help the companies improve their performance.

Case study 1—Cost savings through waste segregation

Stamford Press is a local printing company and the first SME to achieve ISO 14000 certification in Singapore. The company engaged PSB to help them solve a wastewater treatment problem. With increase in production, the wastewater treatment plant was unable to cope. PSB consultants assisted the company to map out the process flow and carry out a material balance. It was found that in the waste streams, highly concentrated spent chemicals from the printing process and large quantities of very dilute process wastewater were mixed. As a result, there

was a large quantity of wastewater that had to be treated. PSB recommended that the waste streams be segregated. The small volume of spent chemicals from one of the processing tanks, which was one of the two main pollution sources, could be sent for off-site treatment. The second spent chemical, which was also in small quantity, was the other major pollutant. This waste could be sold to a recycler because it contained precious metals. The large volume of the process wastewater could be discharged into the sewer as it met the legal discharge limit. So, instead of building a large wastewater treatment plant, the company could now operate without any wastewater treatment system. This saved the company substantial amount of money in hardware cost and also running cost of the treatment plant. The space, which was originally set aside for the treatment plant, was converted to production space.

Case study 2—Cost savings through process modification

Spindex Engineering Pte Ltd is a local precision engineering company. It was Singapore's first GDPD project. Like Stamford Press, Spindex was already ISO 14000 certified when PSB started the GDPD project with them. The company had put in place several programmes to improve its environmental performance. Oil consumption was identified as a significant environmental aspect. They were convinced that they were consuming large amount of cutting oil, perhaps more than the industry average. They therefore started an oil recovery programme. Waste metal chips were segregated and kept in perforated drums to recover as much oil as possible before the chips were sent away for disposal. The company also put in place many other oil conservation programs. In spite of all these efforts they were still consuming substantial amount of oil. This made them wonder where exactly the oil was getting lost.

Oil consumption was identified as a significant environmental aspect.

PSB consultants put the company through the six GP steps. In the area of oil recovery, it was found that most of the oil loss was through the products and not through the chips, i.e. there was more oil adhering to the products than the chips. The oil-coated products were then degreased before going to the next production step. This was the reason for the loss of oil from the process. The GP team then explored ways to recover oil from the parts. The method that was adopted required the printer shafts, immediately after machining, to pass through a tightly fitted rubber "O" ring. The "O" ring

could remove a substantial amount of oil which was affecting the quality of the shaft (See Fig. 1).

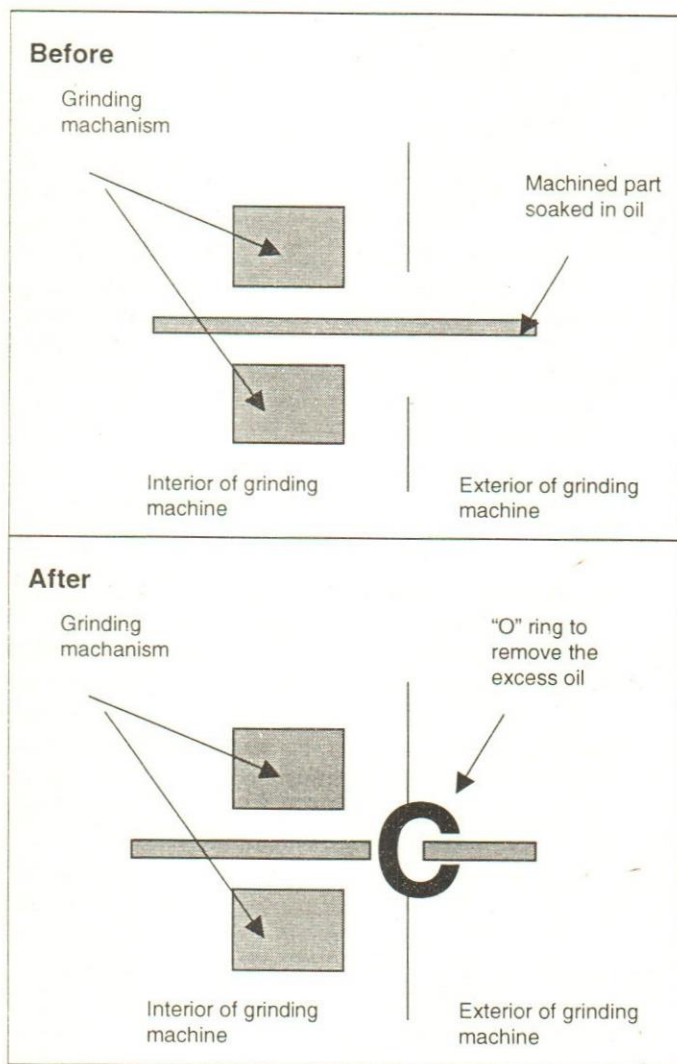


Fig. 1. Schematic diagram showing improvement to grinding machine to remove excess oil from machined parts.

For smaller parts, a perforated basket was used to contain the parts after they were ejected from the grinding machine. These parts were soaked with oil and were allowed to remain in the basket for some time, to recover as much oil as possible. Unfortunately, the basket would sit on a tray. As the oil drained from the parts, the oil would collect in the tray. Naturally, not much oil could be recovered as the parts were always wet with oil. The GP team introduced an improved basket design. The improved basket had a raised perforated platform. (Fig. 2). In this way, oil collected at the bottom of the basket was not in contact with the parts.

Spindex also implemented programmes to conserve water conservation, reduce VOC emission and reduce oil stains on the factory floor.

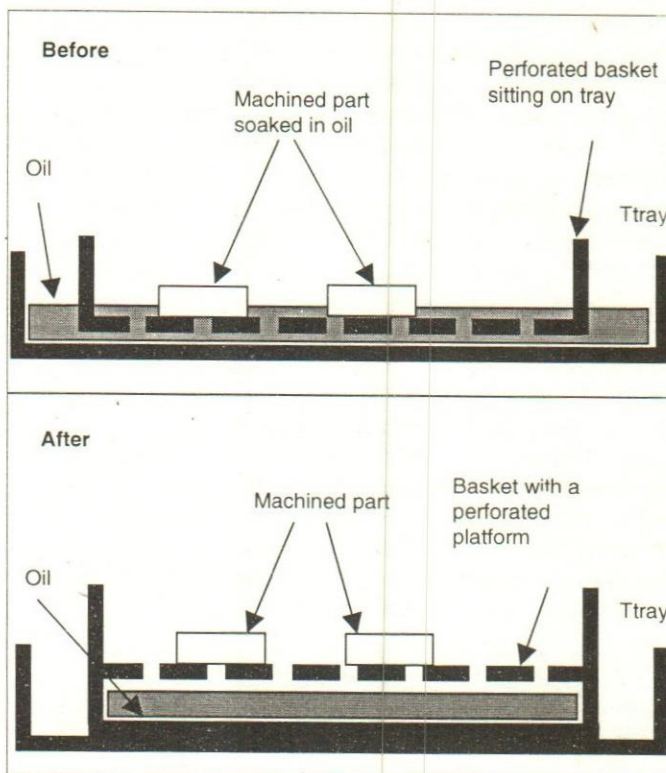


Fig. 2. Improved basket design to allow oil to drip from machined parts.

Case study 3—Waste heat recovery

The third case study involved the use of an advanced heat recovery technology in a local sugar refining company, to recover waste heat from a boiler flue gas. The recovered heat was used to increase the temperature of the boiler feed water and combustion air. A heat pipe heat exchanger was used in this case. With the heat pipe heat exchange, the temperature of the flue gas was brought down from 530°C to 195°C. The temperature of the feed water was increased from 80°C to 112°C while the temperature of the combustion was raised from 33°C to 102°C. The heat exchanger not only reduced the fuel consumption by more than 7,000 litres per day, it also improved the boiler efficiency from 65 per cent to 88 per cent. The measure not only saved the company more than \$600,000 Singapore per year (payback of 1 year), it has also improved the environmental performance of the company as less carbon dioxide is now being emitted to the environment.

Case study 4—Extending the shelf-life of fruits

Fruits are ideally harvested just before eating or when their visual quality is judged to be at an optimum. However, with increasing remoteness of production areas from population centres, this practice is no longer possible. Fruits are normally harvested before they are ripe and

then transported to the market. Ripening occurs during the entire process between farm and the end user. However, the time to market can be considerable as the fruits are passed through complex marketing and distribution network. Fruits are living systems and they deteriorate after harvest, even as they ripen. Careless handling results in post-harvest losses. In some cases, these losses can be huge. For example, post-harvest losses for papaya can be as high as 21 per cent (Liu, MS and Ma, PC, Postharvest problems of vegetables and fruits in the tropics and subtropics, 10th Anniversary Monograph Series, Asian Vegetable Research and Development Center, Shanhua, Taiwan (1983).

The rate of deterioration varies greatly between individual fruits, depending on the rate of metabolism. For many fruits, deterioration can be rapid. This prevents fruits from reaching far away markets. Alternatively, these fruits have to be air-freighted. This increases the cost of the fruits considerably. There are technologies now available which can delay the ripening of fruits. Fruits can be coated with a biodegradable, natural-based food ingredient to delay their ripening. Typical results on the effectiveness of the ripening retardant are given in Table 1.

Table 1: Extending Shelf-life of Fruits

Fruits	No. of days to ripen	
	Without coating (days)	With coating (days)
Mango	7	14
Banana	5	12
Papaya	7	21
Guava	8	16
Star-fruit	7	14
Duku Langsat	2 to 3	5 to 6

Wastage can now reduced and tropical fruits can be shipped to temperate countries, where such fruits command premium pricing.

The way forward

PSB has almost completed the Awareness-Educa-

tion-Action-Ownership cycle in its GP promotion programme. There is however, still a need for greater awareness building education, action and ownership of GP by industry. PSB will work closely with other government agencies to encourage greater adoption of GP by industries. The Ministry of Environment has recognised GP as a useful tool in helping improve the environmental performance of companies. It has included GP in the revised Singapore Green Plan. The Green Plan is Singapore environmental management masterplan. Internally, PSB will allocate more resources to the GP programme and has incorporated GP into the National Cost of Quality (COQ) programme. PSB will continue to deploy trained consultants to companies requesting GP training and consultancy.

There is a need for greater awareness building education, action and ownership of GP by industry.

The next phase of GP promotion will focus efforts in promoting energy conservation. PSB, with the assistance of APO, has embarked on a second demonstration project with special emphasis on energy management. A seminar is to be conducted on energy management in June and December, where the results of the GPDP will be disclosed.

Conclusion

Although some success has been achieved in promoting GP to industry, there is still room to do more. With concerted effort from various government agencies and increased private sector participation, more companies will be adopting GP as a strategy to achieve higher productivity and competitiveness.

Acknowledgements

The author would like to thank Dr Loh Wah Sing and Mr Chan Wai Chong for their contribution to this paper. □

Prospects for Biotechnology Industry in India

P.K. Ghosh

Biotechnology encompasses techniques applied to organisms or parts thereof to produce, identify or design substances, or to modify organisms for specific applications. Biotechnologists use molecular keys and biological tools to produce tangible and intangible wealth. India has been practising conventional biotechnology for several decades. Products manufactured by the use of genetic engineering, immunological techniques, cell culture methods and hybridoma technology are increasingly being used during the last 5 years and local research in these areas has been intensified. India has developed competence in selected areas that provide the entrepreneurs an edge over other countries. With these strengths in view and having regard to the market demand of products and processes in Indian context, the investment opportunities in various sub sectors of biotech industry have been projected, and the estimated future demand of 53 products have been worked out, by the author.

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Biotechnology encompasses techniques applied to organisms or parts thereof to produce, identify or design substances, or to modify organisms for specific applications. Cell fusion techniques, hybridomas, recombinant DNA technology, protein engineering and structure based molecular design are considered as modern biotechnology. Emanating from the above, the structural and functional genomics complemented with computer-aided informatics are making fast inroads into the frontiers of modern biotechnology. In addition, several technology platforms have emerged from increased understanding of signal transduction pathways of cells and tissues, cell based immune rejections, tissue engineering, proteomics, bio-informatics including bio-chips and genomic sequencing of organisms; all these areas hold enormous hope for providing new biotech products that would have wide applications.

Conventional biotechnology includes fermentation or conversion of substrates into desired products by biological processes; downstream processing for recovery of metabolites; use of microbes or enzymes for producing value added products; sera, vaccines and diagnostics produced by conventional methods; reproduction, artificial insemination and embryo transfer technology for animal breeding; methods for fish spawning induction; plant cell or tissue culture; plant breeding for producing better seeds or plants cultivars; bio-fertilisers; bio-pesticides; plant growth stimulants; extraction and isolation of active principles from plants or animals or parts thereof etc.

Biotechnologists use molecular keys and biological tools to produce tangible and intangible wealth. The flowsheet (Fig. 1) depicts the activities undertaken by biotechnologists the world over to create wealth in different sectors such as health care products, agriculture, bio-industrial products and sustainable environment management practices. Right teaming up of biotechnologists skilful at least in molecular biology, immunology, chemistry and chemi-

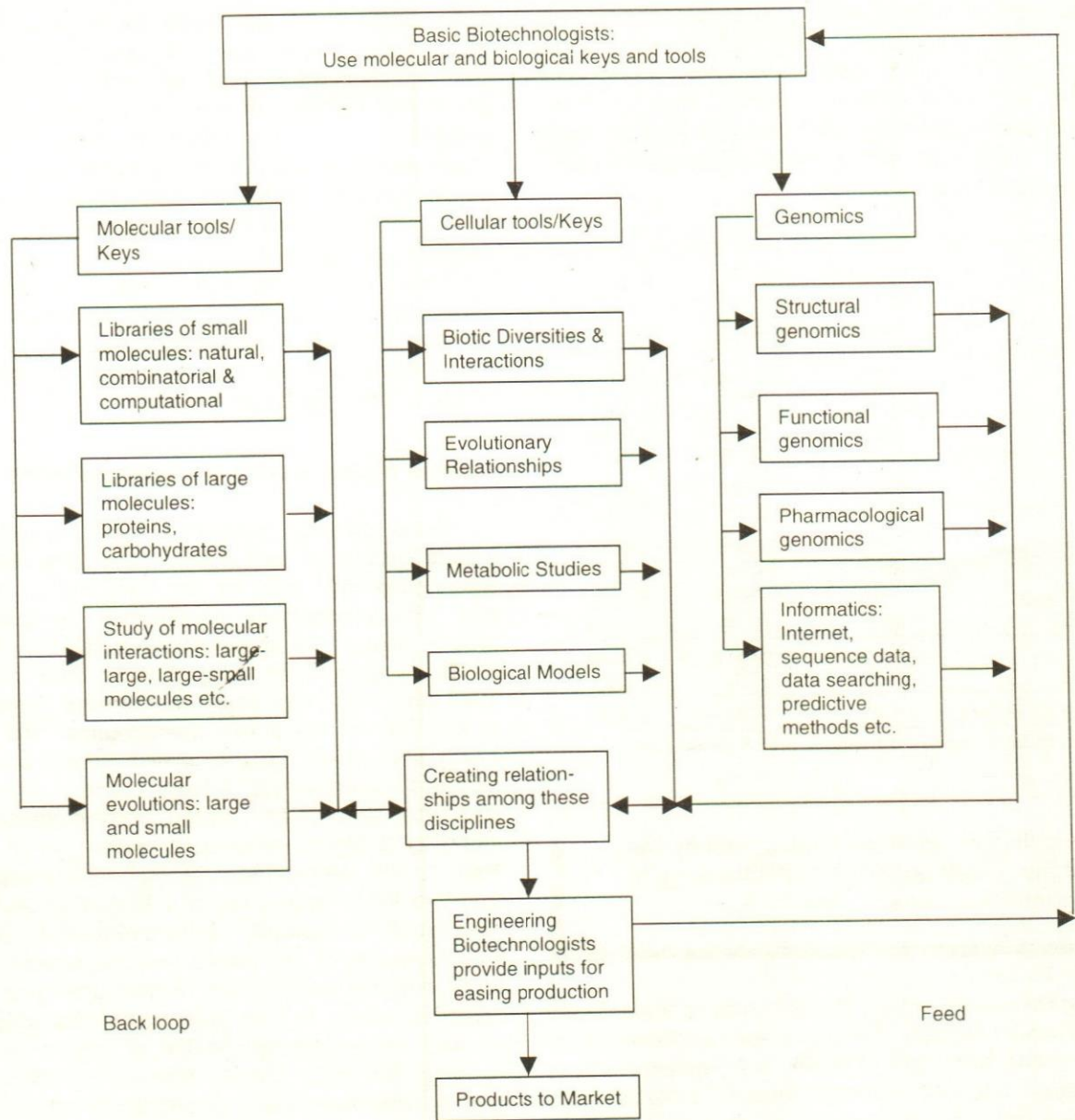


Fig. 1. Flowsheet depicting activities of biotechnologists

cal engineering sciences is rare. But this combination holds a great potential of taking products of this powerful technology from laboratory to the market. In agriculture, the breeders must also be a part of the team.

Teaming up of biotechnologists skilful in molecular biology, immunology, chemistry and chemical engineering sciences holds a great potential of taking products of this technology from laboratory to the market.

Consumption Scenario of Biotech Products in India

India has been practising conventional biotechnology for several decades. Products manufactured by the use of genetic engineering, immunological techniques, cell culture methods and hybridoma technology are increasingly being used during the last 5 years and local research in these areas has been intensified. Table 1 gives the current consumption and the future demand of biotech products in India, as compiled and computed by the author.

It will be seen that health care products shall dominate the scene and may contribute to about 40 per cent of the consumption market by 2010 from nearly

37.5 per cent in 1999. Contribution of biotechnology in agriculture may also rise to nearly 33.7 per cent from its share of 29.8 per cent in 1999. Contributions in industrial products and other biotech materials may go down from the present 32.7 per cent to about 26.3 per cent, although in monetary terms, the absolute contributions in these areas would also rise.

Table 1: Consumption of Biotech Products in India

(Rs. in Million)

Particulars of Biotech sub-sectors	Actual Consumption 1999	Future Consumption Estimate 2005	Future Consumption Estimate 2010
Human and Animal Health care Products	32240 (37.5)	35320 (37.6)	93540 (40.0)
Agriculture (including seeds)	25670 (29.8)	28880 (30.7)	78720 (33.7)
Industrial Products	27090 (31.5)	28500 (30.3)	53590 (22.9)
Other Biotech Products	1040 (1.2)	1300 (01.4)	7940 (3.4)
Total	86040 (100)	94000 (100)	233790 (100)
In million US Dollars	1789	2186	4270

Figures in brackets indicate contributions in % of the total)

Health care products shall dominate the scene. Contribution of biotechnology in agriculture may also rise

Modern biotechnology is rather new to India. There is little doubt about the increased applications of modern biotechnology in the country. The products or processes, produced through modern biotechnology hold great potential for providing much better solutions to improve the health of people and the quality of life, improve agricultural productivity significantly alongwith supplying more nutritious food, produce industrial bio-products at much cheaper prices and improve the quality of environment effectively on a sustainable basis.

World leader-countries in Biotechnology

USA would lead the world in modern biotechnology, but developments in other countries especially in Europe would also be significant. Countries such as UK, Germany, France, Sweden, Switzerland, Belgium, Denmark, Italy, Finland, Ireland, Russia, Hungary and Poland would make significant progress. Among the Asian countries, Israel, Japan, China, India and South Korea shall have several modern biotech companies.

India, China and South Korea are expected to emerge as major players towards providing health care products at much cheaper prices than the prices they are available today. In agriculture, China may pioneer achieving major breakthrough among developing countries that is likely to inspire many poor countries to adopt modern biotechnology in their agriculture. Australian developments in certain sectors are also expected to be substantial. Besides, significant progress is foreseen from Canada, Brazil, Argentina, Mexico, Cuba and Columbia. Among the African countries, maximum developments are expected from South Africa. Globally, main developments are expected in health care products followed by agriculture.

Hotspot biotechnology research platforms

Gene splicing, creation of host compatible constructs initially in prokaryotic organisms followed by using eukaryotic cells for the transcription, translation and post-translational modification to create near natural equivalents of bio-active proteins in 1970s and 1980s revolutionised drug therapy. The decades of 1980 and 1990 had seen phenomenal growth in the production of bio-active therapeutics; the trend is being and would be maintained during another two decades. Concurrently, a large number of technology platforms have been created from increased understanding of signal transduction pathways of cells and tissues; the development of high-throughput screens that provide a wide array of information that facilitate the search for clinically useful compounds; and better understanding of cell based immune rejection thereby facilitating the possibilities of interrupting or delaying rejection, which in turn shall make allotransplantation as well as xenotransplantation of organs increasingly feasible. Stem cell culture, tissue engineering and tissue transplantation are emerging as alternative solutions to organ failure. In agriculture, transgenic plants are expected to ease agricultural production with reduced use of chemical pesticides as well as reduced usage of fertilisers and water; several designed crops are expected to emerge that are nutritionally superior. Environmental pollution problems are expected to be addressed more efficiently by the use of engineered microbes and plants. Biochips are expected to contribute to simple and easy-to-use

Environmental pollution problems are expected to be addressed more efficiently by the use of engineered microbes and plants

diagnostic kits for detecting genetic disorders, discovering new drugs and research applications. Proteomics would shed light to genome-encoded events and would contribute to drug discovery and research. Bio-informatics would facilitate the progress of research in pharmacogenomics, bio-chips and data mining. The lead biotech platforms are combinatorial chemistry, proteomics, bio-chips, pharmacogenomics, tissue engineering, allotransplantation, xenotransplantation, genetically modified plants and other agricultural biotechnology. Several products and services are expected to be emerging from each of these platforms.

Biotech companies need to have correct information in contemporary technology and current business environment. As biotechnology is highly science based, contemporary technological knowledge can only be gathered through up-to-date information of the science behind the technology. Knowledge has to be applied through actions. Therefore, the prelude to actionable technological information would be the presence of a uniquely talented group of people in organisations to make the latter successful. Research based commercial organisations in biotechnology would have a large number of scientific personnel in addition to able business managers. Generally, scientists do not spend time to understand business developments; often business information does not enthuse them. Such a situation must be corrected in order to benefit the commercial organisations. Scientists need to spend at least one fourth of their time in understanding the nitty-gritty of business trends in order to enable them to divert their attention to developing more competitive goods and services that the market is looking for. Business managers should also spend one third to one fourth of their time in understanding and analysing the science and technology of their business and gather competitive intelligence information. Good reading habits need to be inculcated; concomitantly, effective discussions and seminars should be conducted periodically to keep the team current and productive. Information in public domain is the starting point. However, what is more important is the value added information or knowledge that is eventually gathered by organisations by the assimilation of the knowledge in the public place and by creating new knowledge or digested knowledge from out of it. Organisations that can create more of value added digested knowledge have more action points and therefore, can progress faster. Digested knowledge is always very different from what is available in the public domain. Digested knowledge will lead to actions and will make the company more alert than others. Organisations involved in research in cutting edge technology

platforms need to keep their people updated in contemporary knowledge in technology and business trends.

Indian capabilities in modern biotechnology

Coming back to Indian developments, while there exists over 800 companies operating in all sectors of biotechnology, there are only about 25 companies that are working in modern biotech sectors. These include Shantha Biotech, Hyderabad; Bharat Biotech, Hyderabad; Wokhardt Biotech Ltd, Aurangabad; Panacea Biotech, Ropar; Torrent Biotech, Ahmedabad; SPIC, Chennai; Scheering India Ltd., Mumbai; Serum Institute, Pune; Sun Pharmaceuticals, Ahmedabad; Span Diagnostics, Surat; J. Mitra and Company, Delhi; Ranbaxy-Eli Lilly, Delhi; Dr. Reddy's Laboratory, Hyderabad; East India Pharmaceutical Works, Calcutta; Infar India Ltd., Calcutta; Cadila Health Care Ltd., Ahmedabad; Cadila Pharmaceuticals Ltd., Ahmedabad; Hindustan Antibiotics Ltd., Pune; A.S.C. Ltd., Baroda; Maharashtra Hybrid Seeds Company Ltd., Mumbai; Pro-Agro PGS, Gurgaon; Indo-American Hybrid Seeds, Bangalore; Rallies India Ltd., Bangalore; Monsanto India Ltd., Mumbai; Novartis India Ltd., Mumbai etc. None of the Indian companies have introduced any product of original research in Indian market that could be considered as unique, introduced for the first time in the world. But some have introduced known products that are tantamount to effective import substitution. Some others have teamed up with foreign companies for sourcing technologies and are experimenting with new products produced by foreign technologies with a view to introduce them into the Indian market within the framework of Indian laws. Certain companies are also introducing novel and effective but intellectually protected genes into Indian germplasms to increase agricultural productivity or to reduce agricultural production costs. All these conditions and situations are satisfactory to begin with, but the country has to go a long way to come up with innovative products that would be original and would have cutting edge impact in the global context.

None of the Indian companies have introduced any product of original research.

Developing a modern biotech product from scratch and testing its efficacy to be effective and safe within the framework of law in any country including in India is a time consuming process and an expensive affair. It is presently technologically difficult too. Concerned people would have to have patience and would have to look for sufficient funds for creating the right kind of research and development environment. It is prudent in this context to turn our attention to the current govern-

ment policies to understand in what directions these interventions are moving.

Developing a modern biotech product and testing its efficacy is a time consuming process and an expensive affair.

Indian Government intervention in the management of economy

In India, the management of economy and industry is vested upon the Central Government, which promulgates from time to time the policies of planning, control of industrial capacities, regulation of locations of industrial undertakings, and approval of foreign collaborations.

India has believed in socialistic pattern of society. In early years from our independence upto late eighties, the policies followed by the government had major emphasis on creating interventions that work on the distribution of wealth, as it was thought that enough wealth was being created and was getting accumulated in a few hands only. Entrepreneurs create wealth in an environment by deploying capital, labour, technology and infrastructure. Wealth created by entrepreneurs remains with them if adequate interventions are not exercised by the political system and by the government. In the early years upto late eighties, Indian government had put enormous intervention on private ownership of wealth with a view to move towards equitable distribution of wealth among people by taking such major steps as follows:

- Central planning to divert resources as per the visions of the Central Government.
- Pronouncement of Industrial policy to boost the Public Sectors.
- Setting up of highly capital intensive Public Sector Undertakings.
- Nationalisation of major Private Banks and Insurance.
- Regulation of Private Sector Industries by introducing.
 - MRTP act
 - FERA
 - *The Indian Patents Act 1970*
 - Price control

- Control and distribution of essential communities
- Concessions to the Small Scale Sectors

These conservative policies did create an impact on the phenomenon of wealth distribution and created a rise in the population of middle class, though interestingly very little impact was perceived on the real poor. The assumptions that planned development of industries dispersed regionally (with manufacturing capacities created without attention to economy of scale, limited scope of further expansion of manufacturing capacities), price protection of communities to enable industries to recover cost plus margins for the goods and services produced by them from a non-competitive market place, and more such public/local-industry friendly measures would be beneficial to promote economic welfare, could not hold any more beyond late eighties. Symptoms were manifested in terms of lowering of reserves of foreign exchange and insolvency in economy resulting primarily from inefficiencies from productivity in most of the industries but particularly in the public sector undertakings in most of the sectors of industries. Consequently, to correct the situation, the Central Government from the Ministry of Industry substantially modified the previous developmental policies from July 1991 onwards. The licensing policy was enormously liberalised through the enactment of simpler policies successively over the years through the pronouncements of the Foreign Investment Promotion Board of the Union Ministry of Industry to attract large Foreign Investments. The present promotional policy of the Indian Government for the development of industries in all sectors including the biotech sector can be stated as follows:

- Industrial licensing policy has been liberalised for accommodating automatic registration
- 100 per cent foreign equity investment is possible in all sectors
- 74 per cent foreign equity investment is automatic in drugs and pharmaceuticals sector, and over 74 per cent is on case by case basis, provided basic manufacture is undertaken locally
- Fast Tract Clearance route for Foreign Direct Investment

Industrial licensing policy has been liberalised for accommodating automatic registration

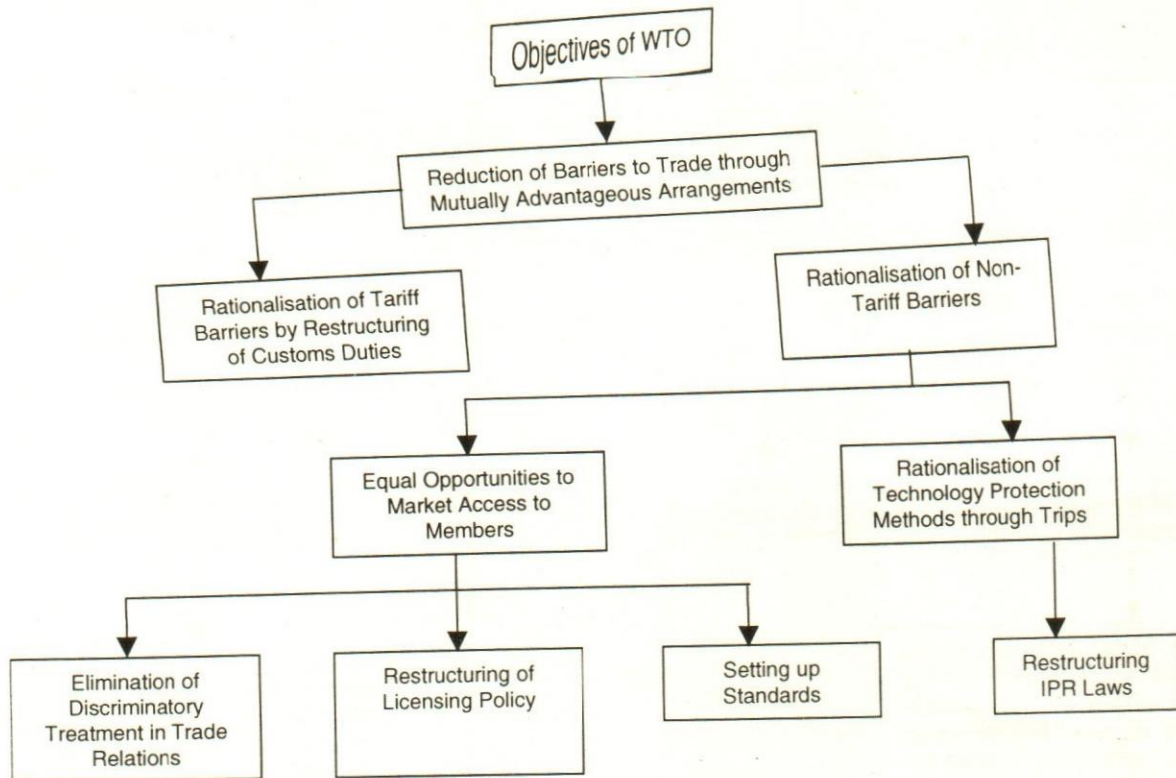


Fig. 2. Flow-sheet depicting objectives of WTO

- Rationalising of customs duties, central excise duties, special excise duties and value added tax
- Central Government playing proactive role of development, in creating conditions for easing open field experiments with genetically modified organisms including plants for enabling industry/entrepreneurs to take products from lab to the market faster
- Creation of equal level playing ground for all sectors of entrepreneur: Indian public sector, Indian private sector or foreign entrepreneurs
- Government investment over Rs 1000 crores in biotechnology for developing skilled manpower, creating R & D infrastructure and providing extramural R & D support to public funded institutions.
- 100 per cent rebate if research is contracted in public funded R & D institutions
- Over 50 R & D labs in public sector in place and over 20 conducting research in frontier areas of biotechnology: these facilities can be used for teaming up by the entrepreneurs/industry; stand-alone research is often expensive and unproductive
- Joint R & D projects are promoted with special fiscal benefits accruing to such projects.

The current liberalized policy implemented in right

spirit has the ingredients of providing the necessary impetus to the entrepreneurs to set up sustainable and competitive local industrial units with the necessary support extended by the Government.

The current liberalized policy has the ingredients of providing the necessary impetus to entrepreneurs.

Realizing that genetically modified organisms (GMOs) could contribute to economic development in all sectors of biotechnology and having regard to the questions of safety emanating from the use of GMOs, the Government had enacted sound Environment (Protection) Act and Rules to deal with GMOs. The Rules framed by the Government of India are one of the earliest and are entrepreneur friendly both for research and commercial applications.

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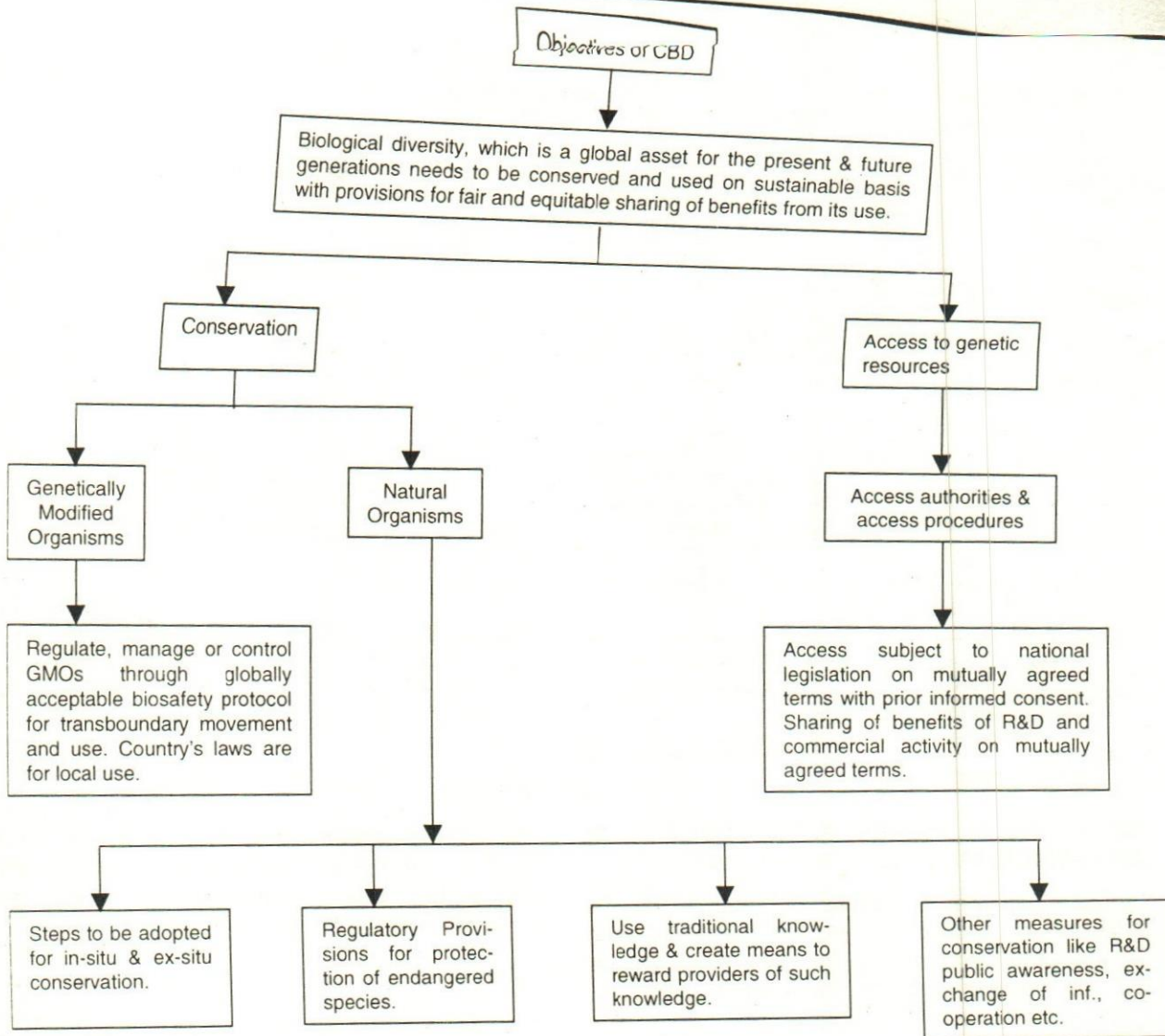


Fig. 3. Flow-sheet depicting objectives of CBD

Indian commitment to globalisation

India is a signatory to the World Trade Organisation (WTO) and the country is taking steps to enact the provision of WTO in letter and spirit. The objectives of WTO are presented in the form of a flow diagram (Fig. 2).

In all the specified areas, the Indian government is taking steps to fulfil the objectives of WTO. But such steps are taken commensurate with maintenance of a rationale that does not create an imbalance in the core competence of the country. No steps have been taken that create a virtual collapse in any industrial sector. All the steps taken by the government are within the broad framework of procedures and principles of the WTO.

Being also a signatory to the Convention on Biological Diversity (CBD), India is committed to protect its genetic biodiversity and concurrently it would consent

to enabling access to people to its genetic diversity. The objectives of CBD are stated in a flow diagram (Fig. 3). As a signatory country to CBD, India would soon constitute its Biodiversity Authority and exact procedures for accessing Indian Genetic Biodiversity by the CBD member countries.

More regulatory dictums within the framework of international commitments of India to WTO and CBD are therefore in the offing. These include the creation of Plant Quarantine Authority of India, the Geographical Indications Act, the Biodiversity Protection Act etc. all of which cut across the interests of the biotech industries. The future years hold enormous inquisitiveness from the entrepreneurs on how the laws are going to be framed and how industry would be benefited from these.

Future trend of development of biotechnology

India already has developed competence in

selected areas that provide the entrepreneurs an edge over other countries to set up viable and competitive biotech industry in certain areas. Indian Government continues to play a significant role in the promotion of biotechnology in all its facets. These efforts have been instrumental to developing competence within the country. The areas of core competence in India in the context of biotechnology are as follows:

- Capacity in handling sterile fermentation processes
- Skills in handling microbes and animal cells
- Skills in plant cell/tissue culture
- Competence in chemical synthesis, proficiency in immunology and hands-on experience in microbiology
- Capacity in downstream processing and isolation methods; Skills in cloning of desired organisms in relation to DNA technology for producing GMOs
- Skills in extraction and isolation of plant and animal products
- Competence in plant and animal breeding
- Infrastructure and skills in fabricating bio-reactors and processing equipment of diverse kinds.

With these strengths in view and having regard to the market demand of products and processes in Indian context, the investment opportunities in various sub sectors of biotechnology are thought to be as follows.

Human and animal health products

The human and animal health care products would grow substantially. There would be increase in the production of more effective vaccines. There is immediate demand for cocktail vaccines of DPT with hepatitis B, Tetanus toxoids with hepatitis B, hepatitis A with B, influenza, vericella and meningitis vaccines; technical solutions exist in all these areas and can be gainfully exploited. There is need for increased availability of effective typhoid vaccines. There is an unmet demand for several animal and poultry vaccines. It is roughly estimated that investment to the tune of Rs. 300 to 400 million can come in vaccine area during the next five years if local opportunities are availed of. There are also opportunities for developing vaccine for protection against hepatitis C, hepatitis C, hepatitis E, HIV, Malaria, Tuberculosis and Leishmaniasis; these developments are closely related with a long term planning on research. There are also opportunities for developing recombinant viral vector vaccines and DNA vaccines.

Disease diagnostic areas are growing fast although the country has kept investment opportunities for local production neglected. Most of the diagnostic products are imported and used although local skills could be sharpened and used as competitive global advantage. Diagnostics based on monoclonals, synthetic peptides and recombinant antigens or antibodies could be made locally, as skills exist; the requirement of membranes could be met from local sources by providing encouragement to skilful local producers. The requirement of speciality plastics could also be met from local capabilities. The intervention in policies could play a vital role in developing this industry locally. With a little readjustment to provide for equal level playing grounds to local producers compared to advantages available to the direct importers of certain products, it is possible to enable the deployment of investment to the tune of over Rs. 500 million in diagnostic business in the next five years to create a globally competitive local industry. Opportunities exist for the setting up of facilities for developing diagnostics devices for detecting HIV, HCV, HEV, Papilloma, Malaria and Tuberculosis. Further, opportunities exist for quantitative estimation of hormones such as T3/T4/TSH, hCG, LH, FSH, Progesterone, Testosterone, Corticosteroids, Alpha fetoprotein and prostatic inhibin. Still further opportunities exist for setting up facilities for producing diverse biochemicals required in health care products in diagnostics such as Monoclonals, monoclonal antigens/antibodies, recombinant antigens/antibodies for various conditions, peptides, nucleotides, specialty plastics, membranes of different molecular weight cut off, polyclonal antisera, conjugates and specialty enzymes.

Disease diagnostic areas are growing fast although the country has kept investment opportunities for local production neglected.

The area of production of therapeutic recombinant proteins is growing locally, but the speed of development is slow. Local skills can be sharpened by prioritising the activities and with the removal of certain impediments it is possible to create a viable and globally competitive industry in India, and investment to the tune of Rs. 0.8 to 1.00 billion could be attracted. Opportunities exist for taking up production facilities for Interferons, Insulin, Human growth hormone, G-CSF, GM-CSF, Erythropoietin, Blood factors VIII and IX, Urokinase, Tissue Plasminogen activator, Streptokinase, Interleukins and Tissue necrosis factors.

The area of production of therapeutic recombinant proteins is growing locally, with the removal of certain impediments it is possible to create a viable and globally competitive industry in India.

In antibiotics area, opportunities for future investment are not presently bright, specially keeping in view the core competence of some Asian countries. However, in order to protect the local industry on scientific considerations such as maintenance of high quality standards effected by vigilant and authoritative monitoring, and introduction of stringent procedures for registration of products, it is possible to create the environment for further growth of antibiotics industry locally. Without disturbing the terminal prices of formulations, it should be possible to readjust strategies within the core of the antibiotics production set-up, starting from the high investment bulk producers to the low investment formulators, to share certain cost elements rationally within the sector, such as the costs of electricity and the costs of capital servicing, with a view to improve the health of the core bulk production sector. If such considerations are brought into play, it should be possible to induct fresh investment to the tune of over Rs. 1 billion during the next five years, besides reassuring the survival of local antibiotics industry. This situation is considered to contribute to protecting and increasing the local skills developed over a long period of ardent perseverance starting from early fifties. In the long run, this will benefit the country economically.

There also exists opportunities for fresh investment in setting up facilities for the fractionation of blood and blood products into cellular and non-cellular components, and sensitised immunoglobulins. Separately, significant demand exists for the production of different monoclonals, peptides, hyaluronic acid and other animal products, besides effective biotechnological drug delivery systems. For all such opportunities to be availed of, over Rs. 1 billion could be invested for creating local production facilities.

Agriculture Biotechnology

In agriculture, major contribution is anticipated from the local production of increased quantities of hybrid seeds and high-yielding varieties. Already core competence exists for developing varieties and hybrids; the cheap labour force available locally is of great advantage. Unfortunately this area has not grown because it has not been possible to bring home the great merits in the replacement of productive seeds every year,

which presently stands at below 10 per cent. Genetically modified plants/seeds are expected to emerge in the coming years and would capture markets in specific sectors of seed industry. Already contained field experiments have been initiated to evaluate the environmental risks, taking also into consideration the risks to human health. Initial results have not shown any unmanageable risks either to the environment or to human health. Indeed the good news is that there has been significant rise in the agronomic benefits, besides reduction in the use of chemical pesticides for plants engineered for resisting the attack of insect pests. There would also be increase in the usage of bio-pesticides including botanical pesticides. Formulations based on Bt, different viruses like NPV and GV as well as neem based pesticides would be increasingly used. The seeds industry alone holds possibilities of investing over Rs. 1.5 billion in another five years. Concomitantly opportunities exist for new investment in bio-fertilisers (over Rs. 200 million), bio-pesticides (about Rs. 300 million), pheromones, growth stimulants/promoters (over Rs. 500 million) and botanical pesticides (over Rs. 600 million).

The seeds industry alone holds possibilities of investing over Rs. 1.5 billion in another five years.

Industrial and other Biotech products

The sector represented by industrial products will remain primarily based on conventional biotechnology although recombinant microbial strains are expected to contribute substantially to the production of bio-catalysts (useful for complex chemical reactions), industrial enzymes, food-grade enzymes, production of simple microbial metabolites such as organic acids and amino acids. There would be a rise in the production of speciality enzymes and oligo-nucleotides in molecular biology research, speciality materials including speciality plastics for specific uses, analytical materials and reagents for diverse use, and application of biological materials in electronic devices. Among the industrial products, new investment opportunities are foreseen in industrial enzymes (over Rs. 500 million) and in amino acids production where investment of over Rs 700 million can come up to meet not only local needs but to cater to export needs also. Opportunities in investment in these areas are clearly linked with India having sizeable quantities of sugar cane molasses, and also other cheap agricultural substrates like various grades of starches from tapioca, maize, potato etc; corn steep liquor (whose quality can be improved if adequate demand is created), sugar, pea/peanut/soyabean meals, and various vegetable oils.

In the area of bakers and brewers yeast, opportunities for production of fresh compressed yeast do not presently exist but production of value-added NAD/NADH and speciality enzymes could be explored by using the locally available compressed yeast. In addition to the above areas of investment, there exists reasonable scope for setting up facilities for the recovery of value-added products from wastes such as proteins from milk whey, bio-gas and composted fertilisers from municipal or agriculture wastes, better methods of recycling of organic wastes, production of speciality bio-chemicals and speciality plastics that are bio-degradable. Opportunities thoughtfully explored can provide avenues for investment of over Rs. 1 billion in these areas too.

Table 2: Demand estimates of selected biotech products

Products category and Products with measuring units	Consumption 1997	Estimated consumption 2000	Estimated demand 2005
A. Animal and health Care Products			
Vaccines (Million doses)			
1 DPT	110	114	124
2 DT	54	57	65
3 Tetanus toxoids	192	200	222
4 BCG	41	43	47
5 Oral Polio	350	1150	225
6 Measles	35	40	70
7 Measles Mumps Rubella	7	8	10
8 Hepatitis B Vaccine	7	18	45
9 Rabies (Tissue culture based)	5	7	12
10 Typhoid (Injectable)	0.4	0.8	2.5
Diagnostics (Million Tests)			
11 Early pregnancy	12	23	37
12 Ovulation	2	4	8
13 Estimation of T3 T4 and TSH	5	14	42
14 HIV infection	9	17	27
15 HBV infection	20	33	53
16 HCV infection	3	8	12
17 Rheumatoid diseases/disorders	0.4	0.5	1
18 Cancer (cervix colon prostate lungs mouth etc.)	0.5	1	2
19 Kidney function tests	34	52	104
20 Liver function tests	35	58	116
Therapeutic Recombinant Proteins			
21 Human Insulin (kgs.)	95	110	270
22 Erythropoietin (gms.)	1500	2000	4000
23 Interferons (million doses)	0.2	0.5	2
24 Streptokinase (million doses)	0.5	1.5	3

(Table 2 Contd.)

Antibiotics				
25 Penicillin G and V 1st crystals (MMU)	4100	63000	63000	
26 Rifampicin (tonnes)	260	300	380	
27 Salinomycin (tonnes)	80	90	110	
28 Tetracyclines (tonnes)	510	500	480	
29 Erythromycin (tonnes)	120	150	220	
Vitamins				
30 Vitamins B-12 (kgs.)	570	660	850	
31 Vitamins C (tonnes)	1200	1600	2500	
B. Agriculture				
High yielding hybrids (HYV)/Varieties (VAR)/Genetically modified seeds (GMS) (in 1000 tonnes)				
32 Wheat	207 (VAR)	220 (VAR) 2 (HYV)	250 (VAR) 5 (HYV)	
33 Rice	155 (VAR)	165 (VAR) 1.6 (HYV)	191 (VAR) 2 (HYV)	
34 Sorghum	21 (HYV) 21 (VAR)	22.3 (HYV) 22.3 (VAR)	26 (HYV) 26 (VAR)	
36 Maize/Corn	5.2 (HYV) 10.4 (VAR)	5.5 (HYV) 11.0 (VAR)	5.0 (HYV) 12 (VAR) 2 (GMS)	
37 Pulses (mainly peas and grams)	42.5 (VAR)	45.1 (VAR)	51 (VAR)	
38 Groundnut	78 (VAR)	82.5 (VAR)	95.6 (VAR)	
39 Mustard/Rapeseed	8.3 (VAR)	8.8 (VAR)	10 (VAR) 2 (GMS)	
40 Soybean	21 (VAR)	32.9 (VAR)	38 (VAR) 2 (GMS)	
41 Sunflower	6.2 (VAR)	6.6 (VAR)	7.7 (VAR)	
42 Cotton	12.4 (HYV) 13.5 (VAR)	13.2 (HYV) 14.3 (VAR)	7.5 (HYV) 14 (VAR) 10 (GMS)	
Bio-fertilizers (Tonnes)				
43 Rhizobium	5000	5500	6700	
44 Azospirillum	3470	3500	5800	
45 Azotobacter 2000	2200	2400		
Bio-pesticides				
46 Bacillus thuringiensis (tonnes)	40	120	200	
Growth promoters/stimulants				
47 Gibberillic acid (kgs.)	7000	15000	30000	
C. Industrial products				
Enzymes				
48 Industrial Enzymes (million rupees)	600	800	1300	
Organic acids/Amino acids (Tonnes)				
49 Lactic acids	1000	1160	1500	
50 Citric acids	11000	13000	16000	
51 Sodium Glutamate	1500	1700	2200	
52 L-lysine	1000	1200	1500	
Yeast/Yeast products				
53 Bakers and Brewers Yeast (tonnes of compressed fresh yeast)	22000	32000	45000	

Note: (VAR) = Varieties; HY V = Hybrid high yielding seeds; (GMS) = Genetically modified seeds.

Future consumption estimates of major biotech products in India

Table 2 gives the list of the current (1997) consumption and the future requirements of a number of important biotech products in the country during the coming years.

Estimated investment opportunities

Over the next five years, possibilities could be created for fresh investment of Rs. 7 to 8 billion in India that hold the promise of changing the biotech production scenario considerably. Such quantum of fresh investment if materialised, would hold the potential of providing turnover of Rs. 9 to 10 billion during the next 5 to 7 years, that could contribute towards import substitution, augmentation of local production and introduction of some new products in the global market.

Concluding Remarks

India is expected to emerge as a strong player in the consumption market of biotech products in the

India is expected to emerge as a strong player in the consumption market of biotech products in the coming years.

coming years. By 2005 AD, the comparative contributions of consumption from health care products are expected to be about 40 per cent from the present 37.5 per cent (1999), while agriculture may rise from 29.8 per cent to nearly 33.7 per cent. The other products would however get reduced from 32.7 per cent to about 26.3 per cent, although in monetary terms, there would be substantial rise in the consumption in these products as well. By adopting appropriate government interventions it should be possible to attract sizeable investment in this sector in near future to create competitive global industry locally. Wisdom lies in taking proactive steps within the provisions of the WTO and other international laws that are in place to develop a competitive local industry than to create demand for a consumption market that is fed by products from abroad.

□

Productivity is, above all, a state of mind. It is an attitude that seeks the continuous improvement of what exists. It is a conviction that one can do better today than yesterday, and that tomorrow will be better than today.

– European Productivity Agency

Innovative Financing of SMEs – Role of EXIM Bank

S.R. Rao

This paper seeks to present, briefly, the role of EXIM Bank in providing a range of lending, service and support programmes to assist externally oriented SMEs to develop, retain and enhance their competitiveness as efforts at integration with the global economy accelerate. Given EXIM Bank's function, this paper dwells upon the Bank's role in responding, in a pro-active manner, to the needs for specialised financing with the focus on international trade and investment.

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Small and Medium Enterprises (SMEs) are required increasingly to operate in open, relatively unprotected markets, often with inadequate policy support interventions. SMEs face a number of challenges including difficulties in availability of credit, and information access, higher risk perceptions and cost of credit, adverse economies of scale and upfront costs associated with projecting credibility and capabilities. On the other hand, it is the SMEs that are the prime drivers of the economy. It is recognised that SMEs are hampered in their efforts at accessing traditional sources of institutional funding. Initiatives have been taken by Governments, worldwide, and multilateral agencies to address this issue. In India, a network of state and national level financial institutions as also supportive lending policies have been set in place to help create an enabling environment. Various institutions seek to serve the generic needs of SMEs be it working capital finance, long term finance, venture capital or other forms of equity and quasi and quasi-equity finance. Financial support is thus provided for specific needs such as setting up of green field projects, modernisation, diversification, procurement of balancing equipment, product adaptation and development, exports (including export marketing), and credit guarantees.

The EXIM Bank

Export-Import Bank of India, set up in 1982, for the purpose of financing, facilitating and promoting international trade of India, is the principal financial institution

SMEs are hampered in their efforts at accessing traditional sources of institutional funding; hence initiatives have been taken by the Government to address this issue.

in the country for co-ordinating working of institutions engaged in financing exports and imports. EXIM Bank promotes exports through a variety and range of lending, service and support programmes. These programmes are tailored to meet the needs of different customer groups: Indian exporters, overseas entities and commercial banks. The bank caters to the diverse needs of an externally oriented company at all stages of the business cycle, from import, development and assimilation of technology, to product development, production, export marketing, export credit at pre-shipment and post-shipment stages, and overseas investment. In addition to its role as a traditional export credit agency, the Bank also offers a competitive range of financing programmes to help companies to enhance their international competitiveness. The Bank's export credit and international competitiveness programmes are supplemented by research and analysis, and value added information services, which are shared with the Bank's constituents. The thrust of EXIM Bank's lending, service and support programmes is on SMEs. The Bank offers several relevant programmes to support SMEs in attaining their corporate objectives.

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Export Oriented Units Programme

EXIM Bank operates a well established programme designed to enhance international competitiveness of Indian companies. The programmes seek to address the needs of SMEs primarily through:

- Financing projects of export oriented units, either directly or by refinancing commercial banks.
- Financing normal capital expenditure by way of asset credit lines.
- Equity financing for the setting up of overseas joint ventures/wholly owned subsidiaries by Indian promoters.
- Export facilitation as for instance through financing minor port development projects and information technology parks.

EXIM Bank's assistance is in the form of term loans in Indian rupees or in foreign currency. Deferred payment guarantees for imports are also available. EXIM Bank's assistance is also available in the form of 100 per cent refinance extended to commercial banks for term loans by the lending bank to an export-oriented unit.

Production Equipment Finance Programme

The programme caters to non-project related capital expenditure of export-oriented units, and is structured as a line of credit for acquisition of equipment. Thus recurring, relatively small value procurement needs are financed under one umbrella arrangement. The structure obviates the need to arrange financing for every purchase, and is designed to facilitate prompt assistance through simplified response process. Acquisition of imported or indigenous plant and machinery, ancillary equipment, including equipment for packaging, pollution control, utilities, quality assurance, research and development are financed. Equipment procurement could be for balancing capacity, replacement, modernisation and capacity upgradation.

Export Product Development Programme

EXIM Bank's lending programme for financing export product development activities aims to support systematic export development plans with particular focus on industrialised markets by providing term loans for product and market development. Term finance is provided for product design and development activities. Typical activities under the programme include research and development activities including manufacture of prototypes, pilot plants, product testing, development of toolings, jigs and fixtures, process development costs and product launches.

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Export Vendor Development Programme

Manufacturer-exporters and Trading, Export Houses source goods from vendors for exports on a regular basis. Such indirect exports constitute a significant component of the country's exports. The Export Vendor Development Programme aims to support vendor development by exporters. Term finance is available on competitive terms to exporters for implementing strategic vendor develop-

ment plans to result in increased exports through creation and strengthening of backward linkages with vendors. Flexibility exists for vendor selection and sourcing. Products purchased from vendors may be finished, semi-finished or intermediate products with the exporter adding value to the product in terms of further processing as also marketing.

Export Marketing Finance Programme

Objective of Export Marketing Finance programme is to help accelerate export growth of products particularly to industrialised markets through development of strategic export marketing plans. Private sector companies and joint sector companies, who have the overall resources, capability, potential, top management commitment and an export strategy to penetrate and retain presence can avail of this programme. Support, by way of a term loan, is available for any manufactured export, including computer software.

Objective of Export Marketing Finance programme is to help accelerate export growth of products particularly to industrialised markets.

Company level activities eligible for such support include:

- desk research
- overseas field market research
- minor product adaptation
- overseas travel
- product inspection services
- training
- establishing overseas operations
- travel to India by buyers overseas
- front-end promotional expenditure
- research and development
- equipment for plant modernisation/capacity enhancement
- tooling, jigs and fixtures
- testing/quality control equipment

It would be appropriate to dwell upon the genesis of this innovative programme that seeks to support what may be termed as 'soft' expenditure. Financial support

to Indian exporters to undertake structured and systematic market development activities commenced with a World Bank supported programme in 1986. EXIM Bank was designated as the agency to operate the Export Marketing Fund component of a World Bank loan to Government of India for promotion of industrial exports (engineering products) from India. A follow-through programme, again supported by the World Bank, offered a loan component for supply side upgradation, and a grant component to address the demand side export development activities. All manufactured, non-traditional goods were covered. Under these two programmes, EXIM Bank motivated 300 companies, mostly in the small and medium sector, to undertake structured export marketing activities based on a long term and strategic plan with industrialised country markets in focus. EXIM Bank provided both financial and advisory support. This has been used creatively for a number of market development activities including technology and product development, identifying partners and market channels, identifying niche segments, acceptance testing and quality assurance. With these two programmes having drawn to a close, EXIM Bank, having institutionalised the learning process has launched a third programme. The objective is to continue support for the export initiatives of Indian manufacturing companies. This successor programme is entirely funded from EXIM Bank's own resources.

Research & Development

The Bank offers term loans, including a concessional element, for financing Research and Development activities of export oriented companies. These activities include.

- development and commercialisation of new product/process/application
- significant improvements in existing product/process/application/design
- development of technology or design to meet international standards, specifications
- setting up and expansion of pilot plants
- research studies necessary for obtaining regulatory approvals, product registrations, cost of filing and maintaining international patents
- research and development centres
- Overseas Investment Finance Programme

EXIM Bank provides equity finance to Indian promoters of overseas joint ventures/wholly owned sub-

subsidiaries. Assistance is extended in the form of term export credit directly to the Indian company or by way of refinance to commercial banks, up to 80 per cent of the equity contribution. Equity contribution may be by way of cash remittances, export of plant and machinery, or capitalisation of export proceeds and management know-how fees. The Bank is also in a position to invest through equity in these ventures along with the Indian promoter. This would provide greater credibility and facilitate the mobilisation of support of other co-financiers. EXIM Bank also finances the Indian promoter company to enable it to extend loans to its overseas venture. EXIM Bank, in addition, provides guarantees favouring overseas lenders to help the Indian ventures obtain finance abroad. The Indian promoter company can also avail of the Bank's pre-shipment and post-shipment deferred credit facilities in the form of suppliers or buyers' credit. Thus, additional exports to the overseas venture of goods and services such as plant and machinery, components and technical consultancy can be financed.

EXIM Bank provides equity finance to Indian promoters of overseas joint ventures/wholly owned subsidiaries.

EXIM Bank carries out technical appraisals of overseas ventures at the request of Indian promoter companies and also provides information and advisory services to facilitate overseas joint ventures. EXIM Bank, thus, offers a comprehensive financing package comprising equity, loans and guarantees to externally oriented Indian companies to create and enhance physical presence through overseas ventures.

Venture Capital

EXIM Bank has made an entry into venture capital finance by investing in a Venture Capital Fund viz. the India Technology Venture Unit Scheme promoted by Unit Trust of India. The objective of the Fund is investment in technology sectors like Information Technology, Internet, media and entertainment, telecommunications, biotechnology, pharmaceuticals and healthcare. The entry of EXIM Bank into venture capital represents an initiative of the Bank to widen its product range and build on the Bank's established presence in the technology sectors and leverage the expertise it has gained over the years. EXIM Bank has been a pioneer in financing companies in the IT sector. Cumulative assistance by EXIM Bank to the software sector aggregates over US\$ 125 mn. EXIM Bank finances capital expenditure for setting up software development facilities as also working capital, equity investment in overseas ventures,

direct equity participation in Indian ventures overseas, export product development, export marketing finance and setting up software training institutes. Notwithstanding the wide array of financing products, it has been EXIM Bank's experience that many technology companies, particularly start-up companies, do not meet the eligibility requirements for debt financing. New ventures in the high technology sectors possess high risk-high return characteristics. In such cases, venture capital is an appropriate financing vehicle.

Trade Finance

EXIM Bank operates a number of lending programmes for financing transactions where supplies constitute the major part of the Indian exporters' contracts with overseas buyers. The lending programmes are designed to facilitate participation with commercial banks, Indian exports of capital, engineering and durable consumer goods through extension of appropriate deferred payment terms at competitive interest rates. EXIM Bank also operates lending programmes to assist short term exports indirectly by providing rediscounting/refinancing facilities to commercial banks.

EBRD Trade Facilitation Programme

Export-Import Bank of India has launched a new programme in association with European Bank for Reconstruction and Development (EBRD), London, to support Indian exports to 26 countries comprising Russia, CIS and East European countries. The programme envisages a credit enhancement facility from EBRD to be extended to EXIM Bank. This initiative enables EXIM Bank to confirm Letters of Credit received by Indian exporters from pre-approved banks in these countries. The present arrangement to confirm letters of credit has been put in place through a special agreement entered into by EXIM Bank and EBRD. It is pursuant to the Framework Co-operation Agreement between EXIM Bank and EBRD. EXIM Bank is the first Indian bank to tie-up with EBRD for extending such a credit enhancement facility to Indian exporters.

Lines of Credit

Lines of Credit is one of the financing mechanisms through which EXIM Bank extends finance to support export of goods and associated services from India. EXIM Bank extends lines of credit to overseas governments/agencies or financial institutions overseas to enable them to onlend to buyers in those countries to import capital/engineering goods, industrial manufactures and related services from India on deferred payment terms. This programme obviates the need for negotiating terms and conditions of credit individually in

each case and enables buyers in these countries to import from India on standard terms and conditions negotiated between EXIM Bank and the overseas agency. The Indian exporter realises full payment on shipment of goods through intermediation of EXIM Bank without being exposed to the credit risk on the buyer or the country of the buyer. The eligible items for finance are a wide range of capital and engineering goods, consumer durables and associated spares. The list can be expanded through an enabling provision. The lines of credit may be viewed as entry mechanisms for Indian small and medium enterprises. Operating under the umbrella of the lines of credit and without the risk of non-payment from the overseas buyer, the Indian exporter is presented with a facilitating environment to pursue trade opportunities. Having established presence and credibility, the Indian exporter would be then well placed to seek additional business directly.

Lines of credit may be viewed as entry mechanisms for Indian small and medium enterprises. The Indian exporter is presented with a facilitating environment to pursue trade opportunities.

Forfaiting

EXIM Bank, as an intermediary, facilitates export of capital and other goods through the alternative trade financing mechanism of forfaiting. Forfaiting is a mechanism of financing exports by discounting export receivables which are evidenced by bills of exchange or promissory notes backed generally by co-acceptance of a bank, without recourse to the exporter. The role of EXIM Bank has been to act as an intermediary between the Indian exporter and the overseas forfaiting agency.

EXIM Bank has taken recently an initiative with Westdeutsche Landesbank Girozentrale (WestLB) of Germany, and International Finance Corporation of the World Bank group of setting up a new company in India to offer factoring and forfaiting services to Indian exporters. EXIM Bank with its knowledge of Indian market, ready client base of exporters and its experience and expertise in trade finance, is well positioned to be the local promoter of the company. Being a pioneer in introducing forfaiting in India, this has been a logical next step for the Bank to bring structured trade financing products to the doorstep of Indian companies. While the worldwide factoring turnover was around US\$ 500 bn, the factoring market in India is not substantial with only a few players operating in the market, mainly in domes-

tic factoring. Now, with the setting up of the new company, Indian exporters no longer need to approach forfaiting institutions abroad.

Project Finance

EXIM Bank extends funded and non-funded facilities for overseas industrial turnkey projects, civil construction contracts, as well as technical and consultancy service contracts.

Non-Funded facilities include:

- Bid bond
- Advance Payment Guarantee
- Performance Guarantee
- Guarantee for Release of Retention Money
- Guarantee for Raising Borrowings Overseas
- Other Guarantees, as for instance in lieu of customs duty

Funded facilities include:

- Pre-shipment Credit in rupees and in foreign currency
- Post-shipment Credit in rupees and in foreign currency
- Foreign Currency Loans

These facilities are extended by EXIM Bank either on its own, or in participation with commercial banks.

Consultancy & Technology Services Programme

Indian consultancy firms can avail of deferred payment facilities from EXIM Bank for provision of a variety of services. These services could include transfer of technology, preparation of feasibility studies, project engineering and implementation services, operations and maintenance.

Support Programmes

The Bank provides a range of information, advisory and support services which supplement the financing programmes. This is facilitated through the Bank developing a network of alliances with multilateral agencies, export credit agencies, chambers of commerce, trade bodies, investment and market promotion boards and service providers. Three representative programmes are as follows:

Product/process certification

EXIM Bank's programme for supporting product/process certification aims to enhance international competitiveness of Indian companies through adherence to international quality systems and standards. EXIM Bank had taken the initiative in the past of evolving a cluster programme through which nearly 100 companies in 10 clusters were supported in achieving ISO 9000 certification. Consultants were deployed to assist these SMEs. The cluster programme enabled addressing common problems, joint efforts, learning from one another through group discussions, identifying areas of improvement and quality issues more readily by being part of the environment, sharing of experiences and peer pressure to achieve desired objectives. The programme also helped address the high quality consultancy cost for small and medium enterprises, through EXIM Bank support and sharing of expenses amongst the beneficiaries.

Multilateral agency funded projects

EXIM Bank assists Indian companies to participate more effectively in opportunities offered by projects financed by multilateral agencies. Indian turnkey project exporters, construction and civil engineering firms, suppliers, and firms rendering consultancy and technical services can avail of these facilities. The Bank helps identify appropriate business opportunities, accesses additional data on projects of interest, advises on practices and procedures adopted by funding agencies, provides bid advisory and intervention services. Projects are tracked from the point of identification through successive stages till final outcome. Data generated during the various stages of the project cycle are accessed in a timely manner to increase prospects for successful bidding.

EXIM Bank has taken several initiatives to strengthen its linkages with these multilateral agencies. Some of these are as follows:

- The Bank has entered into an Agreement with the African Development Bank for co-financing projects.
- EXIM Bank has developed working arrangements with International Finance Corporation to facilitate their utilisation of Indian consultants for various project facilities that are supported and administered by them.
- The Bank has a Framework Co-operation Agreement with European Bank for Reconstruction and Development.
- EXIM Bank has a Memorandum of Understanding with Multilateral Investment Guarantee

Agency which facilitates obtaining investment cover for Indian investment in other developing countries which are members of MIGA.

- It conducts a series of business seminars with faculty from institutions such as Asian Development Bank, World Bank, European Bank for Reconstruction and Development and the African Development Bank.
- EXIM Bank has led delegations of Indian firms covering consultants, suppliers and contractors to these multilateral agencies in order to project Indian capabilities across sectors.

Asian Countries Investment Partners programme

Asian Countries Investment Partners (ACIP) programme aims at promoting Joint Ventures in India with companies in East Asian countries, through four facilities that address different stages of the project cycle. ACIP seeks to catalyse investment flows into India by creation of Joint Ventures in India between Indian companies and companies from East Asian countries. ACIP as a funding instrument provides finance at various stages of a Joint Venture project cycle viz., sector study, project identification, feasibility study, prototype development and technical, managerial assistance.

Conclusion

EXIM Bank, through its menu of programmes, seeks to partner Indian SMEs in their globalisation efforts. The Bank endeavours to create an enabling environment for two-way trade and investment. The Bank has worked closely, either directly or indirectly, with several SMEs, and constantly seeks to deepen its relationship with these corporates, through an innovative mix of lending and support programmes.

EXIM Bank, through its menu of programmes, seeks to partner Indian SMEs in their globalisation efforts.

Acknowledgement

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Venture Capital System in Korea: Development & Implications

Moon-Kyum Kim

This paper examines the role of Korean venture capital industry in recent venture boom years. Specific issues covered include the progress of the venture capital industry, government's support system and future prospects.

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The beginning of Korea Venture Capital Industry goes back to 1974. The concept of venture capital was not, however, defined clearly and the venture capital industry remained in its primitive stage until 1997. When Korea experienced foreign exchange crisis in late 1997, Korea's conglomerate-based mass-production pattern, which has been the key to fast economic growth, lost its effectiveness in boosting Korean economy and sustaining growth. Korea then chose the Venture as its new growth engine for the 21st century under circumstances in which globalization and digital economy formulate a new economic paradigm. The Korean government has made all efforts to provide an atmosphere in which a new concept company, the venture business, could take roots in a short period of time. Various measures that the Korean government took included implementation of an Act on Special Measure for Promotion of Venture Business, reduction of government regulations, promotion of foreign direct investments into Korea etc. The New Economy Policy of Kim Dae Jung government, which took the venture business as the most important and vital component of its overall economic policies, drove the whole country into the venture fever, coupled with the social consensus that the conglomerate (Chae-Beol) and financial industry were the principal offenders in the 1997 economic crisis and they should be put through reform process.

The results were so amazing and instantaneous that the venture industry exploded and the KOSDAQ, a counterpart of NASDAQ in the U.S., expanded enormously with a year. The venture firms increased dramatically in number from 4,934 in 1999 to 9,331 in 2000¹. The number of venture capital firms increased from 61 in 1997 to 147 in 2000 and the market value of KOSDAQ

1. It would not be simple to define Venture Company precisely. But, in case of Korea, the government certifies "Venture Company" to firms that satisfy the required criteria stated in the Act on Special Measure for Promotion of Venture Business of 1997.

of the 1999 jumped up 13.3 times as large as its value one year before. However, the venture fever which swept the whole country slowed down rapidly as the economic reforms got delayed and the world economy, especially that of Japan and the U.S., moved into sluggish stage. The current KOSDAQ index is around 70, just one-fourth of its value a year ago. In sum, Korean venture industry has moved back and forth from hell to heaven, and again to hell within the same year.

Progress of Korean Venture Capital Industry

The Korea Technology Advancement Company (KTAC), established by the government in 1974, was the first venture capital firm in Korea set up in order to translate the research results of Korea Institute of Science and Technology into business. The current shape of the Korean venture capital industry originated from two laws enacted in 1986—Act on Start-up Promotion of Small and Medium-sized Business and Act on New Technology Business Financing on which the Small Business Start-up Investment Companies (SBSICs) and the New Technology Business Financial Companies (NTBFCs) were based, respectively. Thus, the Korean Venture Capital Industry became two-tiered because of the two different laws governing and supervising two kinds of venture capital firms.

At present, the SBSICs and NTBFCs are privately owned and managed venture firms, but they are supervised and regulated by government agents. The SBSICs, supervised by Small and Medium Business Administration (SMBA), make investments in venture companies and small and medium-sized enterprises (SMEs) with less than 15 years business history while the NTBFCs, supervised by Financial Supervisory Service (FSS), invest in the new technology business firms designated by the law, with no regulation on the business years. SBSICs support venture companies by way of equity investment and straight loan only, but NTBFCs use a variety of ways like equity investment, loan, lease and factoring. The number of SBSICs is 147 as at the end of 2000 and the number of NTBFCs is 13 with only five of them being venture capital NTBFCs. In this paper, both SBSICs and NTBFCs are regarded as the same and referred as "venture capital firms".

Korean venture firms, unlike the ones in other countries, have a form of corporation with paid-in capital of at least ten billion Korean Won. And the venture capital firms as a lead investor organize venture capital funds by attracting funds from various sources like government agents' funds, private and public pension funds, foreign investors, financial and insurance companies, corporations and individuals.

The venture capital companies put those funds in investment practice with their own responsibility and expertise and distribute the fruits of the investment among the participants. Venture capital funds usually have rather longer maturity of 7 to 10 years as compared with 3-year maturity of corporate bonds in Korea. Also, a venture capital firm can make several venture capital funds at the same time and each venture capital fund is treated in accounting as an independent identity. The venture capital fund makes investments in the portfolio of several companies to diversify investment risk. As presented in Table 1, not all venture capital firms have made venture capital funds. Only a half of the venture capital firms on average have made venture capital funds as their source of funds to use. The venture capital fund is the most appropriate source of funds for the venture capital firms for maturity and investment purposes. The increased number of venture capital funds in the recent couple of years is an indication showing that the Korean venture capital industry has moved in the right direction.

The venture capital fund makes investments in the portfolio of several companies to diversify investment risk.

Table 1: Korean Venture Capital (Summary Statistics)

(Unit: No. Billion Korean Won)

	'95	'96	'97	'98	'99	Oct. 00
No. of VC Firms*	48 (29)	53 (28)	61 (32)	72 (35)	87 (42)	147 (74)
- Paid-in Capital(BW)	601	761	884	1009	1484	2139
No. of VC Funds	66	71	79	92	149	323
- VC Fund Raised(BW)	685	719	832	900	1144	2361
Total Venture Capital Under management	1962	2676	3302	3715	5095	6755
No. of Portfolio Company	1356	1649	1872	1782	2743	4778

Source: Korea Venture Capital Association

*: (No.) indicates No. of VC firms that raised VC Funds

Table 1 reveals that the rate of growth in number of the venture capital firms has been remarkable as it has recorded 33 per cent growth on average since 1995, and 67 per cent growth rate in 2000 alone is an all-time-high level. The number of venture funds and amount raised in 2000 also reached all-time-high

levels. The raised amount of capital has been almost doubled in two years from 1998 through 2000 and the number of benefited companies increased by more than 2.5 times during the same period. The statistics clearly show the rapid growing trend of Korean venture capital industry in quantity as well as quality in a very short period of time.

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Management of Venture Capital

Source of Venture Capital under Management

The total venture capital under management amounted to 6,755 billion Korean Won (approximately 5.5 billion dollars) as of October, 2000, which was a 32 per cent increase compared to that at the end of 1999. The growth in size was remarkable from 1998 through 2000. Table 2 shows that the venture capital firms raised 4,566 billion Korean Won, 67.5 per cent of the total capital under management, from such capital sources as paid-in capital, borrowings, and capital surplus, as of October 2000. The firms raised the rest of 32.5 per cent of the total capital by organizing venture capital funds.

Table 2: Venture Capital under Management

(Unit: Billion Won)

	'95	'96	'97	'98	'99	Oct. 00
VC Firms						
Equity	724	942	1122 (34.0)	1271 (34.2)	1484 (29.1)	3122 (46.2)
Borrowing	544	975	1298 (39.3)	1501 (40.4)	2194 (37.1)	1434 (21.2)
Sub. Total	1268	1917	2420	2772	2678	4556 (67.5)
VC Funds						
VC Firms	88	93	97	120	181	281
Investors	597	626	734	781	963	1610
Others	97	133	148	164	273	308
Sub. Total	781	852	980 (29.7)	1064 (28.6)	1417 (27.8)	2199 (32.5)
Total	1962	2676	3302 (100.0)	3715 (100.0)	5095 (100.0)	6755 (100.0)

Source: Korea Venture Capital Association; () represents the percentage of the Total.

The debt capital, however, used to be the largest

portion of the total capital under management before 2000. The portion of capital raised from venture capital funds has decreased constantly since 1995 except in year 2000 even though the government offers various tax and financial incentive systems to facilitate the formation of venture capital funds. This fact implies a problem that has persisted in the Korean venture capital industry. Because the debt capital usually has short maturity in comparison with venture capital investments and accompanied interest payments, the heavy use of debt capital has brought about maturity mismatching problem and eventually financial distress. Also, the paid-in capital (equity) of the venture capital firms was not a desirable source of fund for venture investment because the paid-in capital is a constitutive component for the venture capital firm as a corporation, thus it carries an additional risk when it is invested in venture businesses. Since the venture capital firms operate with long term investment purpose with high risk, the most appropriate and steady source of funds could be venture capital funds because the venture capital funds are raised from those investors with long-term investment purpose and proper level of risk tolerance.

Disbursement of Venture Funds

The law regulates the disbursements of venture capital firms. Venture capital firms should invest in SMEs that have less than 15 years of business history and are not listed or registered on either the Korean Stock Exchange or the KOSDAQ. Also, SMEs belonging to the big conglomerates and SMEs in leisure industry are excluded from the investment scope of venture capital firms. The types of disbursements of venture funds take three forms: equity investment, agreement investment and loan. Equity investment includes a direct investment of purchasing stocks and an indirect investment of purchasing convertible bonds or bonds with warrants. When venture capital firms make agreement investment, they collect a certain amount of royalties from the invested companies in proportion to their sales, and receive stocks or get back the original principal amount in case of success while they receive only a certain portion of the original investment in case of failure. Thus, it could be unreasonable to put agreement investment in the category of pure equity investment.

Table 3 shows that the portion of loan had increased till 1998 and then started to decrease rapidly; investment portion has increased on the contrary. This fact indicates that the venture capital firms were moving toward fulfilling their role in the venture capital market. The portion of funds disbursed through venture capital funds has not yet improved much though that of 2000 was somewhat larger than that of 1999. It is interesting

Table 3: Amount of Venture Capital Disbursements by Year

(Unit: Billion Won)

		'95	'96	'97	'98	'99	Oct. 00
VC Firms	Investment	352 (44.8)	650 (51.7)	806 (54.1)	665 (50.5)	879 (58.9)	1645 (63.7)
	Loan	119 (15.1)	216 (17.5)	265 (17.8)	265 (20.1)	170 (11.9)	24 (1.0)
	Sub. Total	471 (59.9)	866 (69.2)	1,071 (71.9)	930 (70.6)	1,049 (70.8)	1,669 (64.7)
	Investment	297 (37.8)	355 (28.7)	396 (26.6)	368 (27.9)	413 (27.6)	906 (35.1)
VC Funds	Loan	18 (2.3)	26 (2.1)	22 (1.5)	20 (1.5)	24 (1.6)	6 (0.2)
	Sub. Total	315 (40.1)	381 (30.8)	418 (28.1)	388 (29.4)	437 (29.2)	912 (35.3)
	Total	786 (100)	1,237 (100)	1,489 (100)	1,317 (100)	1,485 (100)	2,581 (100)
No. of Portfolio Co.		1356	1649	1872	1782	2743	4778

Source: Korea Venture Capital Association; () represents the percentage of the Total.

to note that most of the loan has come from the venture capital firms while the loan portion of the venture capital funds took only 1.6 per cent of total disbursed funds in 1999. This shows the reluctance the venture capital firms may have in investing in the equity of the venture businesses with their own money. Table 3 shows that the disbursed amount of the venture capital and the number of the benefited companies were 2,581 billion Korean Won (2.1 billion US dollar) and 4,778 respectively, as on October 2000. This was almost 75 per cent increase, both in the amount and the benefited company numbers, compared to the levels of 1999.

Table 4: Venture Capital Disbursements in 1999 by Company Age

(Unit: Billion Won)

Company Age	No. of Companies (%)	Amount (%)
~ 1 yr	535 (19.5)	2090 (14.1)
1 yr ~ 3 yr	685 (25.0)	3247 (21.9)
3 yr ~ 5 yr	418 (15.2)	2892 (19.5)
5 yr ~ 7 yr	313 (11.4)	1969 (13.3)
7 yr ~ 14 yr	774 (28.2)	4560 (30.7)
14 yr up	18 (0.7)	87 (0.5)
Total	2743 (100)	14845 (100)

Source: Korea SMIPC (Small and Medium Industry Promotion Corporation). () represents the percentage of the Total.

The venture capital firms are supposed to support exclusively the start-up of SMEs and venture businesses and their initial technology developments. However, Table 4 shows that the percentage of disbursed amount

Korean venture capital firms still prefer investing in old companies with proven record of success rather than start-up companies with the most need for money.

for the Start-Up companies with less than 1 year was only 14.1 per cent while that for companies between 7 and 14 years was 30.7 per cent. This indicates that Korean venture capital firms still prefer investing in old companies with proven record of success rather than start-up companies with the most need for money.

Table 5 summarizes the venture capital disbursements by the industry sector in 1999. The largest portion of the fund went to Electronics, the second largest portion to Information Technology and the third largest portion to Machinery. Thus, 74 per cent of the total amount was assigned to high-tech industries.

Table 5: Venture Capital Disbursements in 1999 by Industry Sector

(Unit: Billion Won)

Industry	No. of Companies (%)	Amounts (%)
Machinery	494 (18.0)	236 (15.9)
Electronics	800 (29.2)	495 (33.3)
Chemical	132 (4.8)	68 (4.8)
Information	653 (23.8)	299 (20.1)
Sub Total	2079 (75.8)	1098 (73.9)
Fabrics	72 (2.6)	31 (2.1)
Construction	134 (4.9)	81 (5.5)
Logistics	124 (4.5)	68 (4.6)
Others	334 (12.2)	207 (13.9)
Sub Total	664 (24.2)	387 (26.1)
Total	2743 (100)	1485 (100)

Source: Korea SMIPC (Small and Medium Industry Promotion Corporation) () represents the percentage of the Total.

Angels

Angels are individual investors who commit capital to venture businesses in seed or early stage and play a role of informal venture capital. The first of its kind did not enter stage until 1997. Once the angels came on the scene in 1997, the scheme has not only made a rapid growth in the number of investors and the raised amount of money, but also has evolved from an unorganized form of investment club to an organized individual venture capital fund. As presented in Tables 6

and 7, there were only 106 angel investors in its birth year of 1997 and the target of 15,371 was reached in as little as 2-year period of time. Organized angel venture capital fund began with 11 of them in 1999 and 27 of its kind were operated as on March 2000. The raised capital grew almost 100 times, 101 billion Korea Won by early 2000 in comparison with the level of its birth year of 1997. This rapid growth is attributable to the enactment of the Act on Special Measure for Promotion of Venture Business in 1997 and the opening of KOSDAQ in 1996 together with the pervasive venture fever in Korea during 1999.

Table 6: Summary Statistics for Angel Investors

	1997	1998	1999	03/2000
No. of Angel Investors	105	349	4253	15371
Amount (BW)	1.06	2.44	52.1	100.8
No. of Portfolio Co.	7	12	86	166

Source: SMBA (Small and Medium Business Administration)

Table 7: Angel Investors by Organisation

	1997	1998	1999	03/2000
No. of Investors	3	349	3879	14,520
Club Invested Capital (BW)	10.5	2.4	45.1	92.2
No. of Portfolio Co.	10	12	81	129
No. of Investors	7	0	221	516
Raised Capital	0	0	14.5	29.3
Fund Invested Capital (BW)	0	0	7.0	8.6
No. of Portfolio Co.	0	0	5	37

Source: SMBA (Small and Medium Business Administration)

KOSDAQ (Korea Stock Dealers Automated Quotation System)

The KOSDAQ was born in 1996 as a stock market exclusively for venture companies and SMEs, by introducing a new electronic auction trading system to the traditional over-the-counter market. The KOSDAQ was designed to provide opportunities of raising long-term and stable capital easily with venture companies and SMEs, without competing with established and large companies. The KOSDAQ offers investors including the venture companies a way of investing in companies with features of "high-risk and high-return" and realizing capital gains. Thus, the KOSDAQ is not a subsidiary or auxiliary market to the Korea Stock Exchange, rather it is an independent, less regulated and more liberal stock exchange in which venture companies or SMEs can advance and withdraw without much difficulty.

The KOSDAQ had shrunk right after its launching in late 1996 because of the economic crisis in 1997. But, it rebounded and made a leaping progress over 1999 aided by strong Governmental promotion policies and improved economic conditions. As Table 8 shows, the total market value of the KOSDAQ had expanded by 13.3 times over one year between 1998 and 1999. The KOSDAQ Index increased by 241 per cent from 75.18 at the end of 1998 to 256.14 at the end of 1999 and the number of the registered companies on the KOSDAQ also increased by 142 per cent recording 453 registered companies. The Venture Index jumped up by 762.7 per cent over the same period of time.

Table 8: Statistics on Registered Companies in KOSDAQ

		96	97	98	99	00
Registered Companies Number	Exist-ent	331 (52)	359 (86)	331 (114)	453 (173)	604 (244)
	New	31 (14)	83 (42)	8 (4)	160 (58)	250 (116)
	Can-celed	39 (9)	55 (8)	36 (2)	38 (7)	99 (2)
Paid-in Capital		3101.8	3494.7	5407.8	13061.5	15128.3
Total Market Value		7606.1	7068.5	7892.2	106280.5	29015.8

Source: KOSDAQ

As the trade amount of venture companies took up more than 50 per cent of the overall trade amount of the KOSDAQ and 22 Venture Capital Funds (Mutual Funds) were newly registered on the KOSDAQ during 1999, the KOSDAQ became a real stock market for venture businesses in terms of quantity and quality. As Table 9 clearly shows, venture companies and venture capital funds occupy more than a half of KOSDAQ with respect to company numbers and market value.

Table 9: Market Value of KOSDAQ by Firm Type in 1999

(Unit: No. and Billion Won)

	No. of Firms	No. of Items	Outstand-ing Share (1,000 Share)	Paid-in Capital	Market Value
Total	453	474	4,089,875	13,0615	106,2805
Venture	173	180	1,260,164	9877	30,7601
General	222	236	2,254,281	9,1813	72,2166
VC Firms	58	58	575,430	2,8925	3,3039

Source: KOSDAQ

Table 10 presents the financing activities in the KOSDAQ over the past several years. It is noteworthy that the financing activities exploded through the IPO (Initial Public Offering) by which the venture capital firms

recovered their investments. However, the growth of KOSDAQ has been frozen abruptly in the second quarter of 2000 due to the delayed economic reforms and sluggish global and domestic economic conditions. The KOSDAQ index had plunged to 115.46 in May 2000 from the highest level of 283.44 in March 2000, -60 per cent decrease over two and half month period of time. As Table 11 implies the KOSDAQ finished the year of 2000 with an index of 52.58, the lowest level in its history over.

Table 10: Financing Activities in KOSDAQ

(Unit: Billion Won)

	96	97	98	99	00
New Equity	123.7	86.8	1873.2	3084.4	5677.7
IPO	27.1	129.4	6.3	2125.4	2568.6
Total	150.8	216.2	1879.5	3882.5	8246.4

Source: KOSDAQ

Table 11: Trade statistics of the KOSDAQ

(Unit: 1000 shares and Billion Won)

	96	97	98	99	00
Trade Volume	35,416	47,191	205,653	8,674,393	51,050,304
Trade Amount	534,967	1,166.2	1,607.2	106,807.9	578,490.1

Source: KOSDAQ

Government Support for the Venture Capital Industry

Government Fund

As with U.S. experiences in her history of venture promotion, in Korea too, the government had to provide public funds to facilitate the process of venture business at early stages of promotion while private funds refused to finance the venture companies. As sizeable amount of venture capital was raised by the venture capital firms and angels, the use of public funds was confined to specific fields related with high technology development accompanying high-risk and uncertainty.

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The Korean government had provided money for the venture industry since the venture capital industry was still in its infant stage and direct financial markets were not accessible. The government funds were distributed mainly in the form of loan to venture companies by various government agents like the Small and Medium Business Administration (SMBA), Ministry of Information and Communication (MIC), and Ministry of Science and Technology (MST). However, from 1999 the government directly participates in the venture capital funds or organizes public venture capital funds directly rather than giving direct loans to the venture companies. As Table 12 shows the disbursement of government fund for venture business increased remarkably from 0.4 per cent in 1998 to 6.1 per cent, out of the government fund for SME.

Table 12: Disbursement of Government Fund for SME by Use

(Unit: Billion Won)

	1998	1999	2000
Facilities	3780 (78.3)	3366 (62.4)	2947 (57.2)
Working Capital	317 (6.6)	1262 (23.4)	957 (18.6)
R & D	713 (14.8)	648 (12.0)	933 (18.1)
Venture Investment	20 (0.4)	118 (2.2)	315 (6.1)
Total	4830 (100.0)	5394 (100.0)	5152 (100.0)

Source: Small and Medium Business Administration (SMBA)

Also, government's various agents raised money to make special-purpose funds for venture companies by selling bonds or getting long-term public loan as depicted in Table 13. The SMBA used the money to support general venture promotion policies while other government agents used the money for specific fields in relation to the agent's function.

Table 13: Venture Promotion Fund Raised by Government Agents in 1999

(Unit: Billion Won)

SMBA	MIC	MST	Others
750.0 BW	261.3 BW	200.5 BW	KDB:
- To support general venture promotion	- To support IT Venture Start-Up	- To support Venture Incubator	Loan 50.0 BW
- Venture R & D	- Venture R & D	- Venture R & D	Equity 50.0 BW

Source: SMBA (Small and Medium Business Administration); MIC (Ministry of Information and Communication); MST (Ministry of Science and Technology); KDB (Korea Development Bank)

Government funds had been disbursed mainly in

the form of direct loan to venture companies. Now, The government has moved toward supporting the venture businesses by participating in equity investments. Table 14 presents the breakdown of government funds invested in venture capital firms or venture capital funds by the various government agents. The amount of 1999 was 2.3 times as large as that of 1998.

Table 14: Government Fund invested in Venture Capital

	SMBA	MIC	MST	MCT	Total
1998	1356	45	150	-	1551
1999	2831	500	150	30	3511
Total (BW)	4187	545	300	30	5062

Source: SMBA (Small and Medium Business Administration);
MIC (Ministry of Information and Communication);
MST (Ministry of Science and Technology);
MCT (Ministry of Culture and Tourism).

The Korean government also organized in late 1999 a 800-million dollar "Korea Venture Fund" in which Korean government and several foreign venture capitalists participated. The detailed constituents and shares of investment are presented in Table 15. The Korea Venture Fund (KVF) will be used for direct investments in venture companies not yet listed on either the Korea Stock Exchange or the KOSDAQ. A special venture capital firm established by the participants of the KVF will operate the Korea Venture Fund (KVF).

Table 15: Participants of Korea Venture Fund

(Unit: 10,000 US\$, %)

Participants	Government Venture Promotion Fund	Foreign Investors*	Institution	Total
Raised Capital	4000	3920	80	8000
Ratio (%)	50	49	1	100

Source: SMBA (Small and Medium Business Administration)

*: The foreign Investors include SSgA of the U.S., ADCM of Hong Kong and Yozma Venture Capital Ltd. of Israel.

Tax Incentive System for Venture Capital Firms

The government tax incentive system for venture capital is in two categories. The first category is for venture capital firms with equity investments in venture companies: the venture capital firm is exempted from taxation on capital gains when the firm sells the stocks or the equity portion of the invested venture companies; taxation on dividend income received by the venture capital firms is to be waived till the end of the year of 2003; the National Tax Administration allows the venture capital firms to reckon a certain portion of investment

loss allowance and technology development allowance in the calculation of loss to reduce taxable income; when the invested venture capital company goes bankrupt, the loss of venture capital firms is calculated based on the market value of the bankrupt company. The second category of tax incentive system is for the investors to the venture capitals—the venture capital firms or the venture capital funds: the investors holding stocks of venture capitals are exempted from taxation on capital gains when they sell holdings of stocks; the dividend income from the equity investment in venture capitals is not subject to progressive taxation, but to separate taxation only; the committed capital to the venture capitals by corporate investors can be treated as allowance for technology development and a certain portion of the allowance can be applied to calculation of loss; when a firm with excessive debt holds other firms' equity, the tax law allows only a part of interest payments to be included in the calculation of loss, but in case of holding the equity of venture capitals, the interest payments are fully reflected in the calculation of loss.

Implications & Conclusion

The Korean venture capital and its support system have been briefly reviewed so far. The features of Korean venture capital and the implications on the progress of venture business in Korea are discussed in this section. The first feature is that the size of Korean venture capital is small in comparison with those of other countries, in both relative and absolute senses. As Table 16 shows the absolute value of Korean venture capital amounts to only 0.9 per cent of the U.S. and 9.1 per cent of Japan. Even though the table indicates, based on 1998 data, a little improvement in the relative size of the venture capitals with GDP, it is still smaller than those of the U.S. and Taiwan.

Table 16: Comparison of Venture Capitals By Country (1998)

(Unit: Billion Dollar, %)

	U S A	Japan	Korea	Taiwan	Singapore
Size of venture capitals	152	14.8	1.35	3.2	0.7
GDP	7248	5111	456	82	261
Ratio of (A/B)	2.10	0.29	0.30	3.91	0.27

Source: Korea SMIPC (Small and Medium Industry Promotion Corporation).

Secondly, the Korean venture capital has a two-tiered system in which SBSIC and NTBFC operate under different laws and different supervisory agents. Even if they are doing the same business, the two-tiered system brings about complexity of regulations and in-

consistency in the operation of supporting policies. It is necessary to unify this two-tiered system to increase the effectiveness and efficiency of promotion of venture capitals. Thirdly, the portion of loan in the disbursement of venture capitals is still big compared with that of other countries, even if it is improving recently. Also, the venture capitals are still reluctant to invest in start-up venture companies as pointed out earlier. This implies that the venture capital firm should be operated in the same manner with the venture capital fund rather than as a corporation.

The fourth feature is about the way of fund raising. There is a limit for venture capitals on expanding their financial resources by selling stocks or borrowing money. Thus, it is desirable to raise funds by organizing venture capital funds because venture capital fund can attract long-term funds without incurring cash outlay of interests from such various investors as government agents, institutional investors, corporations and individuals. However, raising funds through organizing venture capital fund has not been active and the venture capital firms are reluctant to do so. One of the reasons for this is the underdevelopment of the KOSDAQ, and the other reason, more important one, is that the ROI (Return On Investment) of venture capital funds is even smaller than the interest rate of bank time-deposits. Venture capital funds that realized ROI greater than that of bank time-deposit before the KOSDAQ exploded in 1999, are quite rare.

Several factors have contributed to the low ROI of venture capital funds. First, venture capital firms without much experience made investments in a hurry around the eighties and early nineties. And many invested companies went bankrupt because of economic depression in the early nineties, so low ROI was unavoidable. Secondly, there were not many venture companies with high-reward potential until late nineties. The number of venture companies was only about 1500 in 1996 but became 2500 in early 1999. This indicates that it has not been easy for venture capitals to probe good investment opportunities until very recently in Korea. Thirdly, it had been a difficult and cumbersome process to list or register venture companies in the stock exchange and the over-the-counter market. A well-developed stock

market is essential for venture capitals to harvest their investments. It was not until 1996, when the KOSDAQ was born, that the venture capitals secured a way to collect their investments. The KOSDAQ started to play its role from 1998. As the KOSDAQ became bullish over 1999, the venture capitals started to get high rate of return and market participants realized that they could earn higher rate of return in the KOSDAQ than the regular stock exchange. This prompted the explosion of the KOSDAQ during 1999 and early 2000. Unfortunately, however, the boom in the KOSDAQ collapsed all of a sudden in the second half of 2000 and the KOSDAQ still crawls at the bottom. As a result, the venture capital industry is frustrated and the invested money is all locked in. Most of the venture capitals are suffering from a lack of financial resources and are incurring losses. Participation of institutional investors is needed to facilitate the progress of venture capital industry. But this is lacking because private and public pension funds, insurance companies and others were prohibited from investing in venture capital fund by their by-laws. Then, the enactment of Act on Special Measures for promotion of venture business in 1997 paved a way for those institutional investors to participate in the formation of venture capital funds. In many cases, however, institutional investors are still reluctant to make investments in venture capital funds because of the low rate of return and high risk pertaining to the venture business.

Institutional investors are still reluctant to make investments in venture capital funds because of the low rate of return and high risk pertaining to the venture business.

The venture capital industry in Korea has achieved big progress in the recent two years in spite of the current depression and has become the most important contributor to the development of "Venture Korea". However, the Korean venture industry has a long way to go to cope with the challenges that lie ahead.

□

Partnership for SME Development: Ancillarisation/Sub-contracting

S.K. Tuteja

Today's Knowledge Economy has brought information within easy access of customers, providing them with innumerable choices. Consequentially, there is fierce competition in the business arena and large industries have adopted the strategy of concentrating on their core competencies. This trend has given birth to outsourcing and partnerships with small units. The author explores this phenomenon and how it can be leveraged to augment SME development.

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An exponential increase in the information base and its easy accessibility made possible by recent advances in communication technology have ushered in a new environment for business. Digital solutions and a wired world are increasingly conditioning our response in today's knowledge economy. Knowledge itself is emerging as the fifth factor of production. This phenomenon has coincided with equally significant changes in world trade patterns due to WTO agreements. Together, they have changed the international business arena beyond recognition. As we come to terms with a new reality, there is also a realisation that businesses need to change their mindsets and react quickly and effectively. Fortunately, half to two thirds of businesses, all over the world, are Small and Medium Enterprises (SMEs) which have traditionally been known for the agility of their response to a changing environment.

Knowledge Economy & SMEs

SMEs the world over comprise a widely divergent spectrum of establishments, engaged in economic activities ranging from micro and rural enterprise to modern industrial units using sophisticated technologies. Because of their contribution in each and every national economy, the importance and emphasis on SMEs has been accentuated in the minds of policy makers, planners and the industry in the recent past. This is the consequence of the recognition that the shift from agrarian to industrial and to post-industrial knowledge based societies is not through the large industrial houses but through individual and small initiatives by visionaries from the SMEs. While the ability of SMEs to respond quickly to change is well acknowledged because of their extremely lean organisational structure, the demands of the knowledge economy are qualitatively different than those earlier experienced by the SMEs.

In a networked world, information about a far larger

set of goods and services and their vendors becomes available. This challenges one of the erstwhile strengths of SMEs—being able to satisfy local markets with locally sourced material. Globalization implies that cheaper alternatives become increasingly accessible and as a consequence domestic SMEs are required to confront a new challenge—remaining competitive. This competitiveness is not just in respect of costs—it is also in respect of technology, credit, management practices and marketing strategies. SMEs are responding to this challenge in different ways. While refusal to acknowledge that the problem exists can be seen in a few SMEs, a vast majority of them are reacting differently—some are re-engineering business processes, some are striving for quality certification, few are identifying niches where low volumes exist and hence large competition is not present and, finally, some other SMEs are looking at a solution which is arguably more holistic—that of becoming part of a larger production chain through partnerships and linkages. This paper attempts to explore this phenomenon of partnerships.

Globalization implies that cheaper alternatives become increasingly accessible and as a consequence domestic SMEs are required to confront a new challenge—remaining competitive.

The need for partnerships

International production has grown rapidly over the last few decades. Of the factors of production, the availability of capital, specially through Foreign Direct Investment (FDI) has increased phenomenally—from \$209 billion in 1990 to \$865 billion in 1999 itself (UNCTAD, 2000). A burgeoning world population means increased availability of labour force. But most important, has been the restructuring occurring in production relations and business relations. Transnational Corporations (TNCs) have strengthened their presence in almost all countries; large retail chains, whether domestic or international, increasingly dictate quality, quantity and price to individual suppliers; mergers and acquisitions have changed the landscape of many an industry. Alongside, there have also been more transient changes—alliances between large corporates, pooling of resources for a single large product or research initiative, leasing out of excess production capacities, consortia of similar firms, etc. In so far as SMEs are concerned, they are increasingly finding that standalone enterprises face insurmountable challenges in a world which is networking furiously. An individual SME cannot match the deep pockets, economies of scale, advertising muscle or the

technological finesse of the large. Yet, paradoxically, the way forward emerges from within this pessimistic scenario. Large corporations also realise that they cannot do everything in the most efficient manner. They are concentrating on core competencies, preferring to outsource many activities—be it sub-assembly or precision manufacturing. This is where a plethora of opportunities have opened up for SMEs, whereby a win-win solution is created for both the principal, who is freed to concentrate on the more crucial tasks of final assembly and marketing, while the SME can concentrate on production without having to worry about marketing its produce.

Large corporations are concentrating on core competencies, preferring to outsource many activities. This is where a plethora of opportunities have opened up for SMEs.

This partnership can take the form of horizontal networks, or more usually of ancillarisation, whereby substantial (usually 50%-100%) production of an SME is used as an input by a single principal or it may take the form of sub-contracting, which is in the nature of job work, i.e., a certain portion of the production capacity of an SME is utilised for producing as per the requirement of the principal. Meanwhile, the SME also produces under its own name or for a third party. Partnership lends itself to application in a number of business relationships. These include:

Backward linkages: This is the commonly understood practice of vertical partnership. The SME produces an intermediate or component for use by the principal. This relationship can range from a formal one to a very close linkage where even the supervision of the production process is done by staff deputed by the principal.

Equity/Technology/Production: On occasions, joint ventures with equity stake from the principal in the SME have been established. Alternatively, technology tie-ups or production under licensing have been practiced. In such cases, the principal may or may not buy the entire production of the SME/Joint Venture.

Franchising: This is a practice commonly followed by large retail or food chains. The principal is able to extend its brand name to newer locations without having to invest in real estate or manpower. The quality standards prescribed for adherence may be the same as those of the principal or marginally lower.

What partnerships can do

SMEs usually lack information, experience, contacts or even the human and financial resources to put in place a marketing model, carry out an advertising exercise or initiate changes in technological base and management practices in their unit. Partnership allows the SME to change this state of affairs in many ways. These include:

SMEs lack information, experience, contacts and financial resources to put in place marketing model, or initiate changes in technological base and management practices in their unit.

Marketing assurance: In case of ancillarisation or sub-contracting, the principal undertakes to buy the production as specified by it in the terms of agreement. The SME entrepreneur is not required to do any marketing of his finished product.

Advertising support: When the need for marketing is obviated, there is little need for advertising. In some cases, the component which forms a part of the final product itself constitutes an advertisement for the SME brand.

Mentoring support: The principal acts as the friend, philosopher and guide for the SME unit, helping it to come up and meet international quality standards. In some instances, where the SME proves up to the challenge, the principal may even encourage the SME to invest in a new market which the principal has entered.

Access to innovation centres: Certain principals, specially TNCs, have set up innovation centres where considerable R&D is also undertaken. Some principals allow SMEs to access these centres in respect of their project related requirements.

Adoption of best practices: Close association of SMEs with the principal encourages adoption of best practices. These could include structured cost norms, management practices such as Kaizen and Six Sigma, online account reconciliation, etc.

Capacity building: Partnerships help improve capabilities within SMEs. SMEs learn to respond to production changes within the principal and react positively to episodic events such as changes in product specifications, etc.

Access to superior managerial skills: Superior managerial skills, specially in respect of materials management, production scheduling and finance become available to the SME.

Technology and IT support: Technology partnerships greatly enhance technological capabilities of SMEs. Technical training and IT support are often extended by the principal.

Finance and sourcing options: Many principals extend assistance to SMEs in arranging funds and loans. Payment terms can be structured to meet SME requirements. Similarly, a large number of sourcing options become available to the SME in view of the clout wielded by the principal.

The eventual outcome of these interventions is to enhance competitiveness of SMEs.

Partnership offers tangible benefits to the principal as well. These include:

Productivity gains: SMEs are able to concentrate on specialised tasks and over time are able to bring into it considerable efficiency in operations. These efficiencies are lost when a principal tries to undertake all such specialised activities in-house. Consequently, outsourcing results in substantial productivity gains.

Savings on factor costs: Wage rigidities in SMEs are far less when compared to any principal. SMEs enjoy greater flexibility in hiring labour and often this labour is unorganised. Similarly, overheads for an SME are far lower. Together, they result in substantial savings in factor costs.

SMEs enjoy greater flexibility in hiring labour.

Flexibility: Alterations in total product volumes tend to be easier if a number of SMEs are engaged in producing different items, as opposed to a single in-house assembly line production. SMEs are in a position to share the slack as and when there is a production build up.

Lower inventory costs: Initiatives such as "Just-in-time" have been implemented very successfully through SME based outsourcing. These often result in a cost burden of inventories getting passed on from the principal to the SME.

Project cost savings: Outsourcing helps save capital

expenditure which would otherwise be required for setting up similar manufacturing facilities in house.

Identification of SMEs by large corporations

It is often said that principals demand too much from SMEs in the name of "partnership readiness". In respect of TNCs it is argued that this often becomes a pretext for encouraging home SMEs rather than host country SMEs. There is much to be said on either side. Nevertheless, a mature partnership demands that selected SMEs should have the potential to meet the requirements of the principal, even if they are not in a position to do so immediately. It must be remembered that low wages and labour standards in an SME are never adequate to sustain a relationship. Some of the major parameters for identification of SME partners are:

Low wages and labour standards in an SME are never adequate to sustain a relationship.

- A shared vision
- Cost structure and overheads
- Technological capabilities
- Acceptance of principal's guidelines such as JIT, Six Sigma, payment terms, quality certification etc.
- Acceptance of responsibility and penalty relationships
- Ability to achieve minimum acceptable standards and thereafter work at constantly improving these standards
- Ability to react to changes
- Ability to bring in specific add-ons to the partnership, e.g. knowledge of technical processes/local markets/skilled labour, etc.

Bargaining issues for SMEs

One of the pitfalls of such partnership is that more often than not, SMEs come in with a weak bargaining position. In general, however, though SMEs are the weaker partner, they can considerably strengthen their position in a number of ways. These could include:

- SMEs for specialised products, where principals can't play off one against the other.

- Bringing in knowledge of local markets, distribution channels, government regulations, specially when the principal is a TNC.
- Exhibiting a proven capacity to absorb technology.
- Having a track record of constant technology upgradation.
- Not being tied to a single consumer as often an SME fails due to distress in its principal.

Despite these, it usually remains an unequal battle and this is where Government can play a key role.

Role of Government

Government is in a position to play a crucial role in promoting partnerships and at the same time strengthening SMEs by providing a level playing field. Bargaining positions of SMEs can be considerably improved through suitable Government interventions. To begin with, domestic SMEs need an environment favourable to entrepreneurship. Policies and programmes which consciously target SMEs need to be put in place. These would help capacity building of SMEs and encourage them to demonstrate their willingness and readiness to transform. In addition, the following interventions are suggested:

Government is in a position to play a crucial role in promoting partnerships and strengthening SMEs.

- Benchmarking SMEs against global standards.
- Identification of sectors where SMEs have competitive advantage.
- Encouraging specialisations among SMEs.
- Encouraging specialised labour.
- Soft credit lines for SMEs.
- Creation of support institutions, e.g. training centres for transfer of technology, continuous education programmes.
- Providing access to innovation centres.
- Local job creation stipulations.
- Tax breaks for outsourcing.
- Relaxed FDI conditions for TNCs.

Many of these have been tried with varying degrees of success in different economies. Each economy needs to determine which combination of these is likely to work.

Role of International Organisations

International organisations such as the UNIDO, UNDP, ILO, OECD and APO already play a significant role in sensitizing governments about the importance of SMEs. They assist governments in creating a business environment which is conducive to growth and success of SMEs. This often involves a supportive policy framework and appropriate institutional arrangements for promoting the SME sector. SME networking is one of the thrust areas. This stresses on horizontal networking (with other SMEs occupying the same level in the value chain) and vertical networking (with large businesses). Encouragement is also given to networks among enterprises, providers of business development services (e.g. training institutions or technology centres) and local policy makers to facilitate a shared vision and strengthen collective action. UNIDO also runs a project whereby Industrial Sub-Contracting and Partnership Exchanges (SPXs) are established. These SPXs promote match-making between SMEs as sellers and large units or principals as buyers. Table 1 gives details of established and operational SPXs under the UNIDO Industrial Sub-Contracting Programme.

Much more remains to be done. Efforts in the future should specifically concentrate on the following:

- Initiating and developing dialogue on elements for an international environment that is conducive to the creation of viable and just linkages between a principal and SMEs.
- Experience sharing and documentation of best practices in this partnership.
- Articulating concerns of SMEs in international fora such as WTO.
- Eliminating barriers to SME growth and expansion. These would include discriminatory rules of competition, non-technical barriers, export barriers, unfair standards, etc.
- Capacity building of SMEs through training programmes and attachments with principals for enabling partnership readiness.
- Strengthening local institutions engaged in capacity building of SMEs.

TRIMS and Sub-Contracting

Trade Related Investment Measures (TRIMS) under

Table 1: Established & Operational Sub-Contracting and Partnership Exchanges under UNIDO's Industrial Sub-Contracting Programmes

Country	Established SPX	Operational SPX
Algeria	4	4
Argentina	3	3
Bolivia	2	2
Brazil	4	3
Chile	1	1
Colombia	7	8
Costa Rica	1	1
Cote d'Ivoire	1	1
Cuba	1	1
Czech Republic	2	1
Ecuador	1	1
Egypt	1	0
France	1	1
Guatemala	1	1
India	3	3
Iraq	1	0
Jordan	1	0
Kenya	1	0
Madagascar	1	1
Morocco	1	1
Mauritius	1	1
Mexico	7	8
Paraguay	1	1
Peru	3	2
Poland	1	0
Russian Federation	1	1
Saudi Arabia	1	1
Slovakia	1	1
Tunisia	1	1
Turkey	1	1
Uruguay	1	1
Venezuela	2	1
Total	59	52

Source: (UNIDO, 2000)

the WTO have removed one of the support measures which were available to Governments for encouraging outsourcing from SMEs. This relates to local content requirements. A foreign principal (TNC) can no longer be mandatorily required to source locally. Nevertheless, a number of options still remain before Governments as have been outlined earlier.

The Indian Scenario

Before delving deeper into the partnership

scenarios in India, it would be instructive to snapshot the entire SME/SSI Sector in the country for a proper appreciation of its extent and reach. The Indian small scale sector has been fortunate to build upon a local heritage of enterprise, dynamism and renewal. Despite two centuries of colonial rule and total lack of external support, the sector has reestablished itself and consolidated over the last 50 years. From about 80,000 units in the late 1940s to over 3.2 million units today, the sector has been proving its mettle time and again. The last decade of the 20th Century has seen this sector maintain its steady growth. The performance of the Indian small scale sector in terms of critical economic parameters such as number of units, production, employment and export during the last decade is indicated in Figs. 1, 2, 3 & 4 and Tables 2, 3, 4 & 5.

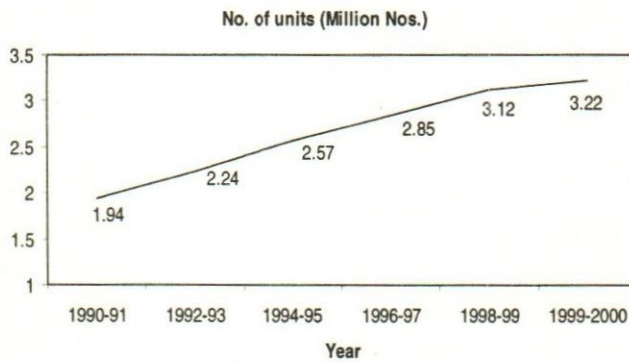


Fig. 1. No. of SME units

Table 2: Performance of SMEs (in terms of number)

Year	No. of units (million nos.)
1990-91	1.94 (6.86)
1991-92	2.08 (6.88)
1992-93	2.24 (7.88)
1993-94	2.38 (6.01)
1994-95	2.57 (7.98)
1995-96	2.72 (5.95)
1996-97	2.85 (4.88)
1997-98	3.01 (5.5)
1998-99	3.12 (3.55)
1999-2000	3.22 (3.33)

Note: A small scale industrial unit is defined as one in which the investment in plant and machinery whether held on ownership terms or on lease or by hire purchase does not exceed Rs. 10 million.

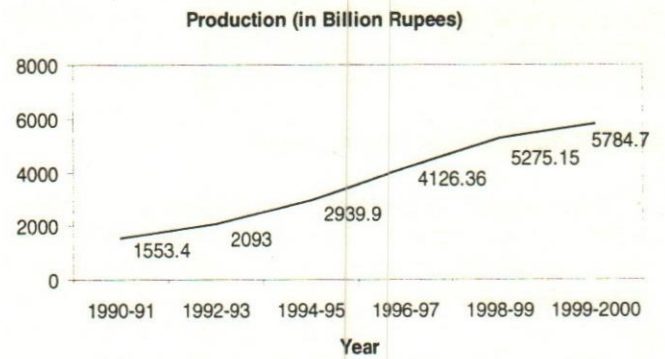


Fig. 2. Production in SMEs

Table 3: Production in SMEs

Year	Production (Billion Rs.) (at current prices)
1990-91	1553.40
1991-92	1786.99
1992-93	2093.00
1993-94	2416.48
1994-95	2939.90
1995-96	3562.13
1996-97	4126.36
1997-98	4651.71
1998-99	5275.15
1999-2000	5784.70

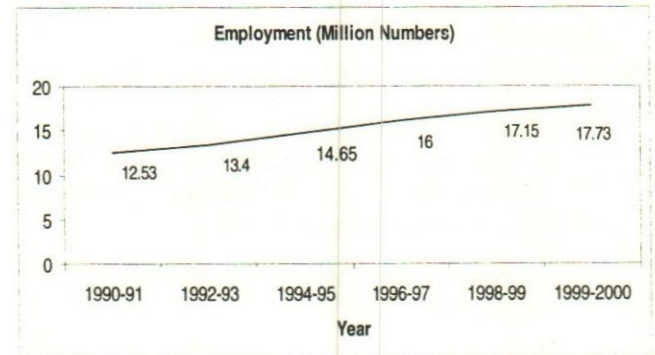


Fig. 3. Employment in SMEs

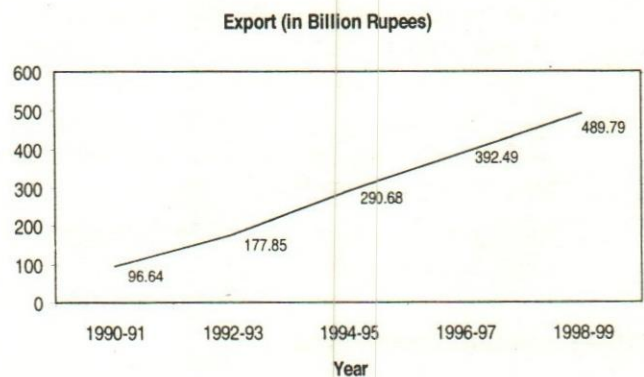


Fig. 4. Export Performance of SMEs

Table 4: Employment in SMEs

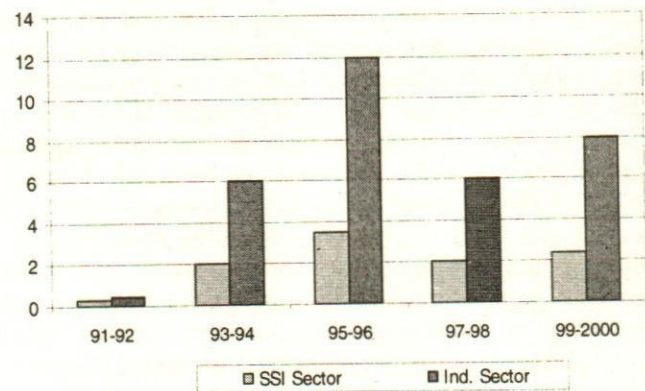
Year	Employment (million nos.)
1990-91	12.53 (4.77)
1991-92	12.98 (3.59)
1992-93	13.40 (3.28)
1993-94	13.93 (3.97)
1994-95	14.65 (5.15)
1995-96	15.26 (4.13)
1996-97	16.00 (4.84)
1997-98	16.72 (4.5)
1998-99	17.15 (2.62)
1999-2000	17.73 (3.33)

Table 5: Export Performance of SMEs

Year	Exports (Billion Rs.) (at current prices)
1990-91	96.64 (26.74)
1991-92	138.83 (43.65)
1992-93	177.85 (28.11)
1993-94	253.07 (42.29)
1994-95	290.68 (14.86)
1995-96	364.7 (25.50)
1996-97	392.49 (7.61)
1997-98	439.46 (11.97)
1998-99	489.79 (11.45)
1999-2000	N.A.

The Indian small sector has been consistently out-performing large industry on crucial parameters such as growth in production and growth in employment. This is indicated by tables 6 & 7 and Fig. 5.

As the Indian economy is in a state of industrial

**Fig. 5. Trends in Growth: SSI and Industrial sector****Table 6: Trends in Growth: SSI and Industrial Sector**

Year	SSI Sector (%)	Industrial Sector (%)
1991-92	3.1	0.6
1992-93	5.6	2.3
1993-94	7.1	6.0
1994-95	10.1	9.4
1995-96	11.4	12.1
1996-97	11.3	7.1
1997-98	8.43	5.8
1998-99	7.7	4.0
1999-2000	8.16	6.5

Table 7: Trends in Growth (SSI and Industrial Sector)

Period	GDP Growth per annum	Increase in jobs per annum	
		Organised Sector including Government	SSI Sector
1980-1990	5.7%	1.59%	6.7%
1991-1997	5.7%	0.86%	3.5%

transition, the contribution of industry in GDP is constantly going up and is presently just over 25 per cent. But, the most spectacular shift has taken place in respect of services sector which now contributes over 46 per cent of the GDP. As the knowledge economy gains ascendance over the traditional smoke-stack economy, far better opportunities are emerging for the Indian small units in the service sector. Such units are generally referred to as Small Scale Service and Business Establishments (SSSBE). Presently SSSBEs upto Rs. 1 million investment are considered as small units in India. The sector is showing very rapid growth and is able to leverage on its basic skills helping it to emerge as a leader in respect of software, servicing and communication. Various activities recognised as SSSBE include Cable TV services, rope-ways, marketing and

industrial consultancy, documentary film making, auto repair, software development, servicing of equipment, long distance telecommunication kiosks, photographic labs etc. Increasingly, the service sector is helping to utilise the skills of a vast number of educated youth of the country. A specific mention must be made of Indian skills in software development which are acknowledged all over the world. In addition, telecommunications, accounting support services, medical and consultancy services, legal work amongst others are opening up new vistas for small units. The abundant supply of educated and technically trained English speaking people in the country has proved to be an invaluable asset in the process.

Partnerships in India – Ancillarisation & Sub-contracting

Soon after Independence, India embarked on a massive program of industrialisation in the 1950s. State owned enterprises were set up in all core and heavy industries. These Public Sector Units (PSUs) were established to provide a sound industrial base to the economy. PSUs were planned with the objective of complete in house production and perhaps at that time this made eminent sense, since there were few other industrial units of any kind to begin with. Outsourcing and ancillarisation were episodic activities. By the mid 1970s things began changing. The employment potential of SMEs began to be recognised and Government looked at concrete steps to support SMEs. The first major push towards ancillarisation came at the behest of the Government as it defined the objective of generating additional employment as well as enhancing industrial activity in the country through partnership. In 1978, the controlling agency of PSUs, in consultation with the Small Industries Development Organisation came out with specific guidelines for encouraging partnership linkages between large and small industries through ancillarisation. PSUs were required to identify non core activities which could be outsourced. PSUs in turn helped ancillaries in procurement of raw material, equipment, training, placement of orders etc. Ancillary owners were made members of plant level committees and involved in decision making. State owned Electricity Boards offered a number of opportunities. A separate definition for ancillary SMEs was also prescribed whereby such units became eligible for a higher investment ceiling.

The exercise yielded results and industrial ancillaries were able to establish a niche for themselves in the private sector, initial attempts at partnership were hesitant. A large number of suppliers and few customers created a buyers' market. Here SMEs often

complained of being squeezed for payment or price or of supplies being rejected. Nevertheless, on the whole, the growth of ancillaries provided depth to the industrial base, promoted entrepreneurship and a vast pool of manpower was trained. Pioneering efforts in this regard were made by large Indian corporations such as Escorts, Mahindras, Telco, Ashok Leyland, Punjab Tractors and Eicher in the automotive sector and the Hero Group in bicycles. Many ancillary units were set up by first generation, technically qualified entrepreneurs. It must be remembered that most such units were associated with procurement of standardised products, components or sub assemblies manufactured with conventional technologies where the criterion of low costs was more important than high quality.

SMEs often complained of being squeezed for payment or price or of supplies being rejected.

During the 1980s, large multinational corporations such as Suzuki, Mazda, Mitsubishi, Piaggio etc. began setting up production bases in India, often with local partners. These were later followed by Korean chaebols such as Hyundai, Samsung, LG, etc. TNCs brought in global practices of partnership to Indian markets and the maximum impact of this was seen in the automobile sector. A high level of technological sophistication along with commensurate commitment was now expected from vendors. In turn, the principal offered stability of prices, support for skill upgradation and in some cases even direct financial assistance through equity participation. It was in this auto components sector that Indian SMEs really came into their own. They began small but scaled up fast. Considerable investments were made in technology and efforts made to constantly upgrade. Some SMEs even went in for tie ups with the corresponding supplier in the home country. The result is that today India boasts of a world class auto components industry, most of which is in the SME sector. They are not only reliable outsourcing partners, they also export in their own right.

During recent years, consolidation has occurred even amongst ancillaries/sub contractors. Certain principals are opting for just one or two sub contractors for critical components. These are Tier 1 sub contractors. Tier I units in turn farm out some work to downstream Tier II units and so on. A hierarchical business chain thus gets created which has space for tiny, small and medium sized units.

Government initiatives in recent years have focused on encouraging ancillarisation through vendor development programmes and putting in place measures to strengthen SMEs and enhance their competitiveness. As many as 45-50 vendor development programmes are being conducted every year and the current policy interventions focus on technology, marketing, credit and infrastructure. Separately, as many as 61 sub-contracting exchanges(SCX) have been established all over the country, of which 27 are run by industry associations. These provide a valuable platform for buyers and sellers to meet and for facilitating optimal utilisation of existing industrial capacities. Principals work as anchor companies or agents of change, while SMES are increasingly showing enhanced capabilities. Many of these sub-contracting exchanges have emerged as self-financing entities.

Government initiatives focus on encouraging ancillarisation through vendor development programmes and putting in place measures to strengthen SMEs.

Conclusion

The partnership movement in India is now in a phase of consolidation. Certain problems such as delays in payment to ancillary suppliers/vendors persist. While Government has put in a non binding arbitration

and conciliation mechanism in place, the best guarantee for placing the relationship on a stronger footing is greater industrial development which creates choice for sellers, in this case SMEs. In this situation, the principal itself would have a larger stake in nurturing an existing partner SME. There is also a need for greater organised effort at building fresh relationships. In the private sector, much still depends on the initiative of individual corporations. The Government of India has made an endeavor to address this by involving industry associations in operating sub contracting exchanges. It is expected that this would help bring in many more potential partners. Buyer Seller Meets and Vendor Development Programs provide a measure of support to partnership. However SPX (UNIDO) and SCX need to go beyond this. They need to become partners for technology upgradation, facilitating technology transfer. This would eventually enable SMEs to even meet custom specific needs of principals. Partnership works. Its ability to harness the competitive strengths of two unequal partners is what makes it a winner. Across economies it is empowering SMEs. The need of the hour is to sustain the process. In the past, the role of SMEs has been crucial in the economic wellbeing of a nation. It has now become increasingly clear that the knowledge economy shall be no exception.

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□

Good better best never let it rest till your good is better and your better best.

– Productivity Theme Song

IT Applications in SMEs – Impacts of e-Commerce & Corresponding Solutions

Steven Hung-Chi Wu

Chinese Taipei had proposed the project of studying the impacts of e-Commerce on SME in the 1998 APEC Ministers Meeting of SME. In July of 1999, APEC formally promised support to the study project. This project was completed at the end of year 2000. As the project overseer and the Coordinating agency, Small and Medium Enterprise Administration of Chinese Taipei presents the major findings of the analysis of impacts and corresponding solutions for SMEs in the e-Commerce field, in this paper.

Steven Hung-Chi Wu is Secretary General, Small and Medium Enterprise Administration, Ministry of Economic Affairs, China-Taipei. The paper presented at the International Forum for SMEs, New Delhi, 10-12 April 2001, (Organised by NPC India & APO).

Small and medium-sized enterprises (SMEs) will face a different business environment in the 21st century. The tasks that need to be undertaken include:

- Putting emphasis on supply chain management
- Concentrating on core business to enhance competitiveness and product value
- Strengthening human resources management systems
- Enhancing capabilities in information technology.

Collaboration from the government is essential. This is particularly important in such areas as maintaining a stable economic and political environment, fostering a sound operating environment for the development of SMEs, developing a comprehensive infrastructure for knowledge creation and transmission, promoting industry clusters to encourage cooperation among SMEs, and cultivating high quality personnel and workforce. Furthermore, traditional financial market operation need to be adjusted, from providing credit on the basis of tangible assets as collateral, to assume more risk. Both formal and informal venture capital funds will play an increasingly important role, and governmental financial agencies will need to take account of these changes in financial market management in the future.

SMEs should embrace e-commerce as early as possible in order to meet future challenges. If a company is aiming only to become a user of the Internet, they need to find appropriate solutions and to introduce them immediately. If a company wishes to use the Internet to transform itself into a service provider, then it needs to decide on its market position and segmentation. In either case, the role and drive of top management is important.

General Business Operating Environment

The business operating environment comprises the

internal and external environment. In the external environment, enterprises pursue promotion of efficiency and face fierce competition. According to Michael Porter's competitiveness theory, a company may face five kinds of threats: the threat of supplier's price negotiation, the threat of customer's price negotiation, the threat of existing competitors, the threat of potential competitors and the threat of substitutes. The enterprise can create its competitive advantage by understanding the surroundings, and improving its internal efficiency and capability. The enterprise should adapt itself to the changes of external environment. The overall business operating environment is illustrated in Fig. 1 & 2.

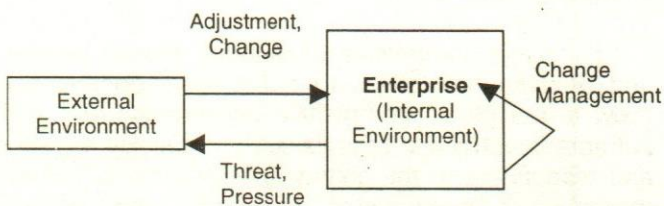


Fig. 1. Representation of Business Operating Environment

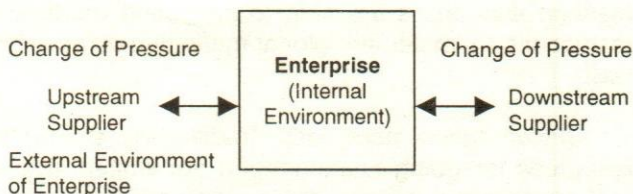


Fig. 2. Representation of Business Operating Environment (SCM Perspective)

Characteristics of e-Commerce – Supply and Demand

Analysis from Supply Chain Management (SCM) Perspective

As illustrated in Fig. 3, the e-Commerce applications for enterprises include: electronic transactions such as e-auctions and on-line ordering, virtual mall, e-Procurement, CRM, EDI and so on.

The participants in the supply chain are as follows:

- R & D product designers
- Product Distributors
- Marketers
- Forecasters and Planners
- Finance
- Suppliers

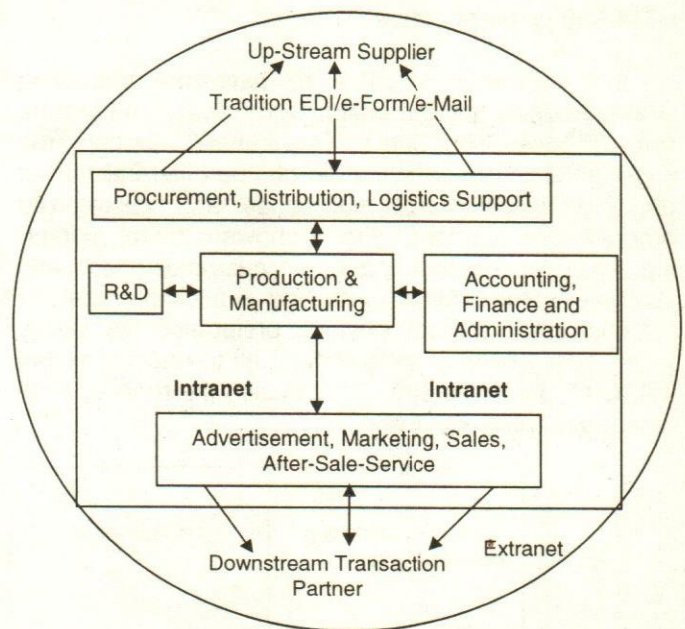


Fig. 3. e-Commerce Applications for Enterprises (SCM Perspective). Sources: MIC/III

From each participant's perspective, the enterprise with higher e-Commerce application capability can get more benefit in the following items (Table 1):

Table 1: IT Application in SMEs

Supply Chain Participant	Advantages
Product Designer	<ul style="list-style-type: none"> • Can use general or secondary parts for multiple products. • Can design products easy to be assembled at last phase. • Can design general products customized for the local market.
Product Distributors	<ul style="list-style-type: none"> • Can Improve customer service quality while lowering the inventory cost. • Can decrease warehouse cost. • Can decrease logistics cost, such as transportation cost. • Can provide information flow management capability and develop streamlined physical flow.
Marketers	<ul style="list-style-type: none"> • Can decrease product distribution cost. • Can raise customer expectation for product distribution. • Can increase reliable product acquisition rate. • Can help create specifications of future products that will be easily manufactured and distributed. • Can provide the connection with customers that will help participation in the overall supply chain management.
Forecaster and Planner	<ul style="list-style-type: none"> • More accurate forecasting of information, reliable distribution and overall planned supply chain strategies that will make financial planning more easy • Can enable the factory to schedule for production more easily
Finance	<ul style="list-style-type: none"> • Less investment to gain more outputs. • Less investment on inventory. • Higher benefits from tax, customer and cash flow. • Lower bad debt risk.
Suppliers	<ul style="list-style-type: none"> • Can obtain better prediction information and continuously stable purchasing orders from customers. • Can enhance suppliers' distribution reliability.

e-Marketing perspective

It is common practice to have the marketing strategy based on customers. Don Pepper and Martha Roger's book "The One to One Future" mentions the importance of the combination of "the differentiation of customer needs", "customer values" and "customized products and services". Fig. 4 shows different marketing strategies based on different customer needs and customer values. Mass marketing is a simple strategy for customers without obvious preference. To satisfy those with obvious preference, one-to-one marketing will be the best strategy, and it is also the most complicated and challenging one.

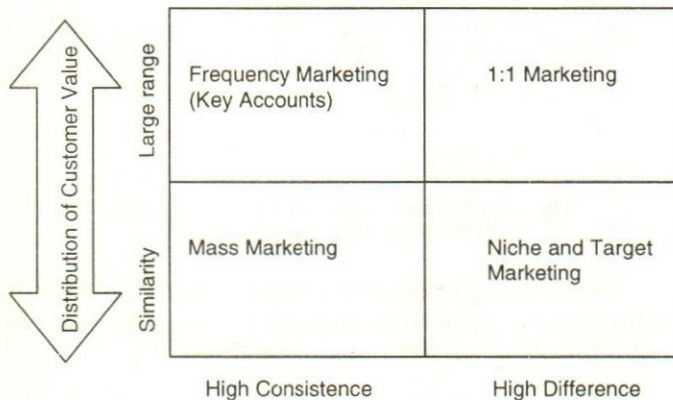


Fig. 4. Customer need and customer value

Sources: Ward Hanson, "Internet Marketing". South-Western, 2000, pp. 205

The degree of e-Commerce applications in marketing activities is illustrated in Fig. 5. Enterprises with lower e-Commerce capability would stay at the marketing stage of Internet advertisement. On the contrary, enterprises with higher e-Commerce capability would be closer to the ideal of one-to-one marketing and the value to the enterprise and the consumer is also higher.

Characteristics of SME Business

Although there is no absolute standard to define the so called "Small and Medium Enterprises", based on the relative measurement of small and medium enterprises from APEC and comparison with large enterprises in the same industry, the characteristics of small and medium enterprises can be summarized as follows:

- Relatively less employees
- Relatively low available capital
- Relatively low enterprise complexity
- Relatively low available resources
- Relatively less-constructive enterprise system

- Relatively high enterprise flexibility
- Relatively low market domain power
- Relatively less customers
- Relatively low R & D capability and expenses
- Relatively low information application and investment
- Relatively low capability of surviving in market depression.

e-Commerce Advantage to Overall Business Operation of SME

The major competitive advantages needed by small and medium enterprises to make them continuously grow in the global competitive environment are: high entrepreneurship and high flexibility in quickly adapting and responding to the changing environment. The advantages of e-commerce for small and medium enterprise operations are as follows:

Unlimited Marketing Ability: Via Internet, small and medium enterprises are able to transcend geographic restrictions to implement global marketing without high cost.

Customization more easy: Traditionally, the human resources for doing customization are limited in small and medium enterprises. Now, customers are able to place order and give specifications via web pages, and companies can design products based on the demand.

Automating the Operation: The operation model of SMEs is much simpler than large enterprises; therefore it is easier for them to introduce information technology, it is faster for them to get online and they have a higher possibility of success.

Supporting flexible processing capability: One of the advantages of small and medium enterprise operations is the high flexibility in production, marketing and human resources. e-Commerce will leverage these assets and raise the competitive advantage.

Higher chance of success: Because of the low complexity in small and medium enterprise operations, reengineering process is simpler. The possibility of success in implementing e-Commerce is higher.

Higher ROI and less time consuming: The return on investment for small and medium enterprises in conducting e-Commerce is higher than it is for large corporations. The time necessary for getting the return is less as well.

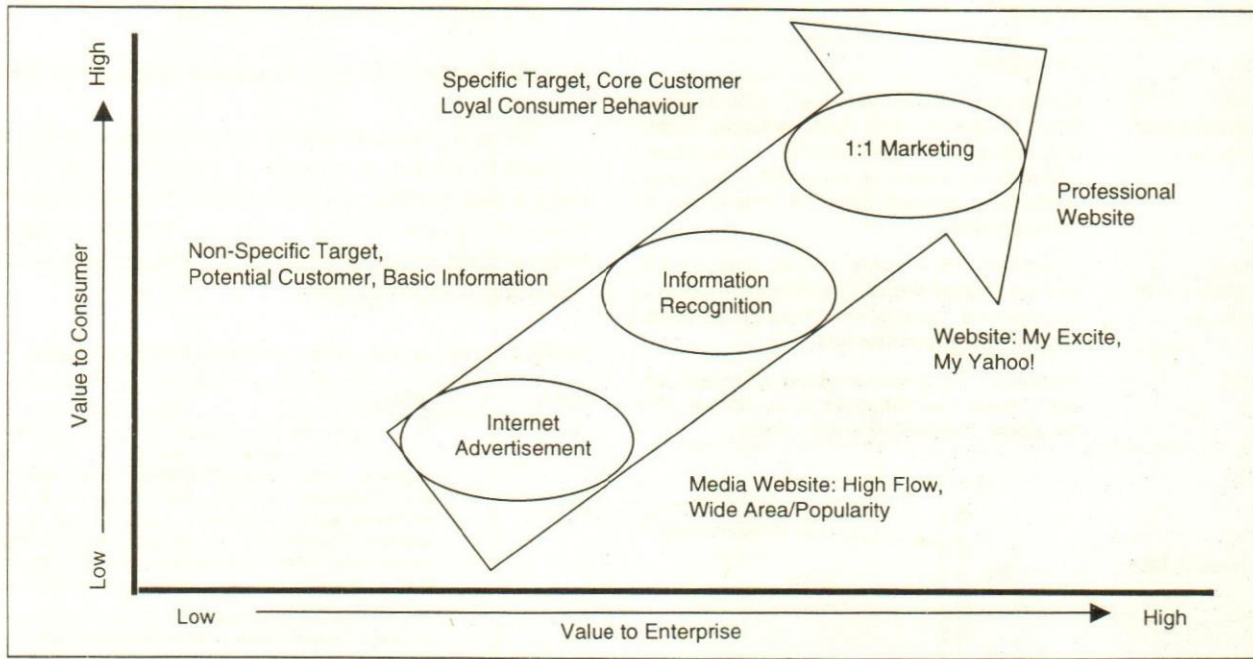


Fig. 5. e-Commerce applications in marketing activities. Sources: MIC, III

Higher Marketing Effect: e-Commerce diminishes the marketing, geographic and time limitations. With the deployment of customer database system, the marketing service power is also enhanced.

Improving Corporate Coordination: Besides the existing relationship with other companies, small and medium enterprises are able to expand their reach to the whole supply chain and e-marketplaces.

Analysis of e-Commerce Impact on SMEs

It is a very complicated interactive process for an enterprise to introduce e-Commerce application, and there might be a lot of impacts during the interactive process. Figure 6 presents the involved factors:

These factors can be categorised into three dimensions: intra-organisational, inter-organisational and overall (Table 2).

After analyzing the impact of e-commerce on small and medium enterprises, the solutions for small and medium enterprises to resolve the negative side of the impact can be discussed based on APEC's 6 tracks as shown in Fig. 7:

- The characteristics of small and medium enterprises.
- The obstacles in small and medium enterprise operations.

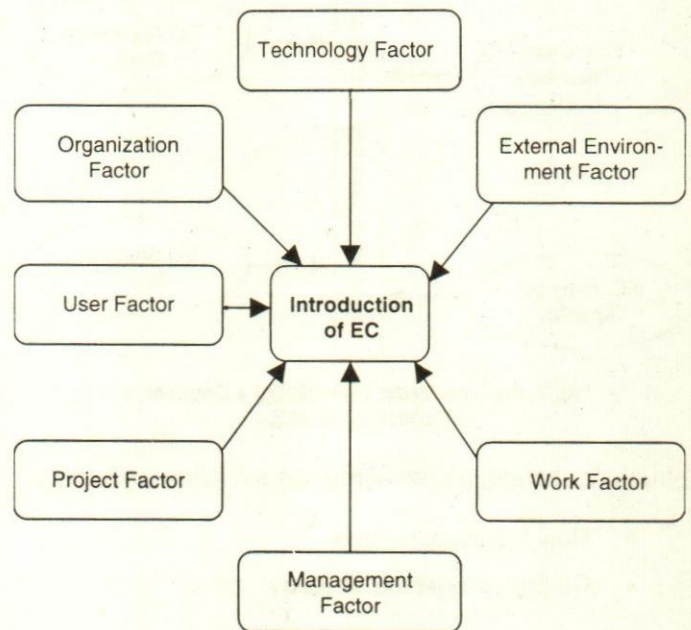


Fig. 6. The interactive factors in e-Commerce

- The capability of small and medium enterprise for e-Commerce implementation.
- e-Commerce development trend.
- e-Commerce development methodology.
- e-Commerce strategies.

Impact of e-Commerce on SMEs

Change of SME Structure: In the aspect of SMEs'

Table 2: Analysis Dimensions

Dimension	Description
Internal Management of Enterprise	Comprises intra-enterprise procurement, R&D, production and manufacturing, sales, distribution, organisational structure, operation performance, materials, manpower, accounting, finance and the administrative management.
External Management of Enterprise	Comprises the industry market environment and the relationship with upstream suppliers, collaborative companies, trading partners, competitors and customers.
Overall	Comprises the overall structure of enterprise, the industry's competitive environment and the global competitive environment

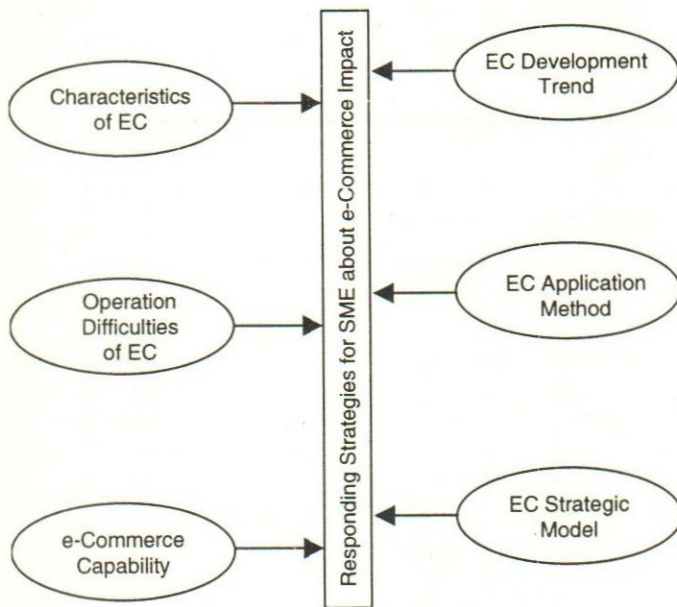


Fig. 7. Analysis Model of Impact of e-Commerce Application on SMEs

structure change, e-commerce has the following impact:

- New business models
- Customer-oriented strategy

Change of Interactive Relations between SMEs & Large Companies: As to the interactive relationship changes between SMEs and large companies, e-commerce has the following impacts on overall development:

- Efficiency differentiation
- Core competence

International Cooperation Opportunities

- Decreasing barriers of nationalization and geographies.

- Perfect competitive market

Factor Analysis of e-Commerce Impact on SMEs

Table 3 presents the factor analysis of e-Commerce impact in SMEs. A variety of impacts such as discordance and conflicts might occur during different interaction processes. These can be further divided into internal and external impacts on the company with the following specifications:

Table 3: Factor analysis of e-Commerce Impact on SMEs

Factor	Description
Users	The users are the operators and participants of e-commerce related IT systems, which include the corporate internal staff and external personnel of suppliers and customers. Usually, the users have fears and resistance against changes to current status, or unknown variables. Therefore, during the initial stage of e-commerce introduction, there might occur situations where internal staff resist against changes, or even become obstacles. When users don't thoroughly understand the purposes and motives of e-commerce, their participation in planning and propelling e-commerce solutions might be affected, and cause losses.
Project	As it takes a long time to plan and execute e-commerce, most companies make it a "project", or form a special team to work on the introduction of e-commerce into the company. It requires good communication, coordination, and cooperation between all team members, as well as good planning, scheduling and cost estimates to ensure project success.
Organisation	If the corporate organisation is pyramid type, or the company has conservative culture and strategies, there would be greater negative impacts and more difficulties while introducing e-commerce.
Technology	As IT has changed rapidly over time it is vital to decide what tools are best fits for individual company, easy to use, or best satisfy the future trends.
Management	Success of e-commerce introduction relies on the support from executives. If executives of the company haven't committed full support, there will be negative impact on the company's organisation. The management of organisational changes, and e-commerce strategies, are all important factors.
Work Flow	Analysis of whether the present work flow is reasonable or not, what processes should be kept, deleted or amended, and the Business Process Re-engineering (BRP) need to be implemented before introducing e-commerce.
Environment	This factor refers to the existing technology and its future development, governmental regulations, incentives, policies and directions on e-commerce, the degree of application by the market competitors in the same industry, customers' preference, habits and acceptability; the upstream and downstream suppliers' acceptance and cooperation degree.

Analysis of Internal Impacts on the Company

Operations

e-Commerce can substantially improve the internal operation performance of the organisation in following aspects: the shortening of lead-time and cost in procurement, R&D, production, and delivery; and effi-

cient control and management of resources like raw materials, manpower, accounting and financing.

e-Commerce can create more flexibility in internal processes and operations in SMEs. Application of e-commerce enables SMEs to master changes in the market and respond in real-time. By utilizing information technology, companies can enter the market with less business entry barriers regarding finance, revenue, and transportation, and gain flexibility to meet customer needs with Mass Customization, Macro marketing, or One to One Marketing. As the SME has simpler organisation form, with the application of e-commerce, great operation flexibility could be expected.

e-Commerce will lead to polarity of corporate sizes. In comparison with companies that have introduced e-commerce already, the non-eC companies have less competitiveness and operational flexibility, as well as slower market responses. The corporate sizes and market shares also show the trends of polarity. As large companies gain benefits from operating e-commerce, the survival spaces of SMEs are squeezed accordingly. Globalization and 24 hour services are the main features of e-commerce, which enable large companies to reach their customers more directly and faster. On the contrary, there would be not much room left for SMEs.

Management

The management must have sharp perspectives of market competition, or they will face great pressure and lose the market. As e-commerce emerges, the whole environment changes so fast that the competition becomes keener. The internal management mechanism of a company must enable the executives to master the market information and e-commerce. If the management can not envision the e-commerce environment and future trends, the company would be doomed. If an SME can effectively propel e-commerce it will soon get recognized in the industry. Due to the broad areas e-commerce is involved in, many difficulties must be overcome before it is successfully carried out. The management model should follow the trends in e-Commerce, and incorporate Corporate ID Features.

Organizational Structure

e-Commerce will result in change of corporate organisational structure, re-structuring of internal human resource, and heavy demand for IT related talents. The organisational structure of a company must be flexible enough to respond and adjust to the rapidly increasing competition and changing environment. As the or-

ganisational structure changes, the introduction of e-commerce may provide the chance to re-consider the internal structure and work flow, and thus hasten the adjustment process. However, this kind of organisational change involves many areas, and usually brings in heavy burden and difficulties, which might produce negative impact on the company.

Processes

e-Commerce will create more flexibility for internal processes and operations for SMEs: By taking advantage of automation and connectivity when introducing e-commerce, resources like work hours and manpower can be more efficiently used and more process flexibility can be generated. For example, video-conferencing can be held so management in different geographic locations can join in the meetings simultaneously and time flexibility could be achieved. In addition, forms and reports can be transferred and managed electronically; the "paperless" working processes can increase process flexibility.

e-Commerce will create more flexibility for internal processes and operations for SMEs.

The introduction of e-commerce will cause change of internal workflow: Once e-Commerce is introduced in the company's internal work, workflow will replace manual management for automation and computation.

e-Commerce ignites competition between companies in production cost aspect: For manufacturers, with the aid of information, the company's productivity could be increased, the production lead-time decreased, as the time-to-market reduces. Communication between branches could be achieved by using e-Commerce tools like network technology, e-mail, videoconference, WWW, ECI, etc. to lower trading and communication cost. Meanwhile, communication between companies and customers can be tightened via e-Commerce, increasing the price bargaining power for companies to deal with their suppliers. Therefore, competition between companies will become keener in the long run.

Analysis of Internal Impacts on Companies

Sales & Marketing

Broader marketing content: e-Commerce provides the chance to sell the company's products and online services over the Internet. Internet marketing attracts cus-

tomers from around the world without any time limitation.

One-to-One marketing: Features of Internet like real-time and interaction provide the company a more efficient, direct and fast tool of marketing campaign, serving the purpose of one-on-one marketing.

Customer Service

Recognition of customer values: The first priority of a company is to "create customers". In a market full of keen competition and rapid changes, consumers have more and more options that include products, brand, prices, suppliers, etc. The problem that a company faces is how to keep the customers and increase customer satisfaction and loyalty.

The first priority of a company is to "create customers".

Customized service: As e-Commerce develops, keen competition has changed the relationship between the company and customers. Providing customized service is likely to increase the customer's loyalty to the company.

Supply Chain Integration

Strategic alliance among companies: Strategic alliances between upstream or downstream vendors in the same industry or across different industries can be formed to broaden the market.

Cross-industries value chain: Application of e-Commerce enables information exchange between the company and its upstream or downstream partners, leading to a more integrated supply chain.

Electronic Transactions

Online transaction payment mechanism: Application of e-Commerce can connect the suppliers and customers, and the payment process can be completed electronically. This not only reduces the error rates caused by manual operation, but also increases the speed, and decreases the cost of transactions.

Larger bargaining power: e-Commerce provides an open environment and the delivery of information or products becomes fast and direct. The company can source information and substitute globally via Internet, thus more scope of price bargaining has been gained by SMEs.

Overall Developments: Pros & Cons

Change of SME's structure

New Business Models: The emerging of e-Commerce ushers in the biggest opportunity of new business models. Companies can explore the new market and the electronic channel at low cost and create new e-Commerce market to make more profits.

Customer Orientation: e-Commerce can shorten the distance between companies and customers, and make their relationship closer and interaction better. Companies can better understand the customers' preference and needs, and become more customer-oriented.

Change of Interactive Relations between SMEs & large companies

Efficiency Differentiation: The company that has introduced e-Commerce will have more corporate operational efficiency, which is a key factor in the company's core competence.

Core Competence: When a company tries to transform itself with Internet, the company size doesn't count as a factor for success. The focus is on core business. The rest could be accomplished by taking advantage of outsourcing. By outsourcing SMEs can get over the disadvantages of limited resources, and beat large companies.

Cross-nation cooperation opportunities for SMEs

Decreasing barriers/internationalization: e-Commerce has destroyed the geographic barriers of business management. Cross-region, international, anytime and anywhere transactions should be carried out completely utilizing the advantages of the Internet. Thus, regional cooperation between SMEs makes perfect sense.

Complete competition market: As e-Commerce emerges, companies can source quickly and globally for information and look for substitutes by alternative manufacturers. Therefore, the perfect competition market is formed, which forces traditional companies to modify the cost structure and increase price competitiveness.

e-Commerce Solutions for SMEs

Table 4 (a-d) and Table 5 (a-d) present the e-Commerce solutions available for SMEs.

It is for SMEs to leverage these solutions and achieve success in their business endeavours.

Table 4: Internal Management of Enterprise

Table 4a: Business Model

Strategies	Solutions	Description
Collective Cooperation Coordinative Cooperation	e-market place	The capital, skills, and available resources of SMEs are obviously much less than large enterprises. However, the impact of e-Commerce on SMEs is huge. If SMEs do not enter the area of e-business, they will be out of the market. Therefore, SMEs should engage in collective cooperation, coordinative cooperation or setup strategic alliance with other enterprises for raising funds, developing common e-Commerce application platform to enhance the competitiveness of each other.
Strategic Alliance		Under the collective cooperation strategy of SMEs buyers could find products and compare the prices directly on the e-marketplace. Not only do the buyers get the benefit, but the sellers also could get the benefit of collective action.
Outsourcing	ASP	Since SMEs are restricted due to limitations of capital and talents, they can't construct the whole information system by themselves. Therefore, SMEs should construct their IT application system by outsourcing. To be an Internet business, SMEs should choose other subcontractors and form the best coordinative cooperation model and focus resources on the core business. ASP service provides software applications for enterprises through Internet. Basically, it is the concept of outsourcing service and it builds, manages and maintains applications for enterprises. Enterprises' data is stored at the data center of ASP company which charges a regular service fee. Therefore, SMEs just need to afford the low cost of hardware and other costs such as consultant, software, maintenance and administration; and the storage could be transferred to ASP company. SME can resolve the cost and technical problems of large IT application systems by ASP services.

Table 4b: Administration Model

Strategies	Solution	Description
Core Mechanism	e-collaboration	In the past, the value-chain comprised many functions and departments such as production, delivery, marketing and services, personnel and purchasing. However, Internet can build up real-time and seamless connection inside the enterprise, cut off the department of bad performance and transfer the business to other subcontractors and just keep the core mechanism. Therefore, SMEs can just focus on enhancing the core competence of their business. e-collaboration is based on close partnership between enterprises. IT enhances the interactive efficiency and cooperative relationship. Through this mechanism, the enterprise is able to cooperate closely with the upstream and downstream partners and decrease the operation risk.
Goals of e-business	IT creation, virtual products, KM, CRM	SMEs should enhance IT knowledge and IT application capability of their staff and administrators. Besides, SMEs should employ electronics in daily operations. Based on e-business strategy, SMEs should not only add IT applications but also do IT innovation. SMEs should create virtual products, KM and CRM by Internet technologies to reform the whole industry's value.
Marketing Oriented	Electronic marketing (e-catalog, e-store, e-marketing, e-selling, e-service)	SMEs are weaker than large enterprises in collecting marketing information. Therefore, the first priority for SMEs is to construct e-Commerce applications for marketing own key businesses.
Customer Oriented	CRM, Customization	Customer-oriented strategy is the only way to expand market share. Besides, maintaining long-term relationship with customers is also very important.

Table 4c: Operation Model

Strategies	Solutions	Description
Standardization	e-form, EDI, XML	SMEs are restricted by limitations of capital and manpower. If SMEs use standardization policy to develop their e-Commerce application, they could save the testing effort and reduce the switching cost. Standardization strategy is suitable for SMEs for developing e-Commerce application. SME could use standard formats such as e-form, EDI and XML. Since they are the common standard, it can greatly increase the efficiencies of data transmission and transaction.
Simplicity	Web-based GUI	The application package for SMEs should be simple and have easy-to-use operation interface. Since web-based system owns cross-platform, multimedia, interactive and easy-to-operate characteristics, it is suitable for SMEs.
Synergy	e-marketplace, Portal Site	Since the SME is often restricted to the small-scale market, the marginal utility of many investments can not meet the requirement. If SMEs use the collective co-operation strategy and complement each other's need it will produce effect of the synergy.
Specific scope e-Commerce application		Since the scope of e-Commerce application is very wide, it is impossible for SMEs to handle employee resistance, low capital, etc. and many SMEs give up. Therefore, it is the first priority to choose short term, specific scope and effective e-Commerce applications to promote. The results will be positive and inspire the staff.

Table 4d: Organisation Structure

Strategies	Solutions	Description
Decrease Hierarchical Levels of Organisation	BPR ERP	Decrease the hierarchical levels of the pyramid structure in organisation to pass information quickly and accelerate the response speed to market changes. Empower employees with more decision-making responsibility and enhance the employees' knowledge and techniques. Employ advanced information technology to handle structure integration and analysis work done by the middle management. This will reduce personnel expenditure and promote efficiency of organisation. High-level management could monitor more employees through the information system, which replaces the role of middle management. ERP cannot only implement BPR but also reorganize the enterprise's resources and make the organisation use resources more efficiently.
Mobile Office	Video Conference	Team members of the organisation could spread everywhere. Members could use communication network, groupware, video-conference and email to conduct internal communication resulting in coordination and cooperation. Employees need not necessarily work at office. They could work from anywhere in the world through Internet. The working time is more flexible.
Cooperative Working Team	e-mail, Web-based GDSS, Web-based Groupware	The organisation should replace the hierarchical departments with cooperative working teams. The organisation should replace the commanding system of organisation with the coordination mechanism of team working. The emphasis of team working lies in coherence, leadership and mutual trust.

Table 5: External Management of Enterprise**Table 5a: Sales & Marketing**

Strategy	Solution	Description
Electronic marketing mechanism	Electronic marketing: (e-catalog, e-store, e-marketing, e-selling, e-service)	SMEs could use the whole package of electronic marketing comprising e-catalog, e-store, e-marketing, e-selling and e-service. They can greatly reduce costs of promotion and selling activities, and create the enterprise's image.

Table 5b: Customer Service

Strategy	Solution	Description
Automatic customer service mechanism	CRM	SMEs can use CRM to enhance the relationship with customers, to attract new customers and raise each customer's contribution. The enterprises can use information technology to integrate and store the related information of customers. By analyzing customer information, the enterprise can understand customer needs, work out the right strategies and provide fast, personalized customer services and reduce the cost of customer service.

Table 5c: Supply Chain Integration

Strategy	Solution	Description
Development of Extranet	e-collaboration	e-collaboration is based on close partnership, and IT is to enhance the interactive efficiency and cooperative relationship. Through this mechanism, enterprise has to cooperate closely with the upstream and the downstream partners and decrease the operation risk.

Table 5d: Electronic Transaction

Strategy	Solution	Description
Transaction Set	e-market place	SMEs could use the e-market-place programme and easily find required products and directly compare prices.
Transaction Standard	e-form EDI	SMEs could use data-formats such as e-form and EDI. Since these are the common standards SMEs can raise efficiencies of transaction and data transmission and build up their competitive advantage.

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Quantification of Total Productive Maintenance (TPM) Benefits Through AHP Model

Rambabu Kodali

TPM has attracted the attention of industries all over the world as it can bring in commendable reforms and improvement in terms of competitive advantage, group culture and high motivation. The quantification of TPM benefits is useful for implementation of TPM. This article presents a multi-attribute decision model using analytic hierarchy process for quantification of TPM benefits.

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Ever since the days of Henry Ford, managements of manufacturing companies have recognized the need to keep plugging away at finding better ways to do things. There is nothing new about striving to improve product design in order to attract more sales, or working out more effective ways of using manufacturing resources in order to reduce costs, or providing better service to customers so that they are encouraged to give you more business.

Before the Japanese miracle started, manufacturing companies in USA and Europe led the world in industrial efficiency, with a steady improvement in productivity being achieved over the years. Pre-1950s, the Japanese productivity levels lagged behind, and their products generally had a poor reputation for quality. That started to change in 1950s when a number of Japanese companies, led by Toyota, set out to bring their performance up to the standards set by the western world. Partly by visiting successful manufacturers in the West, and partly by following the teachings of production experts such as Shigeo Shingo in Japan and quality 'gurus' Juran and Deming from the USA, Toyota developed new ways of improving manufacturing performance that enabled them to make a step change in both quality and productivity. This step change enabled them to overtake their competitors in the West and Toyota became widely recognized as the most efficient volume car manufacturer in the world. The changes initiated by the Toyota then spread to other Japanese manufacturers, particularly in automobile and consumer electronics field. In the recent years, these changes have also been ushered in other centers of manufacturing in the Far East countries such as Korea and Singapore as well as in Europe and USA. In 1960s and 1970s, Japan's labour productivity increased at a rate three to four times faster than that of the USA. By the 1980s, the competitive failure rates of products in semiconductors, cars, air-

conditioners, and televisions showed that Japan's product reliability greatly outperformed the United States. Japanese firms are aggressive in their pursuit of targeted markets. Their secret weapon turned out to be sheer manufacturing virtuosity. Most were producing products similar to those offered by Western countries and marketing them in similar ways. The success of these products was not merely because of their low costs, but also because of the lower incidence of defects, their reliability and their durability. The success of any enterprise lies in customer satisfaction. This success unveils the best industry practices, which are all covered by TPM technique developed by the Japanese manufacturers.

TPM

TPM focuses on using basic resources of men, machinery and materials to achieve and maintain zero defects, zero breakdowns and zero accidents. It also focuses on achieving marked improvement in the productivity, services and facilities, along with drastic reduction in costs. TPM concept originated in Japan and it has been successfully implemented in USA, Europe and South Asia [Pondue, 1994]. In 1971, the Japanese Institute of Plant Maintenance (JIPM) defined TPM as a system of maintenance covering the entire life of the division including planning, manufacturing and maintenance. Some of the direct and indirect factors responsible for loss of market are: equipment under-utilization, downtime losses, high costs involved in frequent breakdowns and repairs, high accident rates, poor delivery scheduling, unhygienic environment, lack of proper technical education and training for continuous improvements, low worker morale. All such factors arise due to improper maintenance, haphazard tool management, dirty machines, lack of standardization, high rejection rates, unsafe practices, lack of motivation. Strict implementation of TPM works towards nullifying these undesired factors. Efficient maintenance guarantees value addition to the organisation. This is not one man's job, but a collective effort of production, design engineering, maintenance and other team members, who work together to achieve true excellence. TPM is not only a strategy, but also a school of thought and practice that believes in continuous improvement, team work and creating a sense of ownership in the operation of each machine. TPM is not just another task to perform, but is a shift in the work culture of the organisation, that aims for higher productivity, zero defects, zero losses and worker safety. The earlier maintenance techniques such as reactive maintenance, preventive maintenance, predictive maintenance, and reliability-based maintenance are not totally effective in improving the effectiveness of machine

and manufacturing systems. The "Total" aspect of TPM indicates inclusion of these aforesaid techniques along with its own benefits.

TPM focuses on using basic resources of men, machinery and materials to achieve and maintain zero defects, zero breakdowns and zero accidents.

TPM Benefits

TPM benefits are as follows:

Productivity: Theoretically, the ratio between output and input is known as the productivity of the concerned factor. The input consists of various factors such as men, machine, material and energy, etc. Productivity of machines is quantified in terms of output per machine hour. In case of materials, productivity is estimated in terms of output per unit measure of a particular material. Worker productivity is expressed as output per man-hour, while energy productivity is output per kilowatt or megawatt of power. TPM aims for zero defects and zero losses, which means that the output of every activity would increase, thus contributing to higher productivity. But the productivity sought is beyond this definition. Productivity implies development of an attitude of mind and a constant urge to find better, cheaper, easier and safer means of doing a job, manufacturing a product and providing a service. The practice of regular up-keep and good equipment care result in higher productivity.

Quality: Any product or service is successful only when it outshines its competitors. And here comes the quality factor into the picture. Quality implies zero defects in the product/services of the organisation. This is one of the major aspects TPM aims for. The (TQM) concept has been developed by Edwards Deming and uses the statistical analysis procedure for achieving higher quality control. TPM, which was evolved from TQM thus has a strong base of commitment to good and usable products/services to gain customer approval. Quality comes for free. All it needs is trained workers and foolproof production plan that would ideally require zero rework. But on the other hand, Quality is not achieved by accidents. It is always a result of high intention, sincere efforts, intelligent directions, skillful execution and a wise choice of many alternatives. Quality improvement should never stop. A quest for better output than the present status should be always be on top priority.

Cost: Costs incurred in a production unit are direct

and indirect costs. Direct costs include the amount incurred on material, labor, energy, etc., while indirect costs are those incurred due to frequent breakdowns, rework, low productivity ratio, idle workforce, improper supervision, non-availability of tools or material, overstocking, etc., to name a few. A cost reduction programme means maximization of profits by reducing costs through economics and savings in the cost of manufacture, administration, selling, distribution and use. Cost reduction is neither technical nor commercial, but is a way of discipline that starts with the 'basic premise that 'there is always a better way of doing things'. TPM goals are zero defects, zero failures. Worker involvement in all activities is ultimately aimed for reduction in overall costs.

High Morale: A sense of ownership gives a sense of responsibility. TPM encourages awarding this autonomy to the workers. Through small group activities, the workers are encouraged to take their own decisions and tackle their own problems. Workers, who are an integral part of development programmes, are free to submit their improvement ideas to the management. This factor of involvement of the lowest level of the organisation in the decision making process gives them a sense of accomplishment, enhances morale, motivation and finds expression in longer and more frequent meetings as well as a greater number of improvement suggestions from workers [Nakajima, 1998]. In order to produce extraordinary results, the organisation has to depend a greater deal on the group culture.

A sense of ownership gives a sense of responsibility. TPM encourages awarding this autonomy to the workers.

Work environment: Quality of work life programmes yield benefits such as improved inter/intra communication, better employer-employee relationship, better career development, reduced stress, high confidence and self management [Gondgalekar, 1996]. TPM goals cover zero accidents, zero pollution and a clean and hygienic work place, thus providing a safe environment to work in.

Competitive advantages: The higher productivity ratios and reduced losses that are direct effects of TPM, definitely result in the organisation having an edge in the market. TPM implementation will not only result in faster delivery and zero defects in products/service, but will also ensure a faster response to customer demands. This can be achieved by diverting all the time saved in breakdowns and delays in supply, towards productive time for meeting customer demands.

Delivery performance: Delivery performance is the ability of the supplier to provide the required type and number of items according to schedule [Korgaonkar, 1992].

Safety: A work environment conducive for better productivity outputs should also have adequate safety and hygiene considerations. Proper identification, assessment and control of environmental factors that are harmful to the health of employees as well as the settlements near the industry, is a must.

Development of Analytical Hierarchy Process (AHP) Model

The AHP has been well received by all concerned as reported in literature [Roger 1987]. Application of this methodology has been found in numerous fields. The general approach of the AHP model is to decompose the problem and make pair-wise comparison of all the elements on a given level with the related elements in the level just above to assist the user in evaluating his/her choices. The schematic of the AHP model is shown in Fig. 1.

Description of the Model

A thorough analysis of the problem is required along with the identification of the important attributes involved. Selection of attributes is determined through literature survey and discussions held with experts during industrial visits. The attributes and sub-attributes used in the AHP model for quantification of TPM benefits are:

Preparation	[PRP]
<ul style="list-style-type: none"> • Declaration by top management to implement TPM [DTM] • Introductory education and campaign of TPM [IEC] • Establishing TPM promotion organisation and pilot organisation Model [EPP] • Setting basic principles and target for TMP [SPT] • Creation of master plan for establishing of TPM [CMP] 	
TPM kick-off (commencement of TPM implementation)	[TKO]
<ul style="list-style-type: none"> • Plan to launch an event to challenge the complete elimination of 16 major losses [PCE] • Presentations to be made at the event [PME] 	

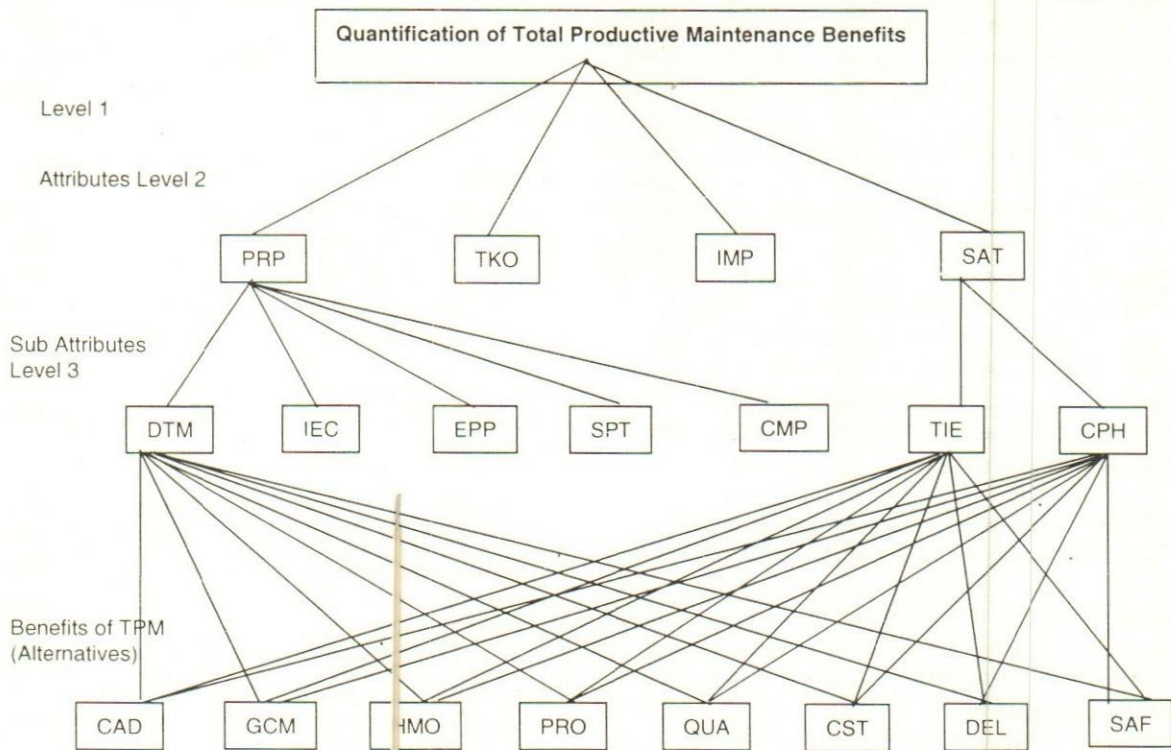


Fig. 1. Schematic of the AHP Model

Implementation

- Establishing systems for improving production efficiency
 - Education and training for operation and maintenance skill upgrade
 - Kobetsu-Kaizen
 - Jishu-Hozen
 - Planned maintenance
- Initial control system for new products and equipment
- Establishing the "Hinshitsu-Hozen" system
- Establishing the office TPM
- Establishing safety, hygiene and working environment protection Systems

Steady application of TPM

- Tangible and intangible effects
- Current problem and future handling

Alternatives

The following alternatives (benefits) are assessed and evaluated by using the AHP model

- Competitive advantages [CAD]

- [IMP]
- [ESI]
- [ETM]
- [KOK]
- [JIH]
- [PMN]
- [ICS]
- [EHH]
- [EOT]
- [SHW]
- [SAT]
- [TIE]
- [CPH]

- Group culture and high motivation [GCM]
- High morale [HMO]
- Productivity [PRO]
- Quality [QUA]
- Cost [CST]
- Delivery [DEL]
- Safety [SAF]

Analytical Hierarchy Process (AHP) Methodology

AHP [Satty, 1982] was developed in 1972 as a practical approach in solving relatively complex problems. AHP enables decision-makers to represent the simultaneous interaction of many factors in complex unstructured situations. For the quantification of TPM benefits, the judgments based on observation are fed into AHP for each criterion and sub-criterion of all levels of hierarchy. Pair-wise comparisons of criterion at each level are done on a scale of relative importance, 1 reflecting equal weightage and 9 reflecting absolute importance (see Table 1 for detailed information).

Steps of the Process

The following are the steps to follow in using the AHP [Roger, 1987]:

Table 1: Scale of Relative Importance

Intensity	Definition	Explanation
1	Equal Importance	Two activities contribute equally to the objective
3	Weak importance of one over another	Experience and judgment slightly favour one over another
5	Essential or strong	Experience and judgment strongly favour one over another
7	Very strong importance	An activity is strongly favoured and its dominance is demonstrated in practice
9	Absolute importance	The evidence favoring one activity over another is of the highest degree
2 4 6 8	Intermediate values	When compromise is needed

1. Define the problem and determine the objective.
2. Structure the hierarchy from the top through the intermediate levels to the lowest level. (See Fig. 1)
3. Construct a set of pair-wise comparison matrices for each of the lower levels. An element in the higher level is said to be a governing element for those in the lower level, since it contributes to it or affects it. The elements in the lower level are then compared to each other based on their effect on the governing element above. This yields a square matrix of judgments. The pair-wise comparisons are done in terms of which element dominates another. These judgments are then expressed as integers. If element A dominates over element B, then the whole number integer is entered in row A, column B and reciprocal is entered in row B, column A. If the elements being compared are equal, '1' is assigned to both positions. Table 2 shows the pair-wise comparison matrix for level 2 criteria.

Table 2: Criteria pair-wise comparison matrix (Level 2)

	<PRP>	<TKO>	<IMP>	<SAT>
<PRP>	1	5	1/2	3
<TKO>	1/5	1	1/7	1/2
<IMP>	2	7	1	7
<SAT>	1/3	2	1/7	1
<SUM	3.533	15.000	1.786	11.500

4. There are $n(n-1)/2$ judgments required to develop the set of matrices in step 3 (reciprocals are automatically assigned in each pair-wise comparisons)

5. Having done all the pair-wise comparisons and entered the data, consistency is determined using the eigenvalue. To do so, normalize the column of numbers by dividing each entry by the sum of all entries. Then sum up each row of the normalized values and take the average. This provides Principal Vector [PV]. Table 3 illustrates the normalized comparison matrix.

Table 3: Criteria pair-wise comparison matrix (level 2) normalized

	<PRP>	<TKO>	<IMP>	<SAT>	<SUM>	<PV>
<PRP>	0.283	0.333	0.280	0.261	0.157	0.275
<TKO>	0.057	0.067	0.080	0.403	0.247	0.062
<IMP>	0.566	0.467	0.560	0.609	2.201	0.550
<SAT>	0.094	0.133	0.080	0.087	0.395	0.090
Consistency Index = 0.0140			Consistency Ratio = 0.0156			

The check of the consistency of judgments is as follows. Let the pair-wise comparison matrix be denoted by M1 and principal vector be denoted by M2.

Then define $M3 = M1 * M2$; and

$$M4 = M3/M2$$

λ_{max} = Average of the elements of M4

Consistency Index (CI) = $(\lambda_{max} - N) / (N - 1)$

Constancy Ratio (CR) = CI/RCI corresponding to N

Where RCI: Random Consistency Index and

N: Number elements

Random Index Table

N	1	2	3	4	5	6
RCI	0	0	0.58	0.9	1.12	1.24

If CR is less than 10 per cent, judgments are considered consistent, and if CR is greater than 10 per cent, the quality of judgments should be improved to have CR less than or equal to 10 per cent.

6. Steps 3-5 are performed to have relative importance of each attribute for all levels and clusters in the hierarchy. Table 4 illustrates the sub-criteria analysis of criteria "Preparations" [PRP]

Table 4: PRP sub-criteria analysis (level 3)

	<DTM>	<IEC>	<EPP>	<SPT>	<CMP>
<DTM>	1	1/2	3	2	1/3
<IEC>	2	1	5	3	1/2
<EPP>	1/3	1/5	1	1/2	1/5
<SPT>	1/2	1/3	2	1	1/7
<CMP>	3	2	5	7	1
<SUM>	6.833	4.033	16.000	13.500	2.176

7. The alternative analysis for the lowest level of sub-criteria is to be carried out in the similar manner as above. Table 5 illustrates the alternative analysis of "DTM". The remaining alternative analysis is to be carried out.

Table 5: Alternative analysis of DTM

	<CAD>	<GCM>	<HMO>	<PRO>	<QUA>	<CST>		<SAF>
<CAD>	1	2	1	1/2	1/3	3	3	2
<GCM>	1/2	1	1/3	1/5	1/5	2	2	1
<HMO>	1	3	1	1/3	3	5	5	3
<PRO>	2	5	3	1	1/2	5	5	3
<QUA>	3	5	1/3	2	1	7	7	3
<CST>	1/3	1/2	1/5	1/5	1/7	1	1	1/2
	1/3	1/2	1/5	1/5	1/7	1	1	1/2
<SAF>	1/2	1	1/3	1/3	1/3	2	2	1
<SUM>	8.667	18.000	6.400	4.767	5.652	26.000	26.000	14.000

8. The desirability for each alternative is calculated by multiplying each value in 'weight of sub-criteria' column by the respective value of 'criteria weight' column, then multiplying by the value for each respective alternative and summing the results.

For use in this problem, the focus is developed. In this case, it is quantification of TPM benefits. The attributes are compared with each other in a pair-wise

Table 7: Weightages of attributes for alternative

Suber	<L4-W>	<3-W ₁ >	<L2-W ₁ >	<CAD>	<CAM>	<HMO>	<PRO>	<QUA>	<CST>		<SAP>
DTM	1.000	0.261	0.289	0.175	0.103	0.407	0.058	0.034	0.101	0.061	0.061
IEC	1.000	0.261	0.289	0.175	0.103	0.407	0.058	0.034	0.101	0.061	0.061
EPP	1.000	0.058	0.289	0.042	0.233	0.130	0.118	0.228	0.105	0.025	0.118
SPT	1.000	0.084	0.289	0.110	0.061	0.026	0.191	0.212	0.060	0.302	0.039
CMP	1.000	0.445	0.289	0.150	0.033	0.056	0.079	0.376	0.078	0.150	0.078
PCE	1.000	0.833	0.062	0.043	0.019	0.130	0.130	0.080	0.265	0.130	0.204
PME	1.000	0.167	0.062	0.056	0.158	0.114	0.031	0.054	0.029	0.254	0.305
KOK	0.168	0.414	0.550	0.053	0.024	0.252	0.215	0.128	0.270	0.034	0.022
JIH	0.466	0.414	0.550	0.095	0.027	0.225	0.019	0.035	0.140	0.232	0.225
PMN	0.069	0.414	0.550	0.053	0.196	0.326	0.132	0.127	0.034	0.059	0.063
ETM	0.297	0.414	0.550	0.175	0.103	0.407	0.058	0.034	0.101	0.061	0.061
ICS	1.000	0.074	0.550	0.053	0.196	0.326	0.132	0.127	0.034	0.059	0.063
EHH	1.000	0.135	0.550	0.039	0.031	0.037	0.185	0.317	0.037	0.123	0.201
EOT	1.000	0.241	0.550	0.134	0.048	0.032	0.074	0.077	0.134	0.048	0.452
SHW	1.000	0.135	0.550	0.039	0.033	0.414	0.056	0.253	0.057	0.056	0.033
TIE	1.000	0.667	0.099	0.056	0.025	0.195	0.293	0.293	0.025	0.037	0.066
CPH	1.000	0.333	0.099	0.052	0.024	0.126	0.212	0.315	0.205	0.034	0.031

comparison with respect to case situation discussed in Table 6. From the analysis, the TPM benefits are quantified under the circumstances of the developed case situation (Tables 7, 8, 9). The reliability of the judgments supplied by the user can be estimated from the graphs (Fig. 2-9).

Table 6: Case situation

Industry type	Product focus
Production volume	High
Company vision	Star performer and market leader
Mission	Continuous improvement of Products, processes and people

A highly user-friendly software, the multi-attribute decision model (AHP) has been developed in C++ language to aid the user in pair-wise comparison of the attributes as well as for the alternatives and for analyzing the user inputs. The reliability of the judgments supplied by the user can be estimated from the graphs (Fig. 2-9) that are generated for each alternative and its corresponding deciding criteria.

Usefulness of Model

The model developed is able to quantify the TPM benefits. The inputs to the model help to clarify the goals of the organisation, as it requires insights for con-

Table 8: Data summary

Suber	<CAD>	<GCM>	<HMO>	<PRO>	<QUA>	<CST>		<SAF>
DTM	0.005	0.003	0.009	0.010	0.011	0.002	0.002	0.003
IEC	0.013	0.008	0.031	0.004	0.003	0.008	0.005	0.005
EPP	0.001	0.004	0.002	0.002	0.004	0.002	0.000	0.002
SPT	0.003	0.001	0.001	0.005	0.005	0.001	0.007	0.001
CMP	0.019	0.004	0.007	0.010	0.048	0.010	0.019	0.010
PCE	0.002	0.001	0.007	0.007	0.004	0.014	0.007	0.010
PME	0.001	0.002	0.001	0.000	0.001	0.000	0.003	0.003
KOK	0.002	0.001	0.010	0.008	0.005	0.010	0.001	0.001
JIH	0.010	0.003	0.024	0.002	0.004	0.015	0.025	0.024
PMN	0.001	0.003	0.005	0.002	0.002	0.001	0.001	0.001
ETM	0.012	0.007	0.028	0.004	0.002	0.007	0.004	0.004
ICS	0.003	0.008	0.013	0.005	0.005	0.001	0.002	0.003
EHH	0.005	0.002	0.003	0.014	0.024	0.003	0.009	0.015
EOT	0.018	0.006	0.004	0.010	0.010	0.018	0.006	0.060
SHW	0.007	0.002	0.031	0.004	0.019	0.004	0.004	0.002
TIE	0.004	0.002	0.013	0.019	0.019	0.002	0.002	0.004
CPH	0.002	0.001	0.004	0.007	0.010	0.007	0.001	0.001

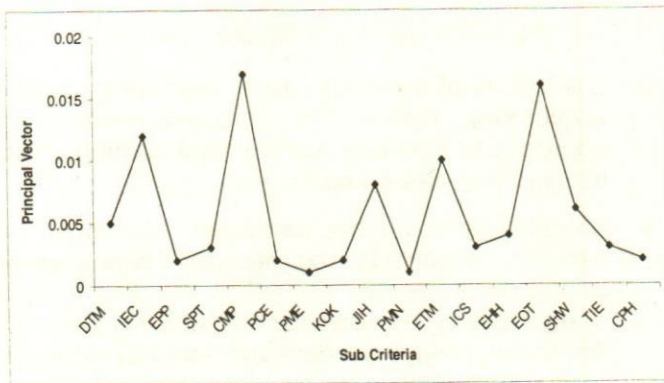


Fig. 2. Data Summary Graph Alternative: CAD

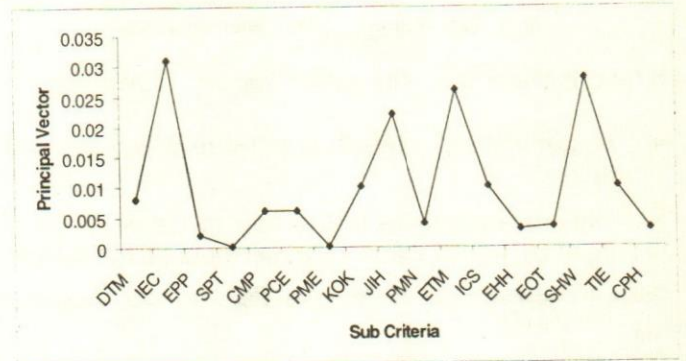


Fig. 4. Data Summary Graph Alternative: HMO

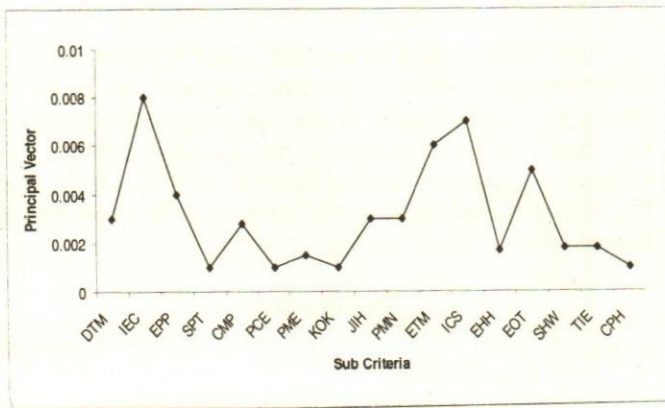


Fig. 3. Data Summary Graph Alternative: GCM

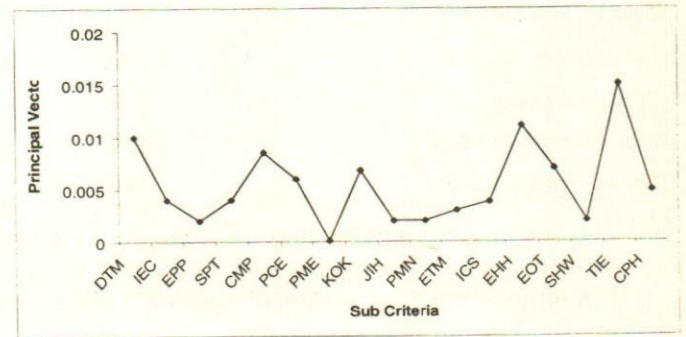


Fig. 5. Data Summary Graph Alternative: PRO

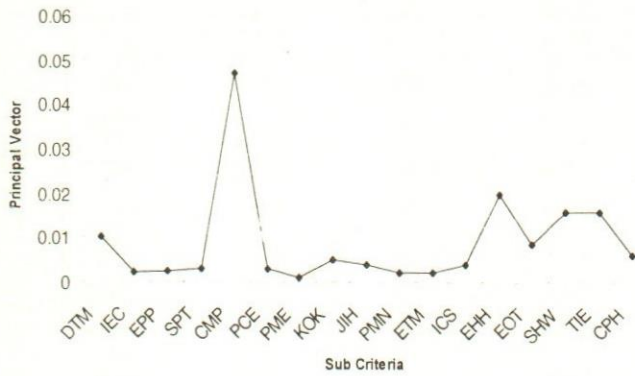


Fig. 6. Data Summary Graph Alternative: QUA

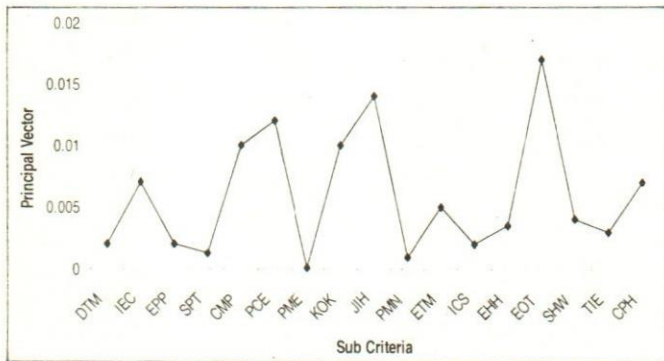


Fig. 7. Data Summary Graph Alternative: CST

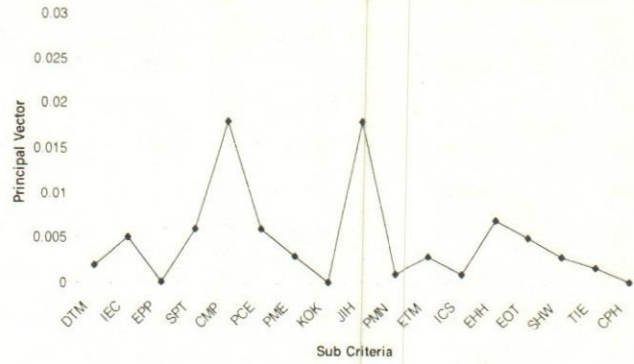


Fig. 8. Data Summary Graph Alternative: DEL

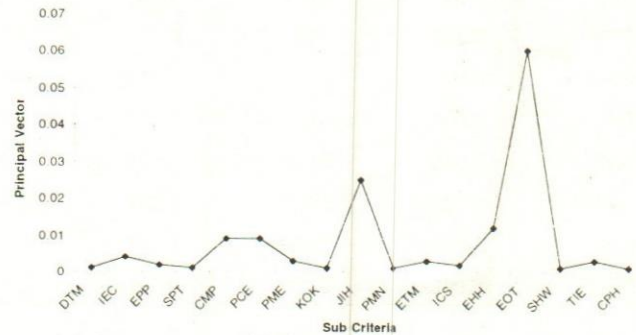


Fig. 9. Data Summary Graph Alternative: SAF

structive discussion. The salient features of AHP are:

- A user-friendly, interactive software which is menu driven.
- Options are offered to the user to define mode of input i.e. from a file, or by direct input on the screen.

Table 9: Decision index for the desirability of each alternative (benefit)

Decision Index of CAD	0.1077
Decision Index of GCM	0.0582
Decision Index of HMO	0.1919
Decision Index of PRO	0.1142
Decision Index of QUA	0.1761
Decision Index of CST	0.1036
Decision Index of DEL	0.0990
Decision Index of SAF	0.1493

- The screen input and editing are done on a clearly defined matrix. The editing can be carried out on the screen itself, thus on-line changes are possible.
- To see the results of the calculations and editing, there are two options. i.e., (a) on the screen, and (b) on an output file, so as to get hard copy.

- The validity of the input data is checked through a consistency criterion. The consistency ratio is an approximate mathematical indicator of the consistency of pair-wise comparisons.
- Graphic display of the calculated weightages for each of the attribute and alternative allows visual estimation of the data entered by the user. In case of discrepancy, the user can immediately enter the edit mode, change the data and return to see result of the changes.

Conclusions

From the result it is evident that TPM can bring in commendable reforms and improvement, in terms of competitive advantages, group culture and high motivation, high morale, productivity, quality, cost, delivery and safety. The quantification of benefits can be very useful for strategic and operational decisions for implementation of TPM.

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What is productivity but making the most of one's time and talent, and energising the whole surrounding environment so that men and women are inspired and motivated: that is make the most of themselves, both as individuals and as members of society on all planes of living, thinking and acting: whether it is politics or economics or home, village or factory, life at the ground level or life of the spirit.

— Mahatma Gandhi

Manufacturing Organisations: Concept & Trends from German & Indian Firms

R.R.K. Sharma, Shobhit Shrotriya, G. Seliger, Marion Eggenstein & Shivanshu Upadyaya

Manufacturing managers are concerned about objectives of their firms, "contents" of their manufacturing strategies and the strategy making processes used in companies. A study was attempted with data from 20 Indian manufacturing companies and 14 German manufacturing firms. It was found that the dominant manufacturing strategy making processes used by the firms were unrelated to the objectives pursued by them. This is contrary to the suggestions by Sharma and Upadyaya (1998). The sample also reveals that much fewer Indian manufacturing firms used "interaction" process of manufacturing strategy making; whereas German manufacturing firms used all the three manufacturing strategy making processes.

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Manufacturing function is technical in nature, and hence researchers have identified the "contents" which top management could consider while making strategic decisions. Significant work has been done to guide the top management in choosing an appropriate set of priorities while planning the manufacturing function.

Contents of Manufacturing Strategy

Earlier, the top management of corporations ignored the manufacturing function and delegated its responsibility to the manufacturing vice presidents who had dominant technical competence and little or no general management abilities. They tended to emphasize a single criterion for which they geared their manufacturing facilities and failed to correctly prioritize the different criteria in the light of market conditions.

Skinner (1969) was the first to point out such a state of affairs in the United States and stressed the need for developing a framework shorn of technical nut and bolts that would help the top management of manufacturing organisations in appropriately designing the manufacturing strategies. Later work by Skinner (1978), led to the identification of the following performance criteria for the manufacturing facilities: manufacturing cost per unit of output, delivery time, quality and investment in manufacturing facilities.

It was argued that to be successful, a specific market segment would require a specific ordering of the priorities around which the respective manufacturing facilities would be built. Logical extension of this led Skinner (1978) to come up with plant within a plant concept (PWP for short), which essentially sought to seg-

ment the production facilities to cater to each of the market segment, so that each segment has its own set of priorities to give superior performance for a specified market segment. Each segment of productive facilities is then able to develop a unique culture that is suitable to give high performance while serving a specific market segment. It was realized that it was not possible for a particular manufacturing facility to be able to meet different performance standards. Skinner (1969) had earlier given a very useful efficiency/effectiveness interpretation of this phenomenon.

Literature on manufacturing strategy has identified different objectives of manufacturing division. If one combines the competitive priorities of Skinner (1969, 1978, 1985), Wheelwright (1978, 1981, 1984), Buffa (1984), Hayes and Wheelwright (1984), Fine and Hax (1985) and Hayes et al, 1988, one obtains the following six dimensions. In different sectors of economy, manufacturing plants will have different importance attached to each of these dimensions: Manufacturing cost; Delivery Performance, dependability and speed; Quality; Flexibility-product mix and volume; Innovativeness and Investment in productive facilities.

Other notable contributions to the manufacturing strategy literature are the plant and equipment strategy and personnel strategies. Skinner (1974) has suggested five decision areas where management makes trade-off decisions: Plant and Equipment; Production, Planning and Control; Labor and Staffing; Product engineering and design; and Organisation and Management. Fine and Hax (1985), Hayes et al, (1988), Hayes and Wheelwright (1984) and Buffa (1984) have added other decision areas such as Structural (capital spending) and infra-structural (manufacturing system and people) decisions; Vertical integration (direction, extent, balance, number); Technology; Capacity (amount, utilization, timing); Ability to introduce new products, Trying to evolve a fit between product process and life cycles; Information Technology (maintenance, material flows, production planning, cost tracking); Customer (access, relationship, support); Quality Management (definition, role, responsibility, yields); New Products (integration, start-up, modification); Process technologies (scale, flexibility, interconnectedness).

Strategy types chosen by the firm

The work of Miles, Snow, Meyer and Coleman (1978) develops a framework that relates objectives to the decisions for a manufacturing organisation. They have identified alternative ways in which organisations can define their strategies and mechanisms of structure and processes to pursue these strategies. Briefly, Miles

and Snow et. al, (1978) have identified four broad strategy types pursued by organisations and these are: Defenders, Prospectors, Analyzers, Reactors.

Four broad strategy types pursued by organisations are: Defenders, Prospectors, Analyzers, Reactors.

'Defenders' have narrow and stable product domains and cost-efficient single core technology. They have low product variety, have centralized control and tendency towards high vertical integration. 'Prospectors' seek to maintain their reputation as an innovator in product and market development. They focus on multiple technologies and have low division of labor, low formalization, complex co-ordination mechanism, decentralized control and high product variety. 'Analyzer' in an organisation is one that attempts to minimize risk while maximizing profit—i.e., an Analyzer combines the strength of both the Prospectors and Defenders. It has some version of matrix organisation structure supported by intensive co-operation between functional divisions of marketing and production. It has extremely complex and expensive coordination mechanisms and tries to achieve balance between stable and dynamic area of operation. 'Reactors' exhibit a pattern of adjustment to environment that is both inconsistent and unstable; this type lacks a set of response mechanisms which can be consistently put into effect when faced with a changing environment. As a consequence, Reactors exist in a state of almost perpetual instability. Reactors pursue a "residual" strategy, arising when one of the other three strategies is improperly pursued.

Categorization of corporate strategy making process

Miller (1987) has presented a summary of different corporate strategy making process used and documented by researchers. The literature has identified three multifaceted dimensions of strategy making process: rationality, interaction and assertiveness.

Rationality: The first dimension, rationality, suggests careful analysis of problems and opportunities, scanning of markets, methodical planning, stress on long term objectives, use of analytical tools in strategy formulation and articulating unified strategies (Ansoff 1965, Steiner 1969). It has been referred to as synoptic by Frederickson (1984); planning by Mintzberg (1973) or rational by Miller and Frieson (1984).

Interaction: The second dimension of the strategy formulation process is "interaction". The name is derived from the fact that men with limited cognitive abilities make decisions while interacting with each other through the process of argumentation. Men with limited cognitive abilities and organisation structure, when faced with complex problems, formulate strategies in disjointed, intuitive, implicit and spontaneous process. Such a non-rational approach is necessary due to wide range of complex problems faced by the organisations and the attendant cognitive limitations and the social and political contexts in which decisions have to be made.

Assertiveness: The third dimension of strategy making process is assertiveness that is concerned with the riskiness of strategy, reactive and pro-active nature of the decisions. Entrepreneurial firms act ahead of their environments by taking bold decisions (Miller & Frieson, 1984; Mintzberg, 1973); whereas more large and complex firms often act conservatively by reacting to the environmental changes.

Entrepreneurial firms act ahead of their environments by taking bold decisions whereas large firms often act conservatively reacting to the environmental changes.

Categorization of manufacturing strategy-making process

Strategy making process is applicable in general and hence it was proposed (Sharma 1997) that it will be applicable to the area of manufacturing as well. Manufacturing strategy process can also be categorized into three dimensions, i.e. rational, interactive and assertiveness.

Rational: A firm pursuing a 'rational' approach to strategy making would use analytical tools such as linear programming and simulation for major manufacturing decisions, use periodic brain storming, have formalized systematic search procedures for opportunities and use specialists for preparing reports and have a futuristic orientation. Such an approach to strategy making would lead to an integrated strategy where the firm would benefit from synergy between various decisions. Carefully planned vertical integration and attention to technology would be the corner stone of an integrated strategy.

Interactive: A firm may choose an "interactive" ap-

proach to corporate strategy making either because it faces an uncertain environment or because it faces resource constraints, or because it faces complex internal environment.

Assertiveness: An assertive manufacturing strategy would mean taking bold steps with respect to manufacturing resources with investments in manufacturing facilities ahead of competitors.

Conceptual Framework

Relating organisation structure and strategy making process chosen by firms: Organisation structure and strategy making processes are highly interdependent, (see Miller, 1987). Aspects of organisation structure are integration, formalization, specialization, standardization, centralization and complexity of workflow.

Integrative liaison devices like task forces and committees can encourage rationality in decision-making. They precipitate contact among decision-makers that may motivate systematic attempts to develop, scrutinize and reconcile divergent perspectives. Integrative devices can also induce interaction. Committees increase face-to-face contacts among managers. They promote consultation, useful exchange of information and worthwhile debate. Integrative devices also increase assertiveness, uniting the perspectives of decision-makers and emboldening them to make decisive and proactive decisions. Formalization leads to the use of formal procedures and job descriptions, cost and quality controls, specialists and professional technocrats increase analytical capabilities and expertise needed for systematic and overtly rational modes of decision making. Specialization and technocratization involve many managers in any given issue and thus can induce highly interactive decision-making. Formalization of policies and procedures however reduce assertiveness. People may ignore decision-making stimuli that no formal system monitors so their firms respond only to obvious and pressing problems.

Table 1: Relating Manufacturing strategy Making Process to Organisation Structure

Organisation Structure Dimensions	Manufacturing Strategy Making Process		
	Rational	Interaction	Assertiveness
● Formalization	+	+	-
● Centralization	-	-	+
● Complexity of Workflow	+		-

Centralization discourages rationality by placing

Table 2: Framework that relates objectives and decisions of manufacturing organisations (except organisation structures)

S.No	Objectives	Plant & Equipment	PPC	Labour Skill	Vertical Integration	Vendor Relationship
S1	Product Variety-low Del. Perf. –low Vol. Flex. –low	Special purpose eqpt. Large capacity to have economics of scale.	Scheduling is not difficult. Focus on minimizing labor cost and wastage. PPC group does not have important role to play	Low skill Levels; able to handle jobs of same kind only.	High	Since vertical integration high, there is low dependence on vendors. But for the objectives of quality and delivery, co-operative relationship with vendors
S2	Product Variety-low Del. Perf. –low Vol. Flex. –High	Special purpose eqpt; Flow Lines; Excess buffer capacity.	PPC does not have important role to play.	Low skill Levels	High	Due to increased volume fluctuations, dependence on vendors increases. Rest is same as S1.
S3	Product Variety-low Del. Perf. –low Vol. Flex. –low	General purpose machines.	With multiple products and GPM's, reducing set up time is important and scheduling is an important activity. PPC group has an important role to play.	Low division of labor, required to handle variety of jobs, hence are multi-skilled.	With multiple products, in house development of large number of parts not possible and Vertical integration is low.	Since speedy deliveries are not important, firms can have multiple vendors for a single part and have competitive relationship with vendors.
S4	Product Variety-low Del. Perf. –low Vol. Flex. –High	GPMs; Little inventories; organize their machines flow lines	Scheduling is important. PPC has important role to play.	High Product Variety, Labor is multiskilled.	Low vertical integration.	Same as S3.
S5	Product Variety-low Del. Perf. –low Vol. Flex. –low	SMPs used. Firm would produce to stock and large buffers will be maintained.	Low importance	Skill level will be low	High vertical integration.	Same as S1.
S6	Product Variety-low Del. Perf. –low Vol. Flex. –High	SPMs used. Higher Investment in capacity as vol. flexibility is high. Large buffer inventory to meet high delivery performance.	Low importance	Skill level will be low	High vertical integration	Same as S1
S7	Product Variety-low Del. Perf. –low Vol. Flex. –low	GPMs. Large inventories in general FMS is encouraged	High importance	Workers capable of handling many products.	High product variety forces low Vertical integration, High delivery per. forces use of JIT kind of purchasing strategy.	Same as S3
S8	Product Variety-low Del. Perf. –low Vol. Flex. –High	GPMs is general but FMS is ideally suited.	Important	Multiskilled labour	Low vertical integration.	Same as S3.

most of the onus of decision-making on top executives. It impedes analysis and planning. It also diminishes a felt need for interaction by inducing conformity in methods and goals via power structures rather than through discussion. Centralization can free top managers to be assertive-venturesome and proactive

because they have more power to commit significant resource to a project. It is possible that assertiveness is less hazardous in the context of a decentralized structure, where decision-making is a participatory endeavor. Miller (1987) gave the above relationship and these are summarized in Table 1.

Relating manufacturing objectives and dimensions of organisation structure

Based on the studies of Miles and Snow et. al, (1978) and Miller (1987), we have formulated a conceptual framework that relates objectives, dimensions of organisation structure and manufacturing strategy-making

Table 3: Framework that relates objectives of manufacturing organisation to its organisation structure

S. No.	Objec- tives	Speciali- zation	Standardi- zation	Formali- zation	Centra- lization	Com- plexity of Work flow
S1	Product Variety-low Del. Perf. -low Vol. Flex. -low	High	High	High	High	Low
S2	Product Variety-low Del. Perf. -low Vol. Flex. -High	High	High	High	High	Low
S3	Product Variety-low Del. Perf. -low Vol. Flex. -low	Low	Low	Low	Low	High
S4	Product Variety -High Del. Perf. -low Vol. Flex. -High	Low	Low	Low	Low	High
S5	Product Variety-low Del. Perf. -High Vol. Flex. -low	High	High	High	High	Low
S6	Product Variety-low Del. Perf. -High Vol. Flex. -High	High	High	High	High	Low
S7	Product Variety -High Del. Perf. -High Vol. Flex. -low	Low	Low	Low	Low	High
S8	Product Variety -High Del. Perf. -High Vol. Flex. -High	Low	Low	Low	Low	High

process. Miles and Show et. al, (1978) have identified alternative ways in which organisations define their strategies and mechanisms of structure and process to pursue these strategies, details of which are given in the form of Tables 2 and 3.

A conceptual framework that relates objectives, dimensions of organisation structure and manufacturing strategy making process has been summarized in Table 4 which is based on the works of Miles and Snow et. al, (1978) and Miller (1987). First two columns of table 4 are derived from the framework of Miles and Snow et. al, (1978) and columns three and three of Table 4 are derived from Miller's framework (1987).

Table 4: Relating Objectives, Dimensions of Organization Structure and Manufacturing Strategy Making Process

Objective of Manufacturing Decision	Dimensions of Organisation Structure	Manufacturing Strategy Making Process	
High Product Variety (Prospector)	Specialization	-Low	
	Standardization	-Low	
	Formalization	-Low	Assertiveness
	Centralization	-Low	Rational & Interaction
Low Product Variety (Defender)	Complexity of Workflow	-High	Rationality
	Specialization	-High	
	Standardization	-High	
	Formalization	-High	Rational & Interaction
	Centralization	-High	Assertiveness
	Complexity of Workflow	-Low	

It thus follows that defenders and prospectors both use all three processes of manufacturing strategy; however we are unable to say much about their relative strengths.

Methodology & Data Analysis

A study was undertaken to assess the link between manufacturing strategy making process and its 'contents'. Two sets of questionnaires were prepared. First set related to the manufacturing strategy making process used by the manufacturing firm. This was a modified version of the corporate strategy making process scale developed by Miller (1987). Second set measured whether the firm was a prospector or a defender. This was done by recording the self report measure on product variety offered, (high/low). Both the

Table 5: Relating Objectives of Manufacturing Division with actual dominant Manufacturing Strategy Making Process for German Manufacturing firms

S.No.	Objectives of Manufacturing Division	Dominant Chosen Manufacturing Strategy Making Process
GC1	Prod. Variety-low	Assertiveness
GC2	Prod. Variety-High	Rational and Assertiveness
GC3	Prod. Variety-High	Interaction and Assertiveness
GC4	Prod. Variety-High	Rational
GC5	Prod. Variety-High	Interaction
GC6	Prod. Variety-low	Rational and Assertiveness
GC7	Prod. Variety-low	Interaction
GC8	Prod. Variety-High	Rational and Interaction
GC9	Prod. Variety-High	Assertiveness
GC10	Prod. Variety-High	Interaction
GC11	Prod. Variety-High	Interaction and Assertiveness
GC12	Prod. Variety-High	Interaction and Assertiveness
GC13	Prod. Variety-High	Rational Interaction and Assertiveness
GC14	Prod. Variety-High	Rational

Table 6: Relating Objectives of Manufacturing Division with actual dominant Manufacturing Strategy Making Process for Indian Manufacturing firms

S.No.	Objectives of Manufacturing Division	Dominant Chosen Manufacturing Strategy Making Process
ICP1	Product variety - High	Assertiveness
ICP2	Product variety - High	Assertiveness
ICP3	Product variety - High	Assertiveness
ICP4	Product variety - High	Assertiveness
ICP5	Product variety - Low	Assertiveness
ICP6	Product variety - High	Assertiveness
ICP7	Product variety - High	Rational and Assertiveness
ICP8	Product variety - High	Rational
ICP9	Product variety - Low	Rational and Interaction
ICP10	Product variety - High	Rational and Assertiveness
ICP11	Product variety - High	Rational
ICP12	Product variety - High	Rational
ICP13	Product variety - Low	Interaction and Assertiveness
ICP14	Product variety - Low	Interaction
ICP15	Product variety - High	Interaction and Assertiveness
ICP16	Product variety - High	Rational and Interaction
ICP17	Product variety - High	Rational
ICP18	Product variety - High	Rational
ICP19	Product variety - High	Rational and Assertiveness
ICP20	Product variety - High	Rational

questionnaires were filled up by the manufacturing chief. Data was gathered from 20 Indian manufacturing firms (see Upadyaya, 1997) and 14 German manufacturing firms (see Shrotriya 2001). The summarized data appears in Tables 5, 6, 7 and 8.

Table 7: Number of German firms pursuing different Manufacturing Strategy Making Process with respect to Prospectors and Defenders

Objective of Manufacturing Division	Manufacturing Strategy Making Process
High Product Variety (Prospector)	Assertiveness - 6
	Interaction - 7
	Rational - 5
Low Product Variety (Defender)	Assertiveness - 2
	Interaction - 1
	Rational - 1

Table 8: Number of Indian firms pursuing different Manufacturing Strategy Making Process with respect to Prospectors and Defenders

Objective of Manufacturing Division	Manufacturing Strategy Making Process
High Product Variety (Prospector)	Assertiveness - 12
	Interaction - 4
	Rational - 10
Low Product Variety (Defender)	Assertiveness - 2
	Interaction - 3
	Rational - 1

It turns out German Manufacturing firms use "Interaction" manufacturing strategy making process more often their Indian counterparts. This is an interesting observation which needs to be further explored. From the data it is evident that all the Indian and German manufacturing firms do not emphasize the different manufacturing strategy making processes (rationality, Interaction and assertiveness) equally. Since manufacturing decisions ("contents") are relatable to objectives (Skinner (1969), Miles and Snow et. al, (1978) and Sharma and Seliger et. al, (2001)) and the link between objectives and processes is weak (see tables 7 and 8), it follows that link between processes and contents is

It turns out German Manufacturing firms use "Interaction" manufacturing strategy making process more often their Indian counterparts. This is an interesting observation which needs to be further explored.

value. In-commensurables lie between the two since they can be readily measured, but not in terms of

weak. This is contrary to suggestions by Sharma and Upadaya (1998).

Conclusions

money. In any investment situation the benefits would lie on the tangible-intangible spectrum. If an investment situation has more intangible benefits by nature, it becomes difficult to measure the benefits through conventional methods. The benefits from IT investments are more intangible as against other conventional investment situations. Inability to measure effectively due to intangibility in no way should undermine the importance of measuring any quantity. The work on IT investment payoff to a large extent is an attempt to put a value on the benefits from IT though these values are not always expressed in monetary terms.

Tenets of strategic management believe that a firm's performance is a function of its strategy and its environment. Since, a lot of IT benefits like innovation and coordination is strategic in nature, a firm's success is a function of its information and use of IT. Strategic resources like information enabled by IT have a particular value to the organisation, and they cannot be easily traded, purchased, imitated, nor do they have readily available substitutes. The policies governing IT strongly relate to strategic orientation and organisational capabilities of the firm in a complex and ambiguous way.

Investments in Information Technology

When new information systems are implemented in a company, it is very easy to talk about the costs of these systems. By implementation of simple accounting techniques one can easily add up the costs of the hardware, software, training, support & other factors and arrive at an expenditure figure. This figure in itself is generally a large amount with hardly any benefits, which are normally quite difficult to quantify, to justify the investments. In other words, many benefits are intangible, and therefore can't easily be shown as offsetting 'real' expenditure. So it is difficult to justify the expenditure on IT system.

When new information systems are implemented in a company, many benefits are intangible, and can't easily be shown as offsetting 'real' expenditure.

It would seem that business investment in IT is no different from business investment in any other. The approach taken to economically evaluate an IT system should be the same as that applied to any investment. After a careful consideration of costs in investment and its anticipated benefits, a decision should be made as to whether the benefits of the investment outstrip the costs

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and by how much. The argument is that an organisation can make investments in many things, which can be one of more information systems. The task is to decide upon the set of investments to make, given constraints on the organisation's financial resources in any given time period, which will maximize the overall rate of return. If the benefits in any IT system are competitive with other investment alternatives, then the firm might commit financial resources to the IT proposal. Otherwise, it won't. The decision making process is at the heart of such capital budgeting where different possible investments are competing neck to neck for funds. The whole argument is in line with traditional financial investments evaluation methods of net present value and discounted cash flow analysis, which require quantitative values to carry out the analysis.

Evaluating investments in IT on these lines poses a number of problems that investing in the traditional assets does not present. The focus shifts from measuring hard and quantifiable rupee benefits that will appear on the firm's income statement to measuring indirect, diffuse, qualitative and contingent impacts that are difficult to quantify well. Much of the problem stems from the nature of IT itself. It does not merely develop over time. Implementation of IT and benefits accruing from it is a continuous process, where the end results are not apparent at earlier stages and the way the system takes shape is often different from what was anticipated. Often the management fails to look through the ambiguity and identify the importance of IT as a strategic business tool. Sometimes management develops a cautious attitude towards emerging IT, which apparently seems a natural and wise reaction on the part of management. However too much caution for too long a time has its impacts in missed revenues and loss of company's competitive position.

IT is judged as a critical success factor for a business organisation in today's global competitive market. It is essential to be able to measure the economic viability or contribution of IT related investment projects, as one would do for other business projects. Quantification of strategic payoffs from IT such as improved image, satisfied customers; motivated staff etc. is an opportunity to demonstrate the payoffs in terms of higher profitability, better response and savings in costs in order to receive top management commitment and support to implement the programme. However, measuring the value added due to IT investment is difficult. The inventor of Applied Information Economics, Doug Hubbard has called for IT Directors to be more diligent in outlining the returns the company may expect from the large capital they pour into IT. But implementation of such a programme requires special skills, knowledge and understanding of carrying out IT invest-

ment payoff analysis. More so it requires highly complicated job of redefining the tenets of measurement of certain items.

IT has been used in many ways to achieve a wide range of difficult objectives. The different types of systems and wide range of objectives suggest that we may need a wide range of evaluation methods suitable for different situations. However, in the real world there are very few pure cases. Therefore, the decision to acquire a new IT system poses a number of serious evaluation and selection problems.

Benefits from IT investments

Spending on IT has steadily grown and outpaced the spending on any other infrastructure area. High risks, problems of running over budget and time, production of uncertain benefits etc. are few trouble areas, which accompany the high stakes in IT investments. A lot of these problems crop up due to lesser understanding of the benefits from IT. A general classification of benefits from IT investments is suggested by Wen and Sylla (1999) as follows:

High risks, problems of running over budget and time, production of uncertain benefits are few trouble areas, which accompany the high stakes in IT investments.

Effort and Operating Process Performance: If IT is used to substitute for human effort and automate tasks and business processes, the major benefits are likely to be an increase in system effectiveness and efficiency. Possible benefits include cycle time reductions, headcount reductions, reduction in communication time and related printing costs, increased income from product/service quality improvements, timeliness and accessibility of data, activity based cost improvements, operating process improvements relative to industrial benchmark, transformation of data into information, distribution of information, transforming information into desired outcomes and growth without corresponding increase in overheads.

Management Support: IT facilitates new ways of managing like decreased time to decision, improvement in decision time and quality, improved communications, standardization, responding quickly to changes in law, better control, increased flexibility, compatibility with customers' systems, more effective

use of the sales force and improvement in the quality of the working life.

Competitive Advantage: IT leads to competitive inequality in the favor of IT implementers. The benefits include improved operating margins relative to the competitors, increased market share, differentiation in the new products and services, creation of unique product features, buyer and supplier power, switching costs and search related costs, customer and supplier switching costs, preemptive strikes, first mover effects, positional advantage and timing, integration with company strategy and leverage of a firm's intrinsic strengths.

Business Transformation: When IT is used to restructure or transform the tasks, operations and procedures involved in the business processes, the investment characteristics can be summed up under the label 'Business Process Reengineering'. The benefits here include allowing business process redesign, assisting business network redesign, facilitating flatter organisational structure, changing the symbols and the image of the organisation and altering the organisation's boundaries to allow new forms of co-operation such as teams and work groups without geographic restriction.

Most of these benefits are essentially strategic in nature hence can only be explained by their implications on the overall performance of the firm. The benefits are not function specific and lack quantifiable values and so could not be compared among themselves or with other more tangible benefits.

Measurement of Benefits

The ability to measure anything lies in three areas namely, the understanding of the concept of measurement, the object of measurement and the methods available for measurement. Proponents of Applied Information Economics stress that anything can be measured and failure to capture most of the intangible benefits is due to the lack in understanding of the concept of measurement for these benefits. Dephne Chunge (2000) has suggested the following procedure to measure quantities, which can be applied to any type of benefit. According to him the measurement of benefits should start with development in understanding of the concepts related to the various benefits. This is followed by a proper definition, which could provide a unit-of-measure for the same. Like 'customer relationship' is defined as increased repeat business that can be measured effectively. 'Employee empowerment' is defined as less management over-

heads and more accurate and faster decisions. Though the latter is not measurable as customer relationship, the definition provides clear criteria of what to observe when one is talking about employee empowerment. The benefits have different characteristics and how effectively it can be measured depends on the management concepts related to it and the definition specified for it. Most of the exercise related to intangibles is in-house exercise in the form of conducting random samples or experiments to measure different aspects of IT. This effort could be substituted by secondary search for the methods already developed by other firms. It reduces efforts in terms of developing techniques but each firm has to adopt methods suitable for its own needs. A firm can even adopt a combination of available measures to suit its unique requirements.

The ability to measure anything lies in three areas namely, the understanding of the concept of measurement, the object of measurement and the methods available for measurement.

IT Evaluation Methods for Tangible Benefits

The traditional methods of Return on Investment and Cost Benefit Analysis can be used as the first step towards establishing systems for measuring IT investment payoffs. These methods rely heavily on the point estimates for every relevant factor in the costs and benefits of an information system. The point estimates are usually specified based on judgment of individuals. In that sense they are subjective in nature and they also fail to capture a lot of intangible or so-called soft benefits, which most often form the largest benefits of information systems. The point estimates also ignore the differences in level of uncertainty associated with the different benefits. Thus, risk analysis should form an integral part of such an analysis. Some methods for investment payoff measurement which are widely used in IT investment situations are as follows:

Return on Investment (ROI): The three commonly used ROI methods are as follows:

- **Net Present value (NPV):** It is the discounted value of expected net payoffs and is the standard criteria for deciding whether a programme can be justified on economic principles. In this method, values are assigned to payoffs and costs, which are discounted using an appropriate discount rate, and subtracting the sum total of discounted costs from

the sum total of the discounted payoffs. NPV as applied in IT sector fails to measure the intangible benefits. Unlike in a manufacturing setup it is difficult to determine the future value & discount rate for IT investments.

- **Discounted Cash Flow (DCF) and payback period methods** are other two widely used methods. DCF calculations base their discount rate on interest rate while the payback period method does not require an assumption of fixed interest rates. It only requires an IT project to repay its investment over a prescribed period of time.

Cost Benefit Analysis (CBA): CBA overcomes the problem of ROI by finding some surrogate measure for intangible costs or benefits, which can be expressed, in monetary terms. This approach attempts to tackle the problems of quantifying the value of benefits that do not directly accrue to the investor in the project and of identifying the benefits or costs, which do not have an obvious market value or price. When CBA is applied to the evaluation of information system, the benefits largely take the form of enhanced efficiency. Here the cost savings are relatively straightforward to quantify. However, as context changes from efficiency to effectiveness as in modern information systems, the firms face difficulty in measuring the intangible benefits that are difficult to relate to profit results. Most of the firms employing CBA method for budgeting generally underfund their IT budgets because they are not aware of benefits of IT.

An alternative method based on similar principles, which is widely used to compare alternate IT investments, is Benefit Cost Ratio (BCR) method. It measures the economic desirability of an investment by dividing the present value of its payoffs (cash inflows) by the present value of the costs (outflows). The alternative with the highest BCR is the most cost effective because it returns the most payoffs per rupee spent. This method inherits the lacunae of CBA method.

Benefit Cost Ratio (BCR) method measures the economic desirability of an investment by dividing the present value of its payoffs (cash inflows) by the present value of the costs (outflows).

Return on Management (RoM): It is argued that IT serves primarily to help the management do its job. The impact of IT on the business unit performance can be

measured through value-added due to direct labor. The advantage of the RoM methods is that they concentrate on the contributions of IT to the management process. The disadvantage is that the residual assigned as the value added by the management cannot be directly attributed to the management process.

IT Evaluation Methods for Intangible Benefits

It is difficult and perhaps inappropriate to try to translate the benefits of IT usage into quantifiable productivity measures of output. Intangibles such as better responsiveness to customers and increased coordination with suppliers do not always increase the amount or even the intrinsic quality of output. In most of the new methods of IT investment evaluation, decision-makers are asked to rate a proposed project for various categories, which are already identified. Corresponding to each category a weight is specified, which is the multiplier for this category. The weights are arrived from earlier studies or from the opinions of experts in this field. The products of mean score of each category and respective weights are summed up to arrive at a cumulative score. The weights are usually standardized for a given company so that all projects are evaluated by comparable criteria, which are unique for a firm and cannot be extended for other firms. Most of the methods for evaluating intangible benefits are subjective in nature and heavily depend on the opinions of experts and senior executives. Some of the methods widely used to measure intangible benefits of IT investments are as follows:

Multi-objective, multi-criteria (MOMC)

This method attempts to develop a general measure of utility where utility is defined as the satisfaction of individual's preferences. The method is based on the belief that people's behavior is determined to some extent by their feeling that their preferences are recognized. People appraise the relative usefulness of different desired outcomes in terms of their preferences and they rank goals by applying a preference weight to each goal. Where there are many stakeholders, the best IT investment is that which will deliver the highest aggregate utility or which provides the highest overall measures of satisfied preferences. The MOMC method is widely applied to complex projects that have intangible benefits. The method is able to explore the value of a set of system proposals in terms of relative preferences for different system features. Also, it arrives at a consensus on the most desired system attributes to be achieved by thoroughly exploring alternatives and preferences. However, the MOMC method fails to provide any data for the RoI calculation, which can be used to compare an investment through cost benefit analysis.

Value Analysis (VA)

Value analysis is a multi-stage iterative method based on the assumption that intangibles can be identified and subjectively assessed but rarely measured accurately. The method emphasizes values rather than cost as it assumes that most successful innovations are based on enhancing value added rather than on cost savings. Most of the end results from this method are user-tailor made, since it is developed through incremental evaluation of benefits and costs, which are opinions of the users of IT system. This method does not provide target estimate of final costs and benefits that can lead to significant programme revisions and unexpected future expenditures. Establishing the required surrogate value and developing prototype is a long, time consuming process.

Critical Success Factors (CSF)

The method is used to explore the potential value of information systems. It invites the analyst to explore with executives the factors, which are in their opinion, critical to the success of the business in particular, the factors that are important for the functions and the activities for which the executives are responsible. The executives rank the issues in levels of importance. It involves comprehensive interviews of key managers to obtain their views about business mission, objectives and current problems. After the interviews, the managers' opinion are cross-tabulated, compared and agreement about system investment priorities is expected to emerge. The advantage of the method is that it provides a focus on the issues, which are regarded as important by the respondents. It also heavily relies on prototyping and pilot installations before proceeding.

The User Satisfaction Method:

This method measures the extent to which users believe the information system available to them meets their information requirement. It is a tool for the evaluation of information systems where surrogate measures of effectiveness are used. The decision to install an information system necessitates a choice of mechanisms to determine whether an information system is needed, and once implemented, whether it is functioning properly. It serves as a substitute for objective determinants of the information system effectiveness, which are frequently not available.

Theoretically, the determination of information system value is a matter of economics:

Net value of the system = Actual benefits – The cost of system operation and development

IT Evaluation Methods for Risk

Payoffs and cost estimates are typically uncertain in IT investments because the decisions are among the most complex of any investment decisions due to the rapid technological change, dynamic costs relationships, and unclear benefits. Ambiguity, uncertainty and intangibility in IT investments call for critical analysis of risks associated with it. The nature of risk is different from other investments primarily due to the fragile nature of the hardware and susceptibility of software to technical crashes, corruption and thefts from remote locations. IT exists in an environment of uncertainty and applying traditional investment methodologies may ignore key variables and lead to poor decisions.

Ambiguity, uncertainty and intangibility in IT investments call for critical analysis of risks associated with it.

Deciding on the IT risks itself involves analyzing costs and benefits. Performing a risk analysis and a cost benefit analysis should be a formal part of the investment analysis procedure to ensure that resources are allocated rationally and all risk exposures are considered when designing the IT application under consideration. The different risk analysis methods available for analyzing risks associated with IT investments are as follows:

Real Option (RO): Real Option method recognizes incremental values arising from flexibility the altered probability distribution of potential outcomes and its impact on risk exposures. When there is a significant degree of uncertainty in outcomes for IT investments, the waiting game might produce substantial benefits. The value of waiting is a reflection of the costs associated with an irreversible investment, which is the sunk cost in an investment. In this context, the identification of real options helps to explain the value of flexibility by demonstrating that the managers are not miscalculating investment outcomes and are acting rationally.

Portfolio Approach (PA): This approach suggests that a company should not only assess relative risk for the single IT project but also develop an aggregate risk profile of IT investment. In an industry where computers are an important part of the product structure, managers should be concerned when there are no high-risk projects. In such a case, the company may be leaving a product or service gap, which may present an opportunity for the competition to step in. On the other hand, a portfolio loaded with high risks projects suggests that the company may be vulnerable to operation-

al disruptions when projects are not completed as planned.

Delphi Approach (DA): It is a technique in which several experts provide estimates of the likelihood of the future events associated with the decision situation. The estimates are collected and distributed to all experts. All experts are then asked if they wish to modify their initial ratings based on the inputs from other experts. After all inputs are collected, final individual values are evaluated and summarized. If the results are sufficiently consistent, final overall values are assessed for all. If any inconsistency is recorded, the experts are asked to discuss the instances of inconsistencies and an attempt is made to reach a compromise on the final value. This and other final values are adopted and used to compute the risks associated with the investment. This approach is particularly useful for the risk analysis of a new IT investment where the risks involved in the investment may be primarily unknown or unfamiliar to the managers.

Strategic Aspects of Information Management

Information is a knowledge-based resource with unique properties that are ingrained into the systems of the organization. Information of a firm can be duplicated and used simultaneously by a firm or transferred through network systems to distant places without increasing costs or depleting the information but the information system in the firm cannot be exactly copied at other locations because the growth of information system is a continuous iterative process where the system grows over time and in the process, the system is modified and upgraded. Information as a resource can be used to partly substitute for traditional resources such as labor, inventory levels, transportation, capital, location and distribution center by better utilization of resources through implementation of systems like supply chain management, ERP, J-I-T etc. Information has a wide and generalized applicability spread over all the functional areas, as it is the basis for all managerial activities, which allows it to be used in multiple firm processes, product and services. Information can be used to control other technology-based processes, including manufacturing or distribution technology.

The firm's reservoir of different strategic resources is a potential source of competitive advantage as different firms are endowed with different combinations of strategic resources. The environment is a strong influence on the strategic position of the firm; hence the specific contribution of resources of the firm's performance must be evaluated within the context of its competitive environment. The firm's competitive environment, which determines the level of uncertainty and complexity takes its

roots from product market strategy. The environmental uncertainty is due to the dynamic nature of the environment and it can be tackled by responding quickly to the environmental changes and more often faster than the competitors. Environmental complexity is due to the number of factors and interdependencies that are very important for the performance of the firm.

Information as a tool enabled by information technology can serve to combat environmental uncertainty and complexity in a variety of ways. In competitive environment, the performance of the firm is related to its knowledge base and information generation and processing capabilities. Knowledge based resources and capabilities are most valuable in uncertain environments, which is evident from the great emphasis, laid on the management of knowledge resources, particularly knowledge workers in the new economy firms, while property based resources are most valuable in stable and predictable environments, which is observable in traditional old economy firms. Information can be used to enhance competitive flexibility by creating a wider range of strategic options that the firm can exercise.

Information as a tool enabled by information technology can serve to combat environmental uncertainty and complexity in a variety of ways.

The environmental dimensions of uncertainty and complexity create the information drivers required by the firm, and these consequently determine the strategic value of the firm's information based resources. These drivers prompt the organisations to react, which they do by employing the information resources. Development of linkages between the organisational processes and the information resources enabled by IT systems is very important. The firm's information processing abilities determine the extent to which it acquires information from the environment, transfers it throughout the organisation, and integrates it within its processes. IT does not serve as a strategic resource merely by ownership alone, its strategic value is revealed when it supports organisational capability. The onus of utilizing IT to support organisational capability lies with the IT managers. The effectiveness of management of IT ensures the extent to which the firm leverages the availability of information resources into development of organisational capabilities unique to the firm.

Innovation and coordination are the organisational capabilities for which a firm can use IT to meet the demands of its competitive environment. Innovation oc-

curs when a new idea or procedure is adapted by a firm or within an industry. Innovation can have many manifestations in various areas like in firm's administrative processes, business processes, or the product and the services of the firm. Innovation creates unique ways of exploiting the resources and creates flexibility in the firm to respond promptly to environmental changes. If the environment is highly uncertain, this capability can be exploited by the firm to track environmental changes and respond before any of the competitors does so. Competitors have difficulty in imitating or duplicating the use of similar resources. Degree of innovation of the firm's strategy is linked to its use of information processing mechanisms. Successful firms in uncertain environment have adopted innovative strategy. Information as a resource enabled by effective IT is an important resource for developing new

Degree of innovation of the firm's strategy is linked to its use of information processing mechanisms.

products and processes repeatedly in innovative ways in an uncertain environment. Coordination in an organisation implies controlling complex tasks between interdependent entities. Coordination is an administrative task of management. The coordination ability is revealed through its integrating mechanism and inter-organisational linkages, particularly in an information intensive organisation.

IT as an enabler can process large amounts of information rapidly, and further it can exploit information through innovations in the firm's processes, products and services. IT derives its strategic value from the level of its technology indicated by financial investments in IT as well as from the level of investments in the organisation processes and the integration of the processes with the IT systems. Information processing refers to the firm's knowledge based capabilities to use information as coordination mechanism between interdependent tasks in the firm's values chain. It encompasses market coordination, production, processing and distribution functions. Information exploitation is a strategy that refers to the firm's capabilities to apply information resources or processing functions in innovative ways. Information as a resource can be exploited through innovative applications. The firm can develop new innovative activities, which are totally new to the industry. For example, the white goods manufacturers can link the items sold by them through some networking systems to its workshop to track the performance of individual items thus prompting the users about required

maintenance as and when necessary. The innovation can take the form of transfers of knowledge within the firm or between the firms or it may be realized through new uses of information. In general, information exploitation will require some adaptation of organisational processes and technology to create the new processes.

Conclusion

Information technology investment payoff problems are different from other conventional investment decisions due to unique characteristics of IT. Capturing intangible benefits from IT is a major problem, which could be tackled to some extent by proper definition of benefits and development of proper unit-of-measure. A host of measurement methods based on different principles are used by different firms. Each method has pros and cons in its ability to effectively capture the various benefits of IT. Since benefits are different in nature and can be placed at different points on tangible-intangible

spectrum, a mix of payoff measurement methods should be employed for different benefits. Risk analysis is critical for any IT investment due to ambiguity and uncertainty of benefits from such investments. IT has strong strategic implications for a firm. As an enabler, IT helps to process and exploit information as a response to the environmental drivers of complexity and uncertainty through innovation and coordination respectively.

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The entire industrial revolution enhanced productivity by a factor of 100, whereas the micro-electronic revolution has already enhanced productivity in information based technologies by a factor of more than a million and the end is not in sight yet.

— Carver Mead

Technical Efficiency & Productivity Growth in Central Public Sector Enterprises

R.N. Agarwal

The present study is based on the data from 58 large Central Public Sector Enterprises (CPSE) manufacturing/producing goods as well as data from industry groups provided by the Department of Public Enterprises, Ministry of Industries, Government of India for the period 1990-91 to 1998-99. The 58 firms cover more than 90 per cent share by sales or the gross assets of the entire CPSE. The objective of the study is to analyse the technological change, technical efficiency and total productivity growth of CPSE, industry group-wise and firm-wise. The results show that the public sector enterprises have not experienced a significant technological change during the 1990s. Results also suggest that a majority of the firms have low levels of technical efficiency and that the efficiency has not improved significantly over time. However, growth of technical efficiency is observed in some firms in the engineering sector and many firms in the petroleum producing/selling sector.

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For decades an overall perception about the public sector enterprises in India has been that except for the oil sector, the entire public sector is inefficient, with excess manpower resulting in a low level of per capita productivity, and that it has a large number of sick units. It is perceived that the public sector has neither been able to improve productivity levels and efficiency, nor has it become competitive in the domestic market. This is attributed mainly to the poor financial performance of a large number of Central Public Sector Enterprises (CPSEs) which, in turn, is the result of old and obsolete plant and machinery, outdated technology, and a low level of capacity utilization. The latest data (Public Sector Enterprises Survey, 1998-99) show that the net worth of as many as 67 CPSEs has become negative due to continuous losses and the Central Government has infused huge capital into the sick units in order to meet their liabilities.

However, the captains of the public sector do not agree with the above mentioned observations. According to them, the prevailing mindsets overlook the content of goals and constraints under which they have worked since their inception. The public sector, according to this perception, was intended basically to serve the cause of social and economic development and not to generate high monetary profits. However, they argue that the financial performance of the public sector at the aggregate level is not worse (if not better) than that of the private sector. Again, the lower size of profits of the non-oil public sector is attributed largely to the losses incurred by the private sector companies which were

Financial performance of the public sector at the aggregate level is not worse (if not better) than that of the private sector.

taken over by the government earlier on compassionate grounds. Thus, the issue of performance of public sector enterprises is debatable. Although the financial health of an enterprise is of utmost importance, profitability has never been the sole objective of a public sector enterprise and hence the criterion for judgement about its performance.

Literature suggests that three important factors for consideration for a firm's performance are the efficiency, (both allocative and technical), scale economies and the technological change introduced as the productivity growth of a firm depends upon these three factors. An efficient and modern firm is most likely to have a lower cost of production, improved quality of products and hence higher profits. Such a firm can be competitive in the domestic as well as global market. Hence, the objective of the present study is to analyse the technical efficiency, technological change, and productivity growth of the public sector at the firm level and at the level of major cognate industrial groups to which these firms belong.

Public sector in India: Structure, Goals, Contribution and Challenges

For the purpose of planning and national accounting, the public sector in India includes all activities funded out of the government's budget. It includes not only government departments but also government companies, whether in the central or the state sector. The focus in this study is, however, on the performance of the CPSEs during the 1990s, particularly, for the period 1990-91 to 1998-99 for which the latest published data is available. These enterprises are established as government companies or statutory corporations excluding the public sector banks. The wide range of activities in which the CPSEs are engaged include manufacture of steel, mining of coal and minerals, extraction and refining of crude oil, manufacture of heavy machinery, machine tools, instruments, heavy machine building equipment, transportation equipment, telecommunication equipment, fertilizers, drugs and pharmaceuticals, petro-chemicals, cement, textiles, consumer goods items, operations in national and international trade, hotel and tourist services, consultancy, contract and construction services, etc.. According to the Public Sector Enterprises Survey 1998-99 conducted by the Department of Public Enterprises, Ministry of Heavy Industries and Public Enterprises, there were 240 CPSEs as on 31 March, 1999 (excluding six insurance companies and two financial institutions) as compared to just five in 1950-51. Their break-up is as follows:

Enterprises under construction (5), enterprises

manufacturing/producing goods (160) and enterprises in the services sector (75). Further, according to the survey, the total investment in the CPSEs operating at the end of 1998-99 was around Rs. 2300 billion. Of this, over two-third was invested in the manufacturing sector and the remaining one-third went to the services sector.

Contribution to Central Exchequer

The public sector contributes to the exchequer in the form of dividend on equity, various forms of duties and taxes. During 1998-99, the public sector contributed about Rs 470 billion to the exchequer by way of dividend (Rs. 2487 billion), interest (Rs. 2548 billion), excise and custom duties (Rs. 28,123 billion), and various taxes (Rs. 13,767 billion). Besides, it has contributed a huge amount in the form of social overheads (Rs. 33 billion in 1998-99).

Contribution to the National Economy

The public sector occupies a key position in several sectors, especially in the production of fuel, basic metals, non-ferrous metals and fertilizers and also in employment. The share of public sector production (PSP) in the national production (NP) for the year 1998-99 is as follows (in percentage) for some major products:

Coal (87.75), Lignite (97.22), Petroleum (90.71), Finished Steel (32.07), Aluminium (43.61), Primary lead (83.16), Zinc (86.46 per cent), Lead (64.00), Copper (79.00), Fertilizers (28.50). Besides, the public sector contributes significantly in employment generation in the country (around 2.0 million people).

The public sector occupies a key position in several sectors and also in employment.

Financial Performance

Financial performance of the CPSEs for the year 1998-99 in the manufacturing/producing goods sector and services sector is presented in Table 1.

The major challenges for the Public Sector Enterprises in India today include achievement of productivity growth through upgradation of technology, boosting of in-house research and development (R&D) activities, and increasing profits and profitability of operations.

Major challenges for the Public Sector Enterprises include achievement of productivity growth boosting of in-house (R&D) activities, and increasing profits.

Table 1: Financial Performance of CPSEs for the year 1998-99.

(Rs. In Crore)

Particulars	75 Firms in Services Sector	160 firms in Manufacturing sector
Capital Employed	90623	183074
Net worth	34163	113857
Turnover	68544	241450
Gross profit	17332	39200
No. of profit making enterprises	51	76
No of loss making enterprises	23	83

Financial Ratios (In Percentage)

Items	Services Sector	Manufacturing Sector
Profit before tax to turnover	9.3	5.5
Profit before interest and tax to capital employed	15.2	14.2
Profit before tax to net worth	18.7	11.7

Source: Public Enterprises Survey, 1998-99, p.10

Technology Change, Technical Efficiency and Productivity Growth

Technological change, technical efficiency and scale economies/diseconomies constitute the three major technological characteristics of a firm/industry. A study that aims at evaluating the performance of a firm (industry) must therefore analyse technological change, technical efficiency and productivity growth together with the financial and other growth parameters. The effect of technological change on productivity can be evaluated in terms of changes in the amount of inputs (say labour and capital) used in production. For a given level of output and input price ratio, a labour-saving technological change results in a higher capital-labour ratio; a capital-saving technological change in a lower capital-labour ratio and a neutral technological change in an unchanged capital-labour ratio. However, this definition is most suitable in the short-run, that is, when output levels can be assumed to remain constant. In the long-run, technological change may be embodied or

dis-embodied. It is said to be dis-embodied if the technological change occurs not in the inputs but outside them. The resulting shift in the production function can be represented by including a time variable 't' along with the inputs, say labour (L) and capital (K). Hence, $Q = f(L, K, t)$. This implies that the same input vector produces different levels of output Q at different time periods. Technological change is called embodied when such changes are embodied in inputs of different vintages. For instance, capital services provided by old and new machines produce different results. Similarly, new technically sound staff and the old non-technical labour produce heterogeneous labour input. In these circumstances, technological change has been defined in three alternative ways as suggested by Hicks, Harrod and Solow, respectively (Link 1987). Hicksian technological change is defined as labour-saving, capital-saving or neutral if it raises, lowers or leaves unchanged the marginal product of capital relative to the marginal product of labour for a given capital-labour ratio. Hence, a Hicks neutral technological change shifts the isoquant inwards which leaves the slope of the isoquant unchanged along a ray through the origin. Hicks neutrality implies that the technological change is equally capital- and labour-augmenting. In the Harrod definition of technological change, capital-output ratio is given. Harrod neutrality implies that the technological change is labour augmenting. Similarly, Solow defines technological change for a given labour-output ratio. Solow neutrality implies that technological change is capital augmenting.

Productivity is the relationship between the output (outputs) generated by a production unit and the inputs provided for the purpose. It is a measure of the efficient use of resources in the production of goods because improving productivity means producing more goods and services with the same resources or maintaining the same level of production with less resources. A firm exhibiting productivity growth is most likely to show better financial performance as well but the reverse is not true. Many of the public sector enterprises show better financial performance as compared to their counter-parts in the private sector. For instance, profits of the Public Sector Enterprises in the petroleum and telecommunication sectors have gone up substantially. But their productivity growth is not significant. This is attributed mainly to the regulated environment under which the public sector units have to perform.

There is no single accepted notion to measure productivity or productivity growth. Generally it is measured in a production function framework. In this sense productivity is considered as the degree of efficiency exhibited in the process of turning inputs into outputs. Since several inputs may be required to produce a

product, productivity can be defined in the partial and total form. Partial factor productivity measures the ratio of the quantity of output Q to the amount used of one single input x . Partial factor productivity can be written as Q/x . Total factor productivity describes the ratio of output to a combination of all inputs used. It is written as $A(t) = Q/\sum w_i X_i$, where w_i are the input weights. Rate of growth (g) over time of total factor productivity TFP, is denoted as $gTFP$ and is required to account for the rate of technological change and the rate of change in technical efficiency under the assumption of constant returns to scale (Kendrick and Sato 1963; Solow 1957).

A Brief Review of Earlier Studies

There is hardly any serious study on the estimation of technological change or technical efficiency for the Public Sector Enterprises in India, although there have been several such studies for the private sector covering the period 1970-71 to 1996-97. In the context of the public sector, most of the studies are concerned with their financial performance only, except for a study by Anita Kumari (1993) which is devoted to the estimation of productivity growth for the period 1971-72 to 1987-88. Technical efficiency in the private sector has generally been estimated by a frontier production function approach. Major studies include Lovell and Schmidt (1977), Forsund, Lovell and Schmidt (1980), Greene and Mayes (1991), Ramaswamy (1990), Bhavain (1991), Agarwal and Goldar (1992). Technological change and productivity growth (partial and total) have been estimated in the context of an aggregate production function using one of the commonly used production functions namely, Cobb-Douglas production function, Constant Elasticity of Substitution (CES) production function, or Trans-log production function. Major Indian studies include Ahluwalia (1991), Balkrishnan and Pushpangdan (1994), Gangopadhyay and Wadhwa (1998), Rao (1996), Pradhan and Barik (1998), Mitra (1999), Trivedi, Prakash and Sinate (2000), Srivastva (2000), and Goldar (2000).

Research Methodology

Scope and Time Period of the Study

The present study is confined to an analysis of enterprises manufacturing/producing goods. The firm-level data for CPSEs has been extracted from the data for 236 CPSEs as provided by the Department of Public Enterprises, Ministry of Industries, Government of India for the period 1990-91 to 1998-99. To begin with, a subset of data for the 100 largest firms out of 236 firms was extracted for each year in the given time period from the given set of data. Only 78 firms were found common in the subset. Further, it was found that only 58 out of these

78 firms belonged to the manufacturing sector and the remaining 20 belonged to the trading and marketing services sector. We have considered only 58 firms belonging to the manufacturing sector for the entire period 1990-91 to 1998-99 for estimating technological change and the growth of total factor productivity using regression methods. These firms cover more than a 90 per cent share by sales or gross assets. Thus our data set has 522 observations. In this data set of 58 firms we find that 11 firms belong to the petroleum/oil sector and the remaining 47 firms belong to the non-oil sector. The non-oil sector has been further classified as the Engineering Sector, Infrastructure Sector, and the Residual Sector. The Engineering Sector includes firms manufacturing iron and steel, non-ferrous metals, heavy machinery and electrical machinery. This sector has 23 firms. Infrastructure Sector includes coal, mining and electricity generation/distribution. This set has 10 firms. The remaining 14 firms form the Residual Sector. Partial factor productivities and the Solow index of total factor productivity have been computed using the industry-wise 12 cognate groups data for the period 1990-91 to 1998-99. The data is published annually by the Ministry of Industries, Department of Public Sector Enterprises, New Delhi, in the form of Public Enterprises Survey. The 12-industry level cognate groups of enterprises manufacturing/producing goods are classified as in Table 2.

Table 2: Enterprises Manufacturing/Producing Goods

Cognate Group	Number of Enterprises
Steel	7
Minerals and Metals	11
Coal and Lignite	9
Power	4
Petroleum	14
Fertilizers	8
Chemicals and Pharma	21
Heavy Engg.	15
Medium and Light engg.	23
Transport Equipment	12
Consumer goods	18
Textiles	14

Variables at Constant Prices and their Definitions

Conceptually, a production function is a relationship between the physical quantity of the output produced and the physical quantities of inputs used. It describes the production technology and tells us the maximum level of output that can be produced using the given level of inputs and factor prices. Alternatively, it tells us the minimum levels of inputs to be used for a given level of output

and prices. But the quantity figures for the output and inputs are generally not available in the published form. Thus, all the variables have been evaluated at a constant price with base 1981-82 = 100. The wholesale price index of machinery and machine tools has been used for deflating the gross capital stock series; and the index numbers of wholesale price of fuel, power, light and lubricants have been used for deflating the time series data on energy consumed by the firms. Although it is considered better to apply the double deflation method to get the value of gross value added at constant price, a single deflation method has been used here on account of the limitation of data availability for raw materials and stores consumed by the firms for several years. Gross value added at current price has been deflated by the index numbers of the wholesale price of the major industrial product group to which the firm belongs.

Gross value added (GVA) is defined as the gross value of production net of the value of raw materials and stores, finished and semi-finished goods consumed and the manufacturing expenses. It describes the contribution of inputs in the production process. For instance, in a three-inputs production function with inputs as labour, capital and energy, the gross value added (GVA3) consists of wages and salary along with the welfare expenses paid/incurred to the employees, interest paid on borrowings, depreciation provisions, expenditure on power, fuel and lubricants, and the residual net profit before tax. In the case of two-inputs as production function with inputs as labour and capital, the gross value added (GVA2) = GVA3-expenditure on power, fuel and lubricants, etc. In the present study, GVA2 has been used because data on energy consumed is not available for a few firms for some years.

Capital input at a point of time is defined as the flow of capital services generated by the fixed capital stock and the working capital at that point of time. However, in the absence of a correct measure of the flow of capital services, total fixed capital stock is generally taken as a proxy for capital. Again, the choice to use gross or net fixed capital stock is debatable, but gross fixed capital stock is generally preferred over the net fixed capital stock. We have followed the same practice.

Labour input is defined as the total number of employees excluding the casual workers. Energy input is defined as the expenditure on power and fuel.

Labour input is defined as the total number of employees excluding the casual workers.

Measures of Productivity Growth

Partial Productivities

To start with, partial productivities with respect to three major inputs as labour, capital and energy are estimated across firms/industrial groups over time. Partial and total factor productivity estimates are obtained on the assumption that a production function accurately describes the maximum output available from a given input vector. Assuming further that the production function is homothetic and separable it can be written as $Q = F(X, t)^1$. Finally, if the technological change is assumed to be Hicks neutral and dis-embodied, then the production process can be described as $Q = A(t).F(x_1, x_2, x_3...)$, where $A(t)$ is a shift factor.

Partial productivities are defined as $Q/x_1, Q/x_2, Q/x_3...$

Total Factor Productivity Growth

Although partial productivities are useful to reveal economies of scale over time for any factor use, changes in partial productivities cannot be associated with only a single input. There might be associated other reasons for these changes such as K/L ratio, management efficiency, financial efficiency and factor substitutions, etc. Solow's (1957) pioneering study was the first to posit an aggregate production function explicitly and to estimate the growth of total factor productivity. His Divisia Index was formulated from a Cobb-Douglas production function having two inputs labour and capital. The model is specified as:

$Q = A(t) K^\alpha L^\beta$, and technological change denoted by \dot{A}/A is derived as under:

$$\dot{A}/A = \dot{Q}/Q - \alpha \dot{K}/K - \beta \dot{L}/L$$

Solow's index (SI) of productivity growth is computed by the following formula:

$$SI(t+1) = SI(t) [1 + \Delta A/A], SI(1) = 1.0$$

This measure of total factor productivity growth has been used extensively in empirical research. However, the index does not distinguish between pure technological change and changes in efficiency with which resources, including technology are used. Also

1. Homotheticity implies that the form of production function is independent of the scale factor that is, that tangents to isoquants are parallel to each other. Hence the marginal rate of substitution is constant for all isoquants along a ray from the origin for a given capital-labour ratio.

the use of the Cobb-Douglas production function is very restrictive in nature. So the Constant Elasticity of Substitution (CES) production function, in the approximation form as suggested by Kmenta (1967), has alternatively been used by many researches. But this type of production function is also restrictive in nature in the sense that the elasticity of scale and substitution are fixed.²

Technical Efficiency and Productivity Growth

Frontier production functions (deterministic and stochastic) have also been used in alternative forms to estimate technical efficiency and productivity growth. Most of the earlier studies in the Indian context have used the deterministic form of frontier production functions with alternative assumptions about the error term. But recent studies have shown (Jondrow et al. 1982; Caves 1988; Green & Mayes 1991; Agarwal & Goldar 1992) that efficient industries might have a high spread of inefficiency within them so that in the general noise term appearing in a production function there might be exogenous shocks which are beyond the control of firms while a part of the noise may be attributed to firms. Hence, for a cross-sectional data it is recommended to use a composite error term stochastic frontier production function.

But in case of having a set of panel data, an alternative form of the composite error term frontier production function model as developed by Cornwell, Schmidt and Sickles (1990) has recently been used to estimate technological change and the technical efficiency of firms. The model has been applied earlier for the Indian industries by Krishna and Sahota (1991) and Mitra (2000). We have also used their methodology but we have also tried a trans-log production function as an alternative to the Cobb-Douglas production function. The function is as follows:

$$\text{Log}Q = a_0 + \lambda T + a_l \log L + a_k \log K +$$

$$\frac{1}{2} b_{kk} (\log K)^2 + b_{kl} \log K \log L + \frac{1}{2} b_{ll} (\log L)^2 + e(t)$$

λ denotes Hicks neutral technological change, $e(t) = v(t) + u(t)$; $e(t)$ and $u(t)$ are error terms comprising a random component $v(t)$ and technical inefficiency component $u(t)$. $v(t)$ are assumed to possess the standard properties of error terms in a regression model.

2. A more generalized production function, namely, Trans-log (non-algebraic) production function has been used to capture the effect of scale economies and input substitution on technological change. Under the assumption of constant returns to scale, using trans-log production function is tantamount to using the CES function.

Thus, Technical efficiency of an i th unit $TE_i(t) = Q_i(t)/\text{Optimum } Q_i(t) = \exp(u_i(t))$. To be consistent with the concept of frontier, $u_i(t)$ are normalized so that TE_i are non-negative with an upper bound of unity. Then, $TE_i(t) = \exp(u_i(t) - u_{\max})$ where u_{\max} is the maximum value of u_i within the sample.

For measuring changes in technical efficiency over time, the estimates of the efficiency component $u_i(t)$ are obtained by regressing the composite error terms $e_i(t)$ over a polynomial in time T . Thus,

$e_i(t) = a_0 + a_1 T + a_2 T^2 + a_3 T^3 + \dots + v_i(t)$ and estimates of $a_0, a_1, a_2, a_3, \dots$ etc. are obtained by applying OLS method of estimation to the sub-samples of data.

Hence, $\hat{u}_i(t) = \hat{a}_0 + \hat{a}_1 T + \hat{a}_2 T^2 + \hat{a}_3 T^3 + \dots$ as $E(v_i) = 0$

Rate of change in technical efficiency $\dot{u}_i = d/dt (\hat{u}_i(t))$,

and, growth of total factor productivity $(gTFP) = \lambda + \dot{u}_i$.

Estimation of the Model

The production function has been estimated by the panel data estimation methods using panel data for 58 firms over a nine year period (1990-91 to 1998-99).³ The models estimated by this method are 'one way' or 'one factor' designs of the form $Y_{it} = a_i + b X_{it} + e_{it}$, where e_{it} are classical disturbance terms with the properties $E(e_{it}) = 0$ and $\text{Var}(e_{it}) = \sigma^2 \text{Sq}(t)$. In the classical case of regression, $a_i = a$ for all units but in the fixed effects model a_i is a separate constant for each unit. That is, $a_i = a_1 d_{1i} + a_2 d_{2i} + a_3 d_{3i} + \dots$, where a_1, a_2, a_3 are individual specific constants and d_1, d_2, d_3 are group-specific dummy variables such that $d_j = 1$ when $i = j$. The fixed effects model is a classical regression model except that the number of observations become large and OLS estimates are a little difficult to be estimated. In the random effects model, $a_i = a + u_i$ so that $Y_{it} = a + b X_{it} + u_i + e_{it}$, where $E(u_i) = 0$, $\text{Var}(u_i) = \sigma^2 \text{Sq}(u)$ and $\text{COV}(u_i, e_{it}) = 0$.

Thus, $\text{Var}(e_{it} + u_i) = \sigma^2 \text{Sq}(u) + \sigma^2 \text{Sq}(t)$. Therefore, the random effects model is a generalized regression model which provides efficient estimates of the

3. Panel data estimation methods can be read from various sources as listed below.

1. Limdep 6.0 Manual, pp. 298-323 on one-way Fixed and Random Effects models 2. Econometrics by G.S. Maddala. 3. Frontier Production Functions by Greene W.H. (1997). 4. The analysis of panel data by H. Cheng (1986). 5. Cornwell et al. (1990).

parameters of the model. There are two standard test statistics to distinguish between the three alternative forms of the model. The large value of the LM statistic suggests the use of one factor models against the classical regression model with no group-specific effect. Again, a small value of the Hausman Statistic reported by the estimation method argues in favour of the Random Effects Model against the Fixed Effects Model (Griliches and Hausman 1986). These test statistics are computed in the course of estimation and presented along with the other results.

Two alternative forms of production function have been considered. But the results are found satisfactory for the C-D production function only and are discussed. Panel data results based on the Random Effects Model corresponding to the translog production function are as follows:

Random Effects Model Estimates using Trans-log Production Function

$$\begin{aligned} \text{Log } Q = & -5.410 - 0.397 \text{ Log } L + 2.34 \text{ Log } K + \\ & \quad \quad \quad (-0.59) \quad \quad (5.36) \\ & 0.0025 T + 0.142 \text{ Log } \text{LSQ} + 0.0047 \text{ Log } \text{KSQ} - \\ & (0.40) \quad (3.36) \quad (0.20) \\ & 0.193 \text{ Log } L * \text{ Log } K \\ & (-4.10) \end{aligned}$$

$$R\text{-SQR} = 0.605$$

$$\text{Estimated Autocorrelation coefficient} = 0.355$$

$$\text{Lagrange Multiplier Test Statistic (Using AR1)} = 1274.11$$

$$\text{Fixed vs. Random Effects (Hausman) Statistic} = 0.0001$$

Empirical Results

Partial factor productivities and the Solow index of total factor productivity based on the 12 - industry cognate groups data were calculated. Results show that there is evidence of productivity growth in some industrial groups as minerals and metals, chemicals, heavy engineering and transport equipment producing industries. On the other hand, productivity shows a sharp decline in many sectors such as power generation, petroleum/natural gas, fertilizers, medium and light engineering, consumer goods and textiles. On the whole, productivity growth is found to be negligible or even negative. This result is confirmed by the panel data estimates also as follows.

The panel data estimates using the Cobb-Douglas production function and Random Effects Model after applying first order autocorrelation correction (ARI) are as follows:

$$\text{Log } Q = 0.298 + 0.262 \text{ log } L + 0.649 \text{ Log } K - 0.0038 T$$

$$\quad \quad \quad (3.34) \quad \quad (9.45) \quad \quad (-0.19)$$

$$R\text{-Sqr} = 0.79; \text{ Lagrange Multiplier Test Statistic (Using ARI)} = 38.69$$

$$\text{Lagrange Multiplier Test Statistic (Without Using ARI)} = 1343.05$$

$$\text{Fixed vs. Random Effects (Hausman) Statistic} = 0.0001$$

The coefficient of time trend is found to be very small and statistically insignificant. This shows that public sector enterprises have not experienced a significant technological change during the 1990s. Further, the results point to a decreasing returns to scale in production. Results suggest that a majority of the firms have low levels of technical efficiency and that the efficiency has not improved significantly over time. However, growth of technical efficiency is observed in some firms in the engineering sector and many firms in the petroleum producing/selling sector.

Major Conclusions of the Study

- Financial results of the Central Public Sector enterprises, as reported in the Public Enterprises Survey, indicate that more than fifty per cent of the 160 firms in the manufacturing sector are currently loss making. But in the services sector, the percentage of loss-making firms is only around 30. It is surprising to find that the total losses of loss-making firms have increased along with the rising profits of profit-making companies. Profitability by any measure is found high in both the sectors (manufacturing and services) at the aggregate level and Public Sector Enterprises have shown consistent growth in turnover/operating income during 1990s. But there seems to have been a decline in turnover in some industries such as transportation equipment, minerals and metals and textiles. Similarly, profitability is found to have declined in many cognate groups in the manufacturing sector as steel, minerals and metals, fertilizers, chemicals & pharmaceuticals, medium and light engineering, transportation equipment, consumer goods, agro-based industries and textiles.
- As judged by the partial productivities as well as by the Solow index of total factor productivity, there seems to be a consistent decline in the productivity of CPSEs in several industrial groups as power, petroleum, fertilizers, medium and light engineering and consumer goods. In certain industrial groups as steel, minerals and metals, chemicals and petrochemicals, productivity seems to have shown some growth upto 1995-96 and then started falling. Productivity growth is evident in the transport equip-

ment sector throughout the period while in the heavy engineering group productivity has shown an upward trend since 1995-96 only.

- The panel data estimates using the Cobb-Douglas production function and Random Effects Model shows that the coefficient of time trend is small and statistically insignificant. This shows that the Public Sector Enterprises have not experienced significant technological change during the 1990s. Further, the results point to decreasing returns to scale in production.
- The results corresponding to technical efficiency of firms, and ranking of firms by technical efficiency in three broad sectors such as petroleum/oil generation; heavy, medium and light engineering; and infrastructure suggest that a majority of the firms have low levels of technical efficiency and that the efficiency has not improved significantly over time. However, growth of technical efficiency is observed in some firms in the engineering sector and many firms in the petroleum producing/selling sector.

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It is not only new products and services that provide competitive advantage, but also new ideas in every area.... and the source of new ideas is people.

— Dr. Rosabeth Moss Kanter

a well-known framework, BPR can be discussed in terms of Structure, Task, Technology and People. BPR strives to progress from a traditional, functional view of the enterprise to a process view. Looking at the framework one can understand that people contribute toward a greater part of organisational processes and its success.

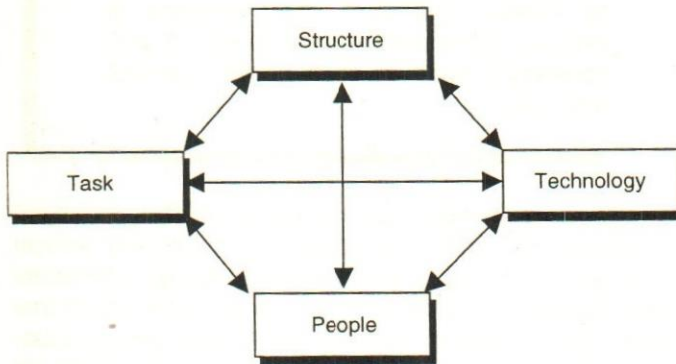


Fig. 1. Framework Related to BPR

“Teamwork” and ‘empowerment’ are abstractions and generalities around which it’s impossible to get one’s arms. They describe characteristics or attributes that one might want an organisation to exhibit, but there is no direct way to achieve them. They are consequences of process designs and they can only be achieved in that context”. (Hammer & Champy, 1993, p32). As discussed by Limerick and Cunnington (1995), “The strength of the reengineered organisation lies in the empowerment of individuals. (p.237).

Empowerment

Empowerment has become a widely used term and has been given a confusing variety of meanings and interpretations. It is the process of transforming oneself from dependence to independence to interdependence state. This is synonymous to taking charge of one’s life. In simple definitional terms, the verb to empower means to enable, to allow or to permit and can be conceived as both self-initiated and initiated by others. For social change agents, empowering is an act of building, developing, and increasing power through co-operation, sharing, and working together. It is an interactive process based on a synergistic, not a zero-sum, assumption about power; that is, the process of empowerment enlarges the power in the situation as opposed to merely redistributing it. Empowerment starts as a pragmatic approach to rethinking power in terms of what can be rather than what has been.

Empowered Organisations

Empowered organisations are composed of em-

powered persons, although it is not necessarily true that a group of empowered persons automatically creates an empowered organisation. Organisations that are truly empowered have moved out of the old paradigm of competition and beliefs in limitation and scarcity. The empowered organisation is one that is moving or has moved into the “new paradigm”. Empowered organisations have transformed themselves so that they are able to demonstrate such characteristics as: clear and honest communications, collaboration within and between work units (usually called teams), shared responsibility in all aspects to task and process, and delivery of high quality products and services driven by customer/client need.

Empowerment is “the process of sharing power and providing an enabling environment (by removing hurdles) in order to encourage employees to take initiative and decisions to achieve organisational and individual goals”.

The above definition applies for self empowering as well as for empowering others. Empowerment is a different way of living together. This requires changes at three levels:

- individual
- team and
- organisation.

Changes are required in

- the mind set of people
- relationship among people and
- organisational structure

The starting point is the changes at individual level which would influence the changes at other levels too. At individual level the changes required are

- Looking inward from outward
- Shifting from process orientation to outcome orientation
- Taking responsibility than waiting for it to be given
- Seeking Information for learning.

Therefore empowerment can also be seen as supported by three pillars of individual, team and organisation in an integrated manner as shown in Fig. 2. An empowered person can empower others; therefore leaders have to be self empowered and then empower others. Most of the leaders may be empowered but

they forget to empower others. An empowering leadership is more important than empowered leader.

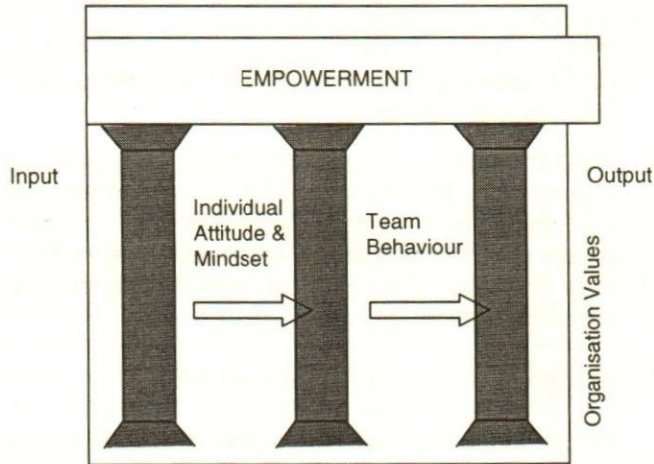


Fig. 2. Pillars of Empowerment

Empowering Framework

In an attempt to measure level of empowerment a measuring instrument based on the conceptual framework was developed by Gupta (1999). In the framework factors were grouped into empowering variables and consequences (outcome variables). Empowering variables contribute in varying the level of empowerment directly whereas the outcome variables affect empowerment indirectly through feedback in a closed loop process.

Empowering variables are:

- Respect for Team Members (RTM)
- Top Management Attitude to Human Resource (TMA)
- Opportunities for Learning Application (OLA)
- Open Communication (OC)
- Organisational Support for Innovation (OSI)
- Responsive Superior (RSR)
- Opportunities for Self Development (OSD)
- Low Formalisation (LFN)
- Performance linked Feedback (PLF)
- Autonomy (AMY)

The factors grouped under consequences are influenced by the empowering variables. These are:

- Self efficacy (SE)
- Organisational Commitment (OCT)

- Job Involvement (JIT)
- Work Environment Satisfaction (WES)
- Role Satisfaction. (RS)

From Fig. 3, it is clear that enhancement of empowering variables would enhance the consequences and as consequences are enhanced they help in enhancing the empowering factors too. Thus it creates positive spiraling effect. (Gupta, 1999).

Principles of BPR

The principles of Business Reengineering emerged during the early 1990's as suggested by Coulson-Thomas (1994) can be divided into following categories:

- Customer Focus
 - External
 - Internal
- Empowering Focus

Customer Focus

External Customer Focus

- Externally, focus on end customers and the generation of greater value for customers.
- Give customers and users a single and accessible point of contact through which they can harness whatever resources and people are relevant to their needs and interests.

Internal Customer Focus

Internally, focus on harnessing more of the potential of people and applying it to those activities which identify and deliver value to customers. This principle tends to be overlooked.

Empowering Focus

Opportunities for Self Development (OSD)

- Encourage learning and development by building creative working environment. (This principle has been almost forgotten in many organisations, the current emphasis being to squeeze more out of people and working them harder, rather than improving the quality of work life and working more cleverly).

A case manager provides a single point of contact

When a customer calls with a complaint, one per-

formance against... specific improvement goals?; What is the vision and strategy for change?; How best can associates col-



- Encourage involvement and participation. This requires error-tolerant leadership.

Low Formalisation (LFN)

laborate in the process and share the vision and strategy for change?

Solutions

Technical Design: What are the required technical resources and technologies needed in the reengineered process?

Social Design: What are the required human resources? What immediate, near term and long range opportunities exist? How will responsibilities change? What training programs will be required? Who is most likely to resist change? How can they be motivated to accept or participate in this change? What will the new organisation look like?

Transformation: How and when should progress be monitored? How should unanticipated problems be handled? How is the momentum for continuous change sustained? Empowerment provides the base to transform whatever shape and size it is required.

BPR Success Stories

The classic example of a reengineered process is the way IBM Credit Corporation now handles credit issuance. IBM Credit Corporation, if independent, would be a Fortune 100 company. Prior to reengineering, it took IBM Credit from 6 days to two weeks to issue credit. Often they would lose customers during the lengthy approval process. Today, the process takes only minutes or hours. Initially, to fix this process, IBM put computer terminals on everyone's desk to pass information electronically. Next they attempted queuing theory and linear programming techniques. Finally they tried setting rigid factory like performance standards for each employee involved in the credit approval process. In each instance, their changes failed to reduce the time it took to approve credit applications.

Finally, "IBM Credit had a brainstorm. Executives took a financing request and walked through all five ladders in the approval process, asking personnel in each of the five offices to put aside what they were doing and to process this request as they normally would, only without delay of having it sit in a pile on someone's desk. They learned from their experiments that performing the actual work in total took only 90 minutes. The remainder, now more than seven days on the average, was consumed by handing the form off from one department to the next. In the end, IBM Credit replaced its specialists—the credit checkers, pricers, etc. with generalists. Now instead of sending an application from office to office, one person called a deal structurer,

processes the entire application from beginning to end" (Hammer & Champy, 1993).

IBM Credit developed decision support systems for the deal structurers to guide them through the credit issuance process. They gave them rapid computer access to all the key information required to issue credit. They developed an approach by allowing routine applications to quickly go through the approval process and having the more complex, troublesome requests addressed by a small pool of specialists.

Common Pitfalls of BPR

Again, according to Hammer (1993) there are a number of common pitfalls that companies fall into while reengineering key business processes. These include:

- Trying to fix a process instead of changing it.
- Ignoring everything except process redesign.
- Neglecting people's values, beliefs and the corporate culture.
- Placing prior constraints on the definition of the problem and the scope of the reengineering effort.
- Trying to make reengineering happen from the bottom up.
- Concentrating exclusively on design, to the exclusion of actual implementation through pilot or full blown projects.

Common pitfalls that companies fall into while reengineering key business processes is ignoring everything except process redesign.

Shortcomings

Consequently the following are the most common shortcomings:

- Spending megabucks on new technology while giving little or no thought to changing the organisation's underlying business processes. The latter is often far more difficult since it involves invading political turfs and soul searching by the company's key executives. Empowering people will help in utilising technology and equipment to get what is required.

- Delegating the task of reengineering to an outside consulting firm. Usually this firm has a little or no track record in reengineering or industry specific experience. The outside firm is a sort of "crutch", relieving the organisation from the sometimes arduous but always rewarding task of empowering and involving their employees at all levels in the reengineering process. Often this outside firm is used to help them in making the technology decision, a task they are usually only marginally qualified for.
- On the other hand, involving the right outside consulting firm can be critical in breaking down organisational barriers and providing a fresh, presumably objective organisational assessment. The outside firm can also facilitate team building which is critical to sustaining the reengineering process.
- Inability to identify key breakpoints in core business processes. Breakpoints are defined as the achievement of excellence in one or more value metrics where the marketplace clearly recognizes the advantage, and where the ensuing result is a disproportionate and sustained increase in the supplier's market share. Identifying the key breakpoints needs every one's effort. Empowered people will be able to identify and fulfill the requirements.
- Most companies fail to commit the resources, internal or external to the task. Their key executives are so busy "putting out fires", they think they don't have time to address BPR planning needs. The key term here is "think". BPR often addresses the most "screwed up" processes of a company. If these are not addressed they fester and can mean ultimate disaster. Empowering environment and empowered people will make top level executive free from routine activities in which most of the executives remain busy.

BPR through Empowerment

The purpose of empowerment is to encourage employees to take initiative and decisions to achieve the company's and individual goals. Therefore the process of individual and family goal setting become the first step in this journey of empowerment. The vision is more about motivating people than about providing them with direction. Empowerment of people in organisation is essential and a necessary prerequisite for implementing BPR. Organisations have to adopt certain empowering practices in order to create an empowering environment. As seen from the framework of empowerment, the organisation has to create an empowering environment at organisational

level. This would help the diffusion of empowerment at team level.

The purpose of empowerment is to encourage employees to take initiative and decisions to achieve the company's and individual goals.

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Alongwith rest of the world, India needs to embrace new ideas, attitudes and approach to meet the new challenges of the new era.

We need to excel in all our activities in order to hold our own in the challenging global economy. There is no alternative but to raise productivity and quality continuously in all walks of life in order to achieve a higher standard of living of our people.

– A.B. Vajpayee, Prime Minister of India

Accountability in Agricultural Education

S. Kannaiyan, C. Ramasamy & T.R. Shanmugam

Professional education in India is cheapest in the world. Agricultural education is not an exception to this. Because of lower cost of agricultural education, students from rural areas and of relatively low socio-economic status can afford to take higher education in most of the agricultural universities in this country. Every year government invests thousands of crores of rupees on subsidized education. The article analyses the methodology to assess return on this investment.

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India continues to face the problem of fast growing population and has to confront the major challenges of feeding the huge population. There was an impressive growth in agricultural production due to a breakthrough in agricultural research, which brought about substantial improvement in productivity of crops. Almost all crops exhibited significant growth in terms of productivity at national level. Total public sector investment on agricultural research and education in India was Rs. 10923.71 million in 1994-95 at current prices. On agricultural extension, an amount of Rs. 3347.67 million was spent during the same period. Empirical studies reveal that investment on agricultural research and education plays a crucial role for the growth of agriculture in India. Teachers in Agricultural Universities have important roles to play. They have to impart knowledge, update syllabi, produce innovative, need-based courses, try out materials and evaluate learners' achievement as reflected in their performance. They must come out with special courses and programmes designed to cater to the needs of students coming from the weaker sections of the community and from rural and tribal areas. They must play their roles in the area of agricultural human resource development and thereby promote academic excellence (AIU 1995). Teachers and researchers in agriculture have a larger responsibility and accountability to the society as huge sum of public money is invested on agricultural education and research. They must be totally committed to development of agriculture. In this paper, an attempt is made to look at the notion of accountability first in general terms and then in the context of Agricultural education and research.

Investment on agricultural research and education plays a crucial role for the growth of agriculture.

Agricultural Education in India

Agricultural development is a multi-disciplinary and

complex process interwoven complementarily to utilize the available resources for higher output. Organized instructions in agriculture and allied sciences started in India in the beginning of the 20th century when six agricultural colleges were established between 1905 and 1908. Initially, these colleges offered diploma courses. Subsequently they started undergraduate and post-graduate programmes in 1920s and 1930s respectively. All these colleges were engaged in teaching alone leaving the research and technology transfer to State Departments of Agriculture and Animal Husbandry. The establishment of Indian Agricultural Research Institute (IARI) in 1958 with the integrating functions of research, teaching and transfer of technology was a landmark in the history of agricultural education in India (Kannaiyan 1994).

The Education Commission (1966) recommended the establishment of atleast one agricultural university in each state with the following functions.

- Concern for all aspects of generating, disseminating and applying knowledge related to agriculture, undertaking both basic and applied research
- Primary emphasis on teaching, research and extension activities which are directly and immediately related to addressing the solution for social and economic problems of the country side
- Readiness to develop and teach wide range of applied sciences and technologies needed to build up the rural economy
- Readiness not only to teach undergraduates, post graduates and research students, but also to give specialized technical training to young people who are not candidates for degrees; and
- Emphasis on adult and continuing education side by side while teaching regularly for enrolled students.

The national agricultural research system is a two tiered system comprising ICAR and its institutions at national level and the State Agricultural Universities (SAUs) and their associated zonal research stations at state level. ICAR employs about 6000 scientists working in 45 research institutes, four national bureaus, nine project directorates, 79 coordinated research projects and 30 national research centres. There are 32 State Agricultural Universities (SAUs) with four ICAR institutions with deemed university status and one Central Agricultural University in India. Currently the SAUs have 22500 sanctioned scientific staff position in 161 col-

leges with under graduate and post graduate admission capacity of 11000 and 6000 students respectively and a total enrollment of about 44500 students (Kannaiyan 1994).

Agricultural Universities withstood the test of time and focussed on complex issues associated with green revolution and environment. The role of SAUs in rural development in general and agricultural development in particular is increasing over the period. The research, teaching and extension activities are accountable to the nation. SAUs not only generate agricultural technologies but also develop man-power for research, teaching and extension. Besides, other dimensions to be covered by agricultural universities are ecology and environment, biotechnology, aquaculture, sericulture, dairy and veterinary, export oriented horticulture, agro-forestry and agri business management (Singh, 1998).

Agricultural Universities not only generate agricultural technologies but also develop man-power for research, teaching and extension.

Agricultural education is a sub-system of the total system of education, which is a sub-system of our socio-economic system. Agricultural education in its broadest sense covers all human endeavours in acquisition, transmission and absorption of knowledge and understanding of the process which lead to scientific farming. Agricultural education covers all basic needs of human beings like food, cloth and shelter. Agricultural education must be practical oriented, skill development oriented and issue based. It must create self-employment and solve social, economic and environmental problems.

Agricultural education must be practical oriented, skill development oriented and issue based. It must create self-employment and solve social, economic and environmental problems.

Every year, our government invests thousands of crores on subsidised education, scholarships, grants to institutions for recurring and non-recurring expenditure and so on (Abdul Kareem & Ramaswami 1997). Total public investment in agricultural research and education, at 1981-82 prices, has shown consistently high growth rate of 5.40 per cent since 1960s. The major

impetus came in the 1970s when the investment grew at the rate of 9.50 per cent, mainly because of manifold increase in central funds. The investment, in terms of percentage of Agricultural GDP increased from 0.21 per cent in the early 1960s to 0.39 per cent in the 1980s, which further rose to 0.49 per cent in the early 1990s. The rate of returns to investment in agricultural education is mostly low. Mehta (1994) has concluded that:

- Social rate of return is low due to large unutilized capacity in faculty and infrastructure.
- Private rate of return is more than social rate of return.
- Unit cost of education is high because of underutilized resources and infrastructure.

The question is about the accountability of huge investments made on agricultural education and research and dividends received by concerned agencies thereof.

Accountability

Accountability means rendering an account of or taking an account of the responsibility or tasks assigned to an individual or a department or an institution or both. Accountability is a broad concept and subsumes the concept of 'responsibility' which means that a person is required to carry out or to see to it that certain tasks assigned to an individual or a department or an institution are carried out (AIU, 1995). Accountability in agricultural education and research must be examined on the following inter-related parameters: teaching, research and extension. The people involved are teachers, learners, researchers, administrators and policy-makers. Accountability is a critical need for the University system at all levels. As the report of the UGC Committee, Towards New Educational Management, says: "Accountability of the teachers through the Heads of Departments/Deans/Directors should be to the Vice-Chancellor and the various University bodies (such as the Board of Management and Academic Council). The University through the Vice-Chancellor should be accountable to the society. Everyone in the University community should realize that autonomy and academic freedom do not free them from being accountable".

Accountability means rendering an account of the responsibility or tasks assigned to an individual or a department or both.

Every person involved in planning, designing, administering and undertaking agricultural education and research must be aware that he is primarily accountable for various responsibilities. In recent times different concepts of accountability in agricultural education and research have been discerned (AIU 1995).

Social accountability

Social accountability refers to the responsibilities of the University system to the society. It is normally measured with respect to its objectives—what the system of agricultural education and research is expected to do and what is achieved and why there occurs a gap in the expectation. Social accountability, therefore, presupposes the formulation of clear cut goals and objectives which should be made known to the society well in advance. Social accountability is difficult to measure and achieve as it involves normative judgement and connotation. The present objective of the agricultural education and research system is framed in normative context and is not expressed in quantitative terms. For instance, the Indian Education Commission has formulated the objectives of the Indian higher education system in the following words; "Education should be developed so as to increase productivity, achieve social and national integration, accelerate the process of modernization and cultivate social, moral and spiritual values".

Social accountability refers to the responsibilities of the University system to the society.

The objectives should be expressed in some concrete form, in terms of quantitative performance indicators, so that the achievement of the University during a period of time can be easily compared with the objectives and the gap between expectation and performance can be analyzed and responsibilities can be fixed for any shortfall or lapse. The objectives of the University may be formulated on the basis of the following considerations:

- The objectives of the University can be spelt out in terms of manpower that would be turned out by the University every year. The target of manpower to be created by the University should be based on the assessment of manpower requirements of the different sectors of the economy based on a manpower survey to be conducted by the University periodically.

- Courses to be offered by the University and their relevance to meet the needs of the society and nation may also influence the objectives of the University.
- The number of students to be admitted in each year, course-wise, sex-wise and caste-wise should be another component. This would help the University to achieve the equity aspect of agricultural educational objective.
- Special facilities and opportunities to be offered by the University to the weaker sections of the society both in the matter of admission and appointment should also influence the objectives of the University.
- Objectives of the University should take into account the type and number of industry and institution linkages expected to be forged during the particular year.
- The University should also take into account the manpower needs indicated in regional and national plans.

The university must have clear-cut and welldefined objectives which will provide solid foundation for the teachers and researchers to pursue their activities which are beneficial to the clientele and the society.

Micro Accountability

Micro accountability is concerned with the responsibilities and performance of each one of the functionaries within the system—academic, administration and financial accountability. Administrative accountability relates to the managerial functions that are necessary for smooth functioning of university and its various subsystems. Academic accountability is concerned with the implementation of academic programmes and the achieving of minimum standards of education. Financial accountability deals with the procurement of funds and efficient utilisation of resources. The degree of accountability can be perceived only when the functions and duties assigned to the agencies in the system are properly evaluated.

Micro accountability is concerned with the responsibilities and performance of the functionaries within the system.

Legal accountability

The educators are accountable to their universities,

government and management. Legal accountability is mainly characterized by following the rules and regulations and managing teaching-learning in the framework of rules. Unlike most traditional universities, agricultural education is not free from irregularities in academic discipline. Such academic indiscipline consequently results in lethargy on the part of students and teachers; superficial coverage of subject matter; inadequate time for practical and skill achievement. In fact, legal accountability should be the major concern of administrators and teachers in agricultural Universities.

Moral Accountability

Moral accountability is towards students and the society. Students put in private investment for education, and society provides social environment in addition to public investments for education. Are we not accountable to the investments of society and are the teachers not responsible to give rich dividends to students in terms of advanced and need-based agricultural education and proficiencies? Yes, the agricultural Universities have definite moral responsibility in this regard.

Agricultural education has also social and ethical norms of the society to which they belong. The students must be able to identify and deal with the agricultural issues of their own society. In Indian conditions, it is more pertinent as the social system is more complex and traditional. Agricultural education system must consider:

- Do our agricultural graduates understand the difference between what is and what ought to be and their role in agriculture?
- Are our students able to relate agricultural science with social and ethical values, beliefs and experiences?

To answer these questions positively, it is necessary to expose our students to teachers who share their experience in dealing with social and ethical issues in non-prescriptive way.

Accountability in economic context

Agricultural education is expected to promote self-employment in rural areas by helping youth develop skills for managing rural agro-based small-scale enterprises. It was the heartfelt expectation of the father of nation, Mahatma Gandhi. The picture is, however, gloomy, forcing agricultural graduates to migrate to urban areas for service. It has reflected in low private

and social rates of return to investment in agricultural education. Today's dynamic, competitive, global multilateral agro business environment necessitates change in agricultural education. However, change is never popular, it is often resisted. The educators, administrators and policy makers in agricultural education sector must accept the role and responsibility to be in the forefront of efforts to build understanding and acceptance of rapid agricultural evolution that is fueled by economies of scale and global competition (Rainey 1992).

Today's dynamic, competitive, global multilateral agro business environment necessitates change in agricultural education.

Agricultural universities are therefore, required to provide higher education in Food process engineering, Biotechnology, Agri-Business Management, and Farming Systems Management to make agricultural graduates complete in knowledge and technology, nationally and internationally. Only competent agricultural graduates would be able to pay back rich dividends to society and earn for themselves substantially more than the investments made. Others would wander disgusted for petty and non-remunerative jobs and curse the university which conferred degree on them.

Agricultural universities are required to provide higher education in Food process engineering, Biotechnology, Agri-Business Management, and Farming Systems Management.

Accountability in Agricultural Education

Having established the need for accountability, let us see how it has to be implemented. Accountability is an extremely useful concept but if steps are not taken to make different faculties of the University system accountable to the society through performance appraisal, all talk about accountability leads us nowhere. Teachers' performance as teachers, evaluators, leaders and socially conscious citizens has to be evaluated through quantifiable norms by the Governing and Management Bodies of the University consisting of representatives of University management, Deans/Directors and Heads of Department. The norms of evaluation should be evolved

by the agricultural university by considering the views of teachers also. Norms of evaluation may include:

- How many students of a particular teacher in a particular subject pass?
- How many of those who passed have earned high marks?
- How many times in an academic year the teacher absents himself in normal circumstances?
- How many times the teacher comes to work late?
- What extra-curricular activities the teacher participates in?
- How many educational conferences he has attended?
- What are his contributions to the expansion of knowledge area?

A good teacher must be a constant hunter of new knowledge. He should also be a good communicator so that the newly acquired knowledge can be shared with the students. Good teachers are innovators. For students to derive the benefit of their innovativeness, Academic Committees should be formed within each college under the overall guidelines of the Board of Studies of the university. New academic programmes relevant to the students and job opportunities and special skills needed in the area where the college is situated can be devised and implemented. The College Academic Committee must have the freedom to devise these courses. The University Board of Studies can examine the proposals and offer expert advice. The University can send an Affiliation Commission to verify the infrastructural facilities available at the colleges. This will help in making teachers more innovative and socially relevant. The second set of norms may include:

- Has the teacher undergone refresher courses within last three years in specific subject area?
- Has the teacher added recent books to the university library?
- Has he helped to purchase recent journals for the university?
- How many books and practical manuals the teacher has written in the past five years?
- What are new methods of teaching introduced by the teachers? (Lecture vs participatory vs audio visuals vs field visits).

- What are the assignments given by the teachers? (Theoretical vs Practical Problems).
- Do the teachers correct deficiencies pointed out by the Review Reports/Impact Evaluation Studies?

Several educational commissions and experts have made it clear that the purpose of education, including agricultural education, is to give the younger generation the right of socio-political, economic and cultural orientation in such a manner that the national needs of socio-economic development are met. The teachers are expected not to coach the students for certain examinations and through them for degrees alone. Universities and Colleges must not be looked upon as mere machines to conduct examinations that churn out graduates in large numbers. Society and Government look upon universities and teachers to provide motivation to the students and shape them as good citizens.

According to the UGC report on Programme of Action (1986) "teachers are accountable to the pupils, their parents, their community, and to their profession".

Programme of Action has enunciated that a system of teacher evaluation should be open, participatory, and database would be created. Norms of accountability would be laid down with incentives for good performance and disincentives for non-performance.

What needs to be emphasized here is that teacher-centered accountability is not and should not be a unidirectional process. It is reciprocal and interactive. The individuals and institutions involved in this process are: the Head of the Department concerned, the Deans/Directors of the Faculty concerned, the Boards of Studies, Academic Council, Board of Management, Society—the community in which teachers and learners interact, the University, the ICAR and Ministry of agriculture. They are all responsible for effective and smooth functioning of academic systems.

The following points must be kept in view in the process of exploring the features and properties of "accountability".

- In the shaping of the personality of learners, it is not only the teachers who play their role; parents, the community and educational system have to play their role.
- Learning cannot and should not be viewed as an input/output activity; teachers' input is not and should not be a unidirectional process: it is an interactive process.

- Effective teaching-learning is possible if and only if the system offers teachers some of the basic facilities such as secretarial, library, and laboratory facilities.

The notion of accountability cannot be examined in isolation. What is really important is to state clearly the objectives of education at different levels and work out a framework of norms in terms of which the roles and responsibilities of different constituents can be examined—keeping in view the primary objective of education which is to help learners externalize their built-in potential. Looking from this point of view, investment in agricultural education is an investment in human resource development, in man-making and nation-building activities.

Investment in agricultural education is an investment in human resource development.

In order to motivate teachers to put in their best, it may be useful to link 'promotion' to 'performance'. Teachers should be asked to submit self-appraisal reports every year and discipline-based committees should examine the reports of teachers in their respective disciplines.

Measures for Improving Accountability in Agricultural Education

Management Efficiency of Teachers

Management is a process of achieving the objectives set forth by efficient use of human and natural resources. It includes planning, organising, direction and control functions. A teacher in order to efficiently discharge his role should plan his curricular and extra curricular activities, organise men and materials, guide his students and control their action through appropriate measures to achieve desirable results. To effectively plan his activities, the teacher must be conscious of time management. Time management must be thought of at a micro-level class room lecture planning to that of annual job plan. This is yet another task is easier said than done. Training must be given to teachers to make them aware of the principles of time management and adopt the same. While organising his resources to impart knowledge and skill to the students, the teacher should not confine to his own potential. He should also be a facilitator who creates an environment for learning. To enrich information flow, he must invite

experts in the related subjects from nearby places or within the university to share their experience with the students. Apart from conventional sources of information (books and journals), teachers must also collate information from internet which enables faster access to latest information. Efforts to guide students must focus on creating a good personality and not confined to mere transfer of subject matter. In this regard, communication skills of the individual will significantly influence in creating a bonding with the students and guiding their action.

Management is a process of achieving the objectives set forth by efficient use of human and natural resources.

An appropriate questionnaire must be designed to get information relating to the aspects indicated above, and the information gathered in that way must be analysed and the teachers' performance must be evaluated. While focussing on measures to improve the managerial efficiency of teachers, it is essential to control their actions through a set of rewards and disincentives, as stated by the National Policy on Education which was evolved in 1986 and revised in 1992, which has suggested measures to improve efficiency of teachers as: "Non-observance of norms must result in disincentives while good performance must receive recognition, incentives, and due publicity".

Accountability through assessment of performance can also be enhanced through simplification of procedures and processes, which hamper action. Modernization of offices will also increase the efficiency of the system and streamline evaluation of performance. To make the college as a whole accountable to the immediate society it serves and the student community, a College Evaluation Committee (CEC) should be formed. The CEC will consist of two educational experts in the State, the Vice-Chancellor of the University to which the college is affiliated, and a representative of the Board. It can also have a representation from Deans and Directors. CEC will visit the campus every year and suggest measures for improvement.

Economic strengthening of SAUs

Because of the constraints on resources, every rupee spent on education, whether it be government-generated or privately raised, should be monitored. Cost effectiveness is of utmost importance in the field of education. This can be implemented through periodic

assessment of the effectiveness of financial and administrative norms. New courses/programmes can be evaluated by examining the following criteria:

- Relevance for prospective users
- Number of users
- Cost per user (unit cost)
- Teaching, evaluation and administrative expenses
- Fees to be collected
- Equipment cost
- Other operational expenses
- No course be offered incurring loss
- No course be offered for making large profit
- Actual cost plus 10 per cent margin for development and future expansion
- 10 per cent be corpus fund open to Inspection

This corpus fund should also take care of special incentives for outstanding teachers and students/research scholars. It is ironical that agricultural education is given secondary importance in SAUs as compared to research. Education needs more investment as it is essential for modernizing laboratories, classrooms and production of instructional material. It is estimated that major portion of the budget allotted to SAUs is spent on administration and thus meagre amount is left for educational and allied activities.

Resource Sharing

In order to ensure accountability among teachers and researchers, adequate facilities must be created at the university level. Information flow across institutions and adequate infrastructure will enhance the performance efficiency of teachers and researchers. Every SAU must interact with other SAUs within and outside the state and there must be an annual sharing of policies and programmes among all such institutions. Such meetings can discuss common problems and remove the cause of those problems in a concerted manner. Procedures and processes that hinder the

Information flow across institutions and adequate infrastructure will enhance the performance efficiency of teachers and researchers.

smooth functioning of agricultural educational institutions can be totally eliminated or greatly simplified as a result of such meetings. Common principles can be evolved for admission procedures, teaching and evaluation methods, reporting of results and elimination of duplication of research projects. Moreover, library and computer facilities can be shared with one another. Networking of agricultural institutions in the state and across the state will remove wasteful expenditure. It will improve efficiency and help to render better services to the people of the state and the nation.

Management Information System

For streamlining the flow of information within an educational institution and between the institutions, a Management Information System (MIS) can be developed. This can be linked to the state and national level information networks. One item of information vital to students is the Academic Calendar. The University should draw up a calendar for the entire academic year detailing the various activities with dates—admission, commencement of classes, beginning and end of terms/semester, summer vacations, holidays, elections, youth festival and other major extra-curricular activities, internal tests, university exams, starting of evaluation, completion of evaluation, announcement of results etc. Each college affiliated to the university must draw up its own calendar of activities in tandem with the university calendar. Setting a date for each activity—whether major or minor—is not merely a sign of discipline; it is at the base of accountability.

A university activity does not drop from heaven. It is a deliberately planned action for the benefit of the students, teachers, administrative staff or the public. It entails deliberations by persons initiating the action. It needs cooperative action by a group of persons. It requires materials and equipment. It may demand space. It definitely needs time, but the time has to be set and connected work has to be broken down into smaller items with their own finishing time and all items have to be coordinated against the time set for finishing the whole activity. Thus one can see how important it is to analyze every activity and enlist the cooperation of all to reach the target within the time set before the activity begins.

If there is a proper understanding between the institution and its teachers/researchers about what to do in a term, when to give mid-term and end-term tests, institution's policy about absenteeism of both the teachers and the taught, how the term papers or test papers have to be valued, grading system and how performance appraisal should be done both for teachers and students, how many class assignments

students must take, then much of the dissatisfaction of teachers with the students and vice-versa, will be removed. Both groups will have ample respect for one another if they transact business with this advance information. Student unions and their leaders must know before hand when they should plan their art and drama festivals so that their plans and the plans of those who are in charge of university/college examinations and class test do not clash. A simple calendar can work wonders. Working against deadlines set before hand may appear a bit too hard in the beginning but in course of time it becomes a pleasurable routine.

Quality Improvement

The system of quality improvement in agricultural education has been implemented by ensuring uniform syllabus of the courses taught in the agricultural universities all over the country. The stamp of accreditation, as a necessary condition for the survival of an institution has been thought of at present. And herein comes the accountability of our agricultural institutions and teachers. In fact it is high time now to have a separate Agricultural Education Policy of the country; so far only policy statements have been made. It will definitely strengthen the agricultural education. However, in context of accountability in agricultural education following recommendations would be useful (AIU, 1995).

Of late, there has been a widespread consensus that quality of graduates in various disciplines of agricultural sciences does not match with the changing needs. Hence, there is an urgent need for the SAUs to give attention for upgrading the quality and standards of agricultural education. Academic inbreeding is considered a major problem in most of the SAUs. Curricula and teaching methods are to be modified, physical facilities, equipment and teaching aids have to be modernized and competency of teachers needs to be improved especially in the context of globalizing Indian agriculture.

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Globalization has inherently a business connotation. In Indian education which is dominated by classical ethos, words like 'business', 'marketing', 'profit', etc., are still untouchable. There is no economic statement in

objectives or even as part of the strategy plan. We should shift the mental paradigm of education as elitist transfer of knowledge from one generation to another to a more industrialised concept and paradigm. Economics and business have to be an agenda and part of ethos of educational institutions as a pre-education to globalization (Mukhopadhyay 1997). This requires agricultural education to encompass business connotation with sound technology base, emphasis on 'natural resource management' to ensure sustainability with inbuilt environmental concerns. This requires the present system of agricultural education comprising the following components, namely, faculty, students, learning environment and the learning content to be reoriented and modified, to meet the imperatives of globalization. The teachers must make efforts to equip them to the changing context such as globalisation. Unless they take personal interest, transformation of agricultural education will get delayed.

It is essential to update the knowledge of faculty with respect to advanced educational and instructional technologies. In view of this, establishment of Educational Technology Cell in each agricultural university, would be very useful. ICAR may provide substantial grants for the same. At present, it is being executed by ICAR in some of the agricultural universities in India.

Agricultural Curriculum

In context of the changing scenario of agricultural sector, it is essential to update and develop present curriculum and courses to suit the needs of farmers, agro-based private sector and public sector. It is observed that old and outdated courses are still continued with and agricultural graduates are never tuned to present requirements. Internationalization of curriculum without disturbing their localized and need-based character needs to be thought of, because our graduates will have to work in an environment that is influenced by competition in international markets in near future. Career guidance cells would be of vital importance in this connection. Students need to be acquainted with present market needs and prepared for accordingly. Linkage between industry and education should be strengthened through guidance cells.

Agriculture is an applied science, hence rigorous practical training and continuous updating of knowledge and skill is necessary. At present due to various reasons, students are engulfed in activities other than learning. Academic calendars are not strictly adhered to, evaluations and assessments are not properly done in case of students as well as teachers, attendance is poor, mostly theory is taught. Lack of experiential and

hand- on experience learning, more weightage to grades rather than overall development, lack of effective and cordial linkage between teacher and student, apathy towards each other's efforts in teaching/learning, inefficient faculty and so on, have resulted in the creation of inefficient, inadequately equipped graduates and post graduates in agriculture. Teachers must rise to the occasion and spur the thinking of management among students to make the whole system relevant to the societal need.

Agriculture is an applied science, hence rigorous practical training and continuous updating of knowledge and skill is necessary.

We always say that ours is an agricultural country and 70 per cent people are dependent on agriculture. Then in how many high schools in the country is agricultural education imparted? In developed countries like USA, in Illinois State, more than 50 per cent schools impart instructions in agriculture (Russell 1993) and in India basics of agriculture start at higher education level in spite of the fact that rural boys and girls live in and around farms during their high school period. Agricultural education should invariably be imparted from school level.

Agricultural education should invariably be imparted from school level.

Accreditation System & Self Study

All over the world, various national and state agencies conduct accreditation as a regulatory process. However, voluntary accreditation of educational institutions, as carried out by the various accrediting bodies, is a uniquely American process. Quality assurance and institutional and program improvement are the two main purposes of accreditation. There are two types of voluntary accreditation of educational institutions. The institution as a whole is accredited or specific programs within an institution can seek accreditation from the concerned national professional associations. However, in India, the concept of assuring quality in agricultural education is relatively new. The concern, which has in the past focused upon standards, has now shifted to quality. Several national organisations are already functioning in relation to assessment and accreditation of institutions of higher

education. For example, the National Board of Accreditation of All India Council of Technical Education (AICTE) is a statutory body that deals with professional disciplines such as engineering, management and pharmacy studies. Another organisation, the National Assessment and Accreditation Council (NAAC) is an autonomous institution established by the University Grants Commission (UGC) that has the mandate of judging and assuring quality in liberal arts, sciences and other disciplines. Similarly, the Medical Council of India looks after the accreditation of medical education, while the Indian Council of Agricultural Research (ICAR) discharges the same responsibility for agricultural education.

ICAR aids, promotes and co-ordinates agricultural education in India. It has been guiding and regulating quality of agricultural education in the country through Education Panel (1952), Standing Committee (1965) and Norms and Accreditation Committee (1974). To further improve and sustain the quality of agricultural education, an Accreditation Board was established in 1996 with well-defined objectives and functions with Director General of ICAR as its chairman, Deputy Director General (Education) as Vice-Chairman and Assistant Director General (Accreditation) as Member Secretary and eleven members of experts from Agriculture and allied sciences and representatives from Agriculture and Agro-Industry. The Accreditation Board has approved a set of criteria and general institutional requirements that must be met by an institution to be accredited. The process starting with a self-study, which is an educative exercise is designed to achieve institution-wide improvements in teaching and learning.

Accreditation is a process of assuring an acceptable institutional quality and is a tool for improving educational standards. The process intends to strengthen and sustain the quality and integrity of education and it is for improving transferability and marketability of students nationally and internationally. Accreditation status of an agricultural institution will constitute a statement to the general public that: it has clearly defined and appropriate educational objectives, it has established an environment that makes achievement of these objectives possible, it is accomplishing its objectives substantially and it is so organized, staffed and supported that it is expected to continue to do so.

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The Accreditation Board has approved a set Criteria and General Institutional Requirements that must be met by an institution to be accredited. The process starts with a self-study, which is an educative exercise, designed to achieve institution-wide improvements in teaching and learning. The accreditation as well as institutional self-study is an on-going process and not an end in itself. One of the goals of self-study is to foster planning and institutional research. As the society is becoming more and more technology dependent, it is of paramount importance that the State Agricultural Universities which are key institutions primarily involved in agricultural education should offer latest science and technology based agricultural education and should follow modern teaching methods. Self study is an important component for educational transformation and continuous improvement of quality in agricultural education. For effectiveness of any accreditation process, the minimum norms and standards for different academic programmes must be prescribed by the universities involved in agricultural education. Indian Council of Agricultural Research has taken up lot of initiatives for improving the quality of agricultural education with a view to training high quality human resources to meet the challenges and requirements of our country in agricultural sector. India is one of the countries in the world which has highly organized Agricultural Institutions for Education, Research and Extension. Agricultural education and research system in India played phenomenal role in achieving self-sufficiency in food production. The system helped improve talents and skill among agricultural graduates who have reflected the acquired capabilities in various ways in the process of agriculture development. Accreditation Board could play a major role in improving the quality of agricultural education. Self-study report mandates participatory role of all faculty members, which inculcates in them accountability and responsibility.

The involvement and commitment of senior and junior level faculties provide a link between different generations of teachers and help to develop second line and third line of educational leaders and research managers. The exercise provides a vision for all those involved in the system. Self-study report is a key document, which will be helpful to assess the comparative performance of institutions during different time periods.

Dynamic assessment is an important factor, which is essential for the growth and development of agricultural institutions. It must have both internal and external components. Evaluation of courses needs serious consideration. While evaluating the course the following aspect may be taken as the basis.

- Flexibility

- Relevance of the course
- Content.
- Emphasis

Dynamic assessment is essential for the growth and development of agricultural institutions.

A proper consideration of these involves an in depth and thorough scrutiny of courses by academic experts. Norms and standards and also procedures for assessment and accreditation of programs and institutions dealing with agricultural education in India have also been developed. There are four criteria, which need to be fulfilled before an institution is considered for accreditation.

- The institution has clear and publicly stated objectives consistent with its mission.
- The institution has organized effectively the human, financial and physical resources necessary to accomplish its objectives.
- The institution is accomplishing its educational objectives.
- The institution can continue to accomplish its objectives and improve its quality of educational programmes and its effectiveness.

All these criteria are to be supported by material and documentary evidences. The accreditation and self study processes will promote accountability among teachers and researchers consistently over time.

Conclusion

Accountability in agricultural education and research is not a simple notion. It is a multi-layered concept, related to 'responsibility' and 'autonomy'. It is not unidirectional, but provides a holistic approach that focuses on both process and product. Academic accountability in agricultural education and research has to be ensured in different areas of operation of the academic system, and accountability in these areas should cover both the academic and non-academic staff as well as the authorities. One area is to keep the market demand and learners' needs as criteria to formu-

late need-based curricula and courses and there should be provision to revise each course every four to five years. To dispel the conventional notion of agricultural education becoming elitist, the university academia have to give special attention to design courses for both students displaying excellence and students belonging to the weaker and disadvantaged sections of the society. To facilitate the achievement of these objectives, adequate infrastructure, which is functional in nature, has to be provided; and writing of low quality and conceptually wrong textbooks should be discouraged. To initiate and sustain accountability measures, some structural changes would be essential. There should be a proactive and supportive academic leadership for providing a congenial environment. There should be change in the style of institutional management besides strong institutional planning, and institutional evaluation.

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Area, Production & Productivity of Sugarcane

K. Ramasamy, C. Kailasam & V. Geethalakshmi

In this paper, the trend in area, production and productivity of sugarcane for Coimbatore district is analysed for 32 years ending 1996-'97 by fitting trend equation with the help of ordinary least square method. The study indicates that there is deceleration in area and production and no significant increase in yield.

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Sugarcane is an important commercial crop of the country occupying an area of 3.8 m. ha of land with an annual cane production of around 270 m.t. 2.8 per cent of the cultivated area is occupied by sugarcane and it contributes about 7.5 per cent to the value of agricultural production of India (Sundara, 1998). The various development measures undertaken by the Departments of Agriculture led to increased average yield of sugarcane in various states of India from 33.4 tons per hectare in 1950-'51 to 36.1 tons in 1960-'61, 48.3 tons in 1970-'71, 57.8 tons in 1980-'81 and 65.0 tons in 1990-'91 in the country (Yadava, 1993). This reflects some progress, however, the gap between the research results and the achievements in the field still continues to be wide. Tamil Nadu has a large contribution to the total cane yield of the country and in Tamil Nadu, Coimbatore district is important for sugarcane because of the impact of Sugarcane Breeding Institute (SBI) of international standard located there. Therefore a study was attempted covering Coimbatore district. Secondary data were collected for 32 years ending 1996-'97 from several publications viz., Season and Crop reports of several years, Tamil Nadu-An Economic Appraisal, Agrostat (a statistical abstract published by the Department of Agriculture, Tamil Nadu), Facts for You, Co-operative Sugars and Annual Reports of SBI.

2.8 per cent of the cultivated area is occupied by sugarcane and it contributes about 7.5 per cent to the value of agricultural production of India.

The time series data for 32 years were studied for trend and cyclical variation, if any, in area, yield and production of sugarcane in Coimbatore district. For the purpose, quadratic and semi-logarithmic trend equations were fitted and the best fit was selected. The trend

equations were:

$$Y_j = \beta_0 + \beta_1 t + \beta_2 t^2 + e_1 \quad (1)$$

$$\ln Y_j = a_0 + a_1 t + e_2 \quad (2)$$

Where Y_j is the variable studied for $j = 1, 2, 3$ being area, yield and production of sugarcane in Coimbatore district.

$t = 1, 2, \dots, 32$ years t_{32} being 1996-'97

$\beta_0, \beta_1, \beta_2, a_0, a_1$ are parameters to be estimated, e_1 and e_2 are the random error terms.

These equations were fitted by ordinary least squares (OLS) method. The value of R^2 guided the choice among the two.

Time series data on area, production and yield of sugarcane in Coimbatore district is presented in Table 1. It shows that the average of yield of sugarcane varied from 82 t/ha to 122 t/ha during the period of 32 years from 1965-'66 to 1996-'97, with fluctuations year to year. Therefore, the data was studied for three sub periods viz. (i) 1965-'67 to 1972-'73 when the first peak in yield was seen (period I), (ii) from 1973-'74 to 1985-'86 when the second peak was reached (Period II) and (iii) the later years (period III) upto 1996-'97. The mean, standard deviation (SD) and co-efficient of variation (CV) of area, production and yield of sugarcane for the three periods are presented in Table 2.

As could be seen in the table, mean yield of sugarcane in Coimbatore district substantially increased in period II over that in period I but marginally declined in period III. The coefficient of variation in yield was 8.88 per cent in period I and it declined to 8.45 per cent in period II and further to 7.79 per cent in period III. Thus the yield of sugarcane was becoming more stable over the years, while mean yield itself was falling in recent years. Variation in area put under sugarcane contributed more than that in yield to the variation in production. As area, production and yield of sugarcane showed year to year fluctuation, trend

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equations of two forms were fitted for area, production and yield for the period of 26 years from 1970-'71 to 1996-'97.

Table 1: Area, Production and Productivity of Sugarcane in Coimbatore District from 1965-'66 to 1996-'97

Year	Area ('000 ha.)	Production ('000 t)	Yield (t/ha.)
1965-'66	25.020	2460.470	98
1966-'67	18.000	1483.200	82
1967-'68	19.500	1592.200	82
1968-'69	33.530	2874.320	86
1969-'70	28.000	2291.180	82
1970-'71	28.000	2291.180	82
1971-'72	25.000	2395.720	96
1972-'73	25.000	2470.200	99
1973-'74	35.000	3447.100	98
1974-'75	38.000	3477.000	92
1975-'76	35.000	3834.100	110
1976-'77	32.000	3532.200	110
1977-'78	35.000	4159.320	119
1978-'79	34.000	4043.760	119
1979-'80	38.000	4424.000	116
1980-'81	35.600	4158.000	116
1981-'82	38.700	4083.400	106
1982-'83	36.790	3719.900	101
1983-'84	31.650	3041.700	96
1984-'85	37.780	4317.030	114
1985-'86	35.966	4147.240	115
1986-'87	29.020	3022.100	104
1987-'88	23.573	2364.615	100
1988-'90	25.171	2554.597	101
1990-'91	22.410	2238.194	100
1991-'92	22.600	2280.000	101
1992-'93	22.500	2661.750	118
1993-'94	29.932	3663.676	122
1994-'95	34.711	3630.770	105
1995-'96	32.000	3831.800	119
1996-'97	29.032	3202.229	110

Source: "G" Return Register, Divisional Statistic Office of Coimbatore.

In trend analysis, two functional forms were tried viz., a quadratic trend equation and a semilog (or log-lin) equation. Of the two, the latter was rejected due to its poor fit as shown by very low value of R^2 and non-

Market Potential of Tetrapack Fruit Drinks

Hailay Gebretinsae

Packaging is a part and parcel of marketing activity. Once a need satisfying product is envisioned and determined by companies, considerable amount of time and effort should be spent deciding on the type of packaging that would suit the product, which it intends to launch. A product category which demands care and attention is food items. Food products can be further classified into different classes, each requiring different packaging material that matches with the special features of the food items. Tetrapack is one type of packaging used to pack fruit drinks and other food items. The article analyses the features of different types of packaging and presents a study on the prevailing trends in tetrapacks selling fruit drinks.

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The concept of packaging is not new, one way or the other it has been in practice since time immemorial. Various forms of packaging activities are undertaken that take advantage of the existing technology, suiting the market demands. Initially the concept and importance of packaging emphasized on protection of the product contained in the package till it reaches its destination safely. Nowadays packaging in addition to its traditional role is also serving as a potent promotion tool. It serves as a silent sales person. Because of the substantive role and contribution it provides, significant number of marketers are commending it to be the fifth P of the marketing mix along with product, price, place, and promotion.

Packaging: Different types

Currently different forms of packaging are on the scene depending on the type of product. Food products account for one of the major product categories making use of packaging activities. Fruit drinks constitute an important component of the food product category. Fruit drinks had been traditionally and currently are being presented in bottles, Aluminum cans, and other forms of packages. Recently, fruit drinks are also being presented in a package made up of 6 layers—80 per cent of which is composed of paperboard. This is better known as tetrapack. Tetrapack packages are internationally produced by various multinational companies operating at a global level. Tetrapacks apart from packaging of fruit drinks are also used for packaging of oil, milk, and other products as well.

Packaging Vs. Packing

Packaging should not be confused with packing. To have an understanding let us look at the following definitions.

Package: Is the container or wrapper in which a product is enclosed, encased, or sealed. A package is

generally designed for a great number of similar products and mass produced by means of machinery. Packages are also called primary containers.

Packaging: May be defined as the activities of designing and producing the container or wrapper so as prevent damage to the contents of the product by outside influences.

Packing: Consists of enclosing an individual item, or several items, in a container, usually for shipment or delivery. This operation is done mostly by hand, machinery being only slightly involved. Packed cases are also called secondary containers.

In recent times, packaging has become a potent marketing tool. Well-designed packages can create convenience value for the consumer and promotional value for the producer.

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Packaging as a System

Total Systems Approach

It is necessary to view packaging not as mere design of a package from whatever material is available, but as a total system. The choice of the primary package by the producer will have to take into account much more than the mere characteristics of the product contained. It will have to consider the entire cycle from the point of production to the point of consumption and a little beyond, viz, the ultimate disposal of the package.

The Elements of the System

The elements of such a system would vary depending on whether one looks at it from the point of view of the producer, retailer, or consumer.

From the Producers' Point of View

- The primary package containing the product
- The intermediate package containing a given number of primary packages
- The transportation package containing a certain number of intermediate packages, which are con-

sidered the most economical size unit for distribution

- The pallet which is intended to unitize a certain number of bulk packages to facilitate storage and handling
- The container, which accommodates a certain combination of pallets for movement by the chosen system of transposition.

From the Retailer's Point of View

- Size and space of the primary package
- Marketing features of the package so that it will move fast
- Economical intermediate size of bulk packages, which he could afford to buy at a time.

From the Consumer's Point of View

- Convenience features like ease of opening, dispensing and storage.
- Easily disposable or reusable

Functions of Packaging

Packaging performs two-dimensional functions. Firstly, it protects the products. Secondly, it plays a promotional role. The fundamental function of packaging is to protect the product or its contents in transit, in storage and use until it is used or consumed. According to Philip Kotler (1998), "Protection, convenience and economy were the three important traditional purposes attached to package" but now in recent years a fourth objective has received increasing recognition from the manufacturers. This has been defined as the promotional function.

Protection (against)

- Damage by mechanical handling
- Product loss – certain products if exposed may be lost, for example oil, petroleum products.
- Pilferage
- Contamination by dirt or dust
- Moisture gain or loss, e.g., cement
- Chemical change, e.g., corrosion
- Insects and rodents attack, e.g., locusts, rats, mice
- Light and fire

Convenience

- Storage convenience
- Convenience in use

Economy

- Loss in quantity is prevented thereby avoiding monetary loss also
- Provides opportunities for reuse
- Creates an opportunity to communicate with the customers

Promotional

Promotional potency of packaging is tremendous; packaging should be looked upon as a powerful tool of promotion just like other devices of promotion, such as salesmanship and advertising. All these functions prompt the manufacturers to take increased interest in packaging. Now packaging occupies an important decision making area under new marketing management.

Types of Packaging

The early uses of packaging were concerned with survival and this highlights basic principles that are just as important today.

Availability: around two-thirds of packaging is used for food—food which must be available wherever there are people.

Protection: many non-food products as well as food products require protection during their distribution from factory to consumer, and none more so than the enormous range of pharmaceuticals, toiletries and household products, that are now a necessary part of modern life. Based on these principles we can have different classifications of packaging: Primary, Secondary, and Tertiary Packaging.

Primary packaging: Is the first and main line of protection, the material which is in direct contact with the product. It represents the barrier between the product and the hazards of the external environment. The roles of packaging are many and varied and the complexity of the packaging used in a product depends to a large extent on the type of product being packed. Therefore, a further categorisation of primary packaging type is as: Commodity packaging; convenience and functional packaging; luxury packaging.

Categorisation of primary packaging type is: Commodity packaging; convenience and functional packaging; luxury packaging.

Commodity packaging: used for staple foodstuffs and household goods, such as flour, sugar, butter, and detergents, is usually kept as simple as possible, whilst still providing safe delivery of the product, in prime condition, from the manufacturer through the distribution and retail chain, to the consumer.

Convenience and Functional Packaging: used for products such as pre-packaged fresh-foods, ready-to eat meals, portion packs and multi-packs, is usually more complex and sophisticated than that used for staple products. It reflects our changing lifestyles, where we spend less time in shopping and preparing meals. These packs may be refined to do more than simply provide basic protection for the product. They may for example;

- extend the shelf-life of perishable products through the use of modified atmosphere packaging,
- be designed to be oven, microwave and/or table ready,
- be tamper evident,
- need to be child resistant, easy-to-open for the elderly or to dispense measured amounts of the product.

Luxury packaging: used for items such as chocolates and perfumery is, by definition, excessive because it is intended to convey extravagance; it is an indulgence rather than a necessity. It is often an integral part of the product being sold. The products are often bought as gifts and the packaging reflects this.

Secondary Packaging: may or may not be part of the product which is sold to the consumer. Primary or sales packs are often delivered in some form of secondary packaging. For example, packets of dried soup may be grouped in boxes for sale and the boxes ground in shrink-wrapped trays for delivery to the retailer. Secondary packaging utilizes the primary packaging providing both the retailers and the consumer with a more convenient means of handling the product. It can also help protect the primary packages from one another, and thus protect the product.

Transport or tertiary packaging: primarily ensures the safe and efficient delivery of products from their

point of manufacture to the next point in their distribution chain, which may be a warehouse, distribution centre, the retailer or even the customer. It may be required to hold together a number of packages, for example corrugated cases of shrink-wrapped pallets. This tertiary packaging must also protect the goods from shock vibration and stacking compression encountered in the distribution chain.

Returnable, Non-Returnable and Recoverable Packaging: The role of packaging in protecting products and helping to make them readily available to consumers, can be served by both returnable and non returnable packaging.

Returnable packaging: has come to mean, refillable and reusable 'multi-trip' packaging, A good example of this type is the use of multi-trip refillable bottle packaging which is widespread for soft drinks.

Non-Returnable Packaging: means disposable 'one-way' packaging.

Recoverable Packaging: Refers to any packaging for which the raw materials can be recycled or reused for the original purpose or other purposes, composted, regenerated or for which the energy value can be utilized as a source of energy generation.

Need for returnability has been one of the most hotly debated topics in the packaging chain from raw material suppliers through to retailers. But the environment justification for returnability is complex and not as simple as it may seem at first sight. For paper and plastics, reuse can be more complicated, since the collected materials must be sorted and graded before reprocessing into either paper board cartons, other papers, plastics containers, or other plastic products.

Need for returnability has been one of the most hotly debated topics in the packaging chain.

Types of Packaging Materials

There are six main groups of packaging materials. These are Aluminium, Glass, Paper and board, Steel/tinplate, Wood, and Plastics.

Aluminium, glass, paper and board, steel/tinplate, and plastics are the options for primary and secondary packaging. Clearly wood for crates would also feature in tertiary packaging. However our emphasis goes to the

materials for primary packaging.

Aluminium: The current extensive use of this material for packaging began in 1913 with the use of foil of over wrap 'life savers' for confectionery products.

Packaging applications fall into three broad categories:

- Cans, where aluminium has the major share of the worldwide beverage can markets. It is also used for other heat processed and non-processed food applications and dominates the easy-open end (EO end) can markets.
- Three dimensional semi-rigid containers are widely used again principally for food applications.
- Foil which will be dealt with under flexible packaging.

Glass: Glass containers have been used for hundreds of years and, whilst having encountered strong competition in a number of its prime markets, the material still dominates many of them, particularly for returnable/refillable applications. Its markets are predominantly for food and beverages.

Paper and board: The first use of paper for packaging is difficult to pinpoint, but the material itself was certainly known to ancient Egyptians. Packaging manufacturers carry out a conversion process, converting paper and board materials into folded blanks or rules of material.

Steel/tinplate: Steel/tinplate packaging has long been established and is widely used in the form of:

- open stop cans for food and beverages where the package has an open-ended container which is filled and closed with a double sealed end.
- a diverse range of tins, with a variety of closures—slip lids, lever lids, hinged lids, screw cap, etc., and used for a multitude of applications.

Plastics: Compared to the other materials, plastics are relative newcomers. Although thermosetting resins, whose molecular structure is cross-linked, have been used since the past century and are still extensively used in coating formulations for packaging, contemporary use of plastics, for primary, secondary, and tertiary packaging is almost entirely based on plastic materials. Today, about one third of all plastic manufactured is used in packaging. To have some understanding on the materials and for general guidance, the following environmental strengths and weaknesses are compiled:

Aluminium

Strengths

- Abundance of raw materials
- High reuse capacity
- High residual value motivating recovery
- High public awareness/esteem of its recyclability.

Weaknesses

- Very high energy consumption for virgin material production
- Pollution risks associated with purification process
- Reliance on voluntary action for recovery.

Glass

Strengths

- Abundance of raw materials
- Hygienic with foods and beverages
- Established capability to be returnable/refillable
- Well-established bottle bank recovery systems in most developed countries
- High public esteem and participation in recovery recycling

Weaknesses

- Significant energy consumption in production
- Pollution risks associated with production-furnaces.
- Relatively high pack weights compared to other materials.
- Safety hazards from breakage/splintering
- Reliance on voluntary action for recovery.

Paper and board

Strengths

- Sustainable raw materials
- Long established recovery and recycling systems
- Degradable
- Energy recovery through incineration

Weaknesses

- Energy consumption can be high
- Pollution risks in manufacture-effluents from bleaching and other chemical treatments.
- Low residual value of much of the recovered material.
- Frequent use as a laminated and/or coated material
- Strong association with litter

Plastics

Strengths

- The most versatile and diverse family of packaging materials
- Efficient and economic use of material for individual packs
- Hygienic packaging for foods and beverages
- Excellent protection from physical damage provided by low mass of expanded materials.

Weaknesses

- Derived from non-sustainable resources of fossil fuels.
- Highly visible contributor to litter.
- Difficult to recover, separate, and recycle from post consumer waste.
- Non-degradable-perceived as a weakness for plastics but not for glass which is no more degradable.
- Some use in multilayer materials, which exacerbates recovery and reuse limitations.

Steel/Tinplate

Strengths

- Apart from tin an abundant supply of raw materials
- Efficient and economic use of materials for individual packs
- High pack security/safety and minimal secondary packaging requirements
- Easiest to recover from the mixed waste stream due to its magnetic properties
- High reuse capacity

Weaknesses

- Significant energy consumption in raw material production
- Pollution risks in material production-furnaces
- Low residual value of recovered material
- Less public awareness of environmental merits than for some other materials.

What is Tetrapack?

Tetrapack is a generic name given to packaging material made up of more than one layer of paper, Polythene, or other material. A tetrapack package is a six-layer package with the innermost layer made of polythene which seals in the 'C' layer of polyethylene adhesive followed by aluminium foil for keeping the flavour in and light, odours and air out. The aluminium layer is surrounded by another polythene layer followed by a paperboard for rigidity and labeling of the pack. The final cover is another sheet of polythene to keep out moisture and germs. The aseptic packaging conditions and lack of extra air within the pack prevents bacterial degradation of the food while preserving its "farm-freshness". The technology comes in handy when it is not possible to transport perishable commodities under refrigerated conditions. The pack is tamper-proof so that the food can be transported and consumed without fear of adulteration. No chemical preservatives need to be added to food packaged in tetrapack while the pack itself can be kept outside the refrigerator for a considerable length of time before it is opened.

Tetrapack is a generic name given to packaging material made up of more than one layer of paper, polythene, or other material.

Tetrapack Techniques

The stages to be pursued in order to come up with a complete tetrapack end product are as follows:

Stage I: Raw material – Dal/Soup

Stage II: Heat processing of the product to inactivate all bacteria

Stage III: Sterilization of the packaging material

Stage IV: Filling the commercially – sterile product into the package in a sterile environment.

Materials used for Packaging

The materials used for packaging are polyethylene, paper, and aluminium foil. By using 6-layer aseptic, tamper-proof packaging product integrity and sterility are ensured. These layers with their respective type of packaging material being applied is indicated in Fig. 1.

- A. Polyethylene – for sealing in the liquid
- B. Polyethylene – for adhesion
- C. Aluminum foil – for oxygen, flavour, and light barrier
- D. Polyethylene – for adhesion
- E. Paper – for strength and stability
- F. Polyethylene – for protection against moisture

Features of Tetrapack

Rip it, heat it, and eat it. This is the expected sequence of customer behaviour, which has inspired the development of the newest technology twist to the packaged foods business. Tetrapack is about to serve up a complete manufacturing and packaging solution for marketing dal-yes, the humble lentil in a ready-to-eat form, using tetrapack packaging. The breakthrough has come in the form of a heat-processing technique for killing the bacteria even in a particulate – where the liquid is lumpy, containing solid and semi-solid particles-product. Earlier this was available only for liquids like

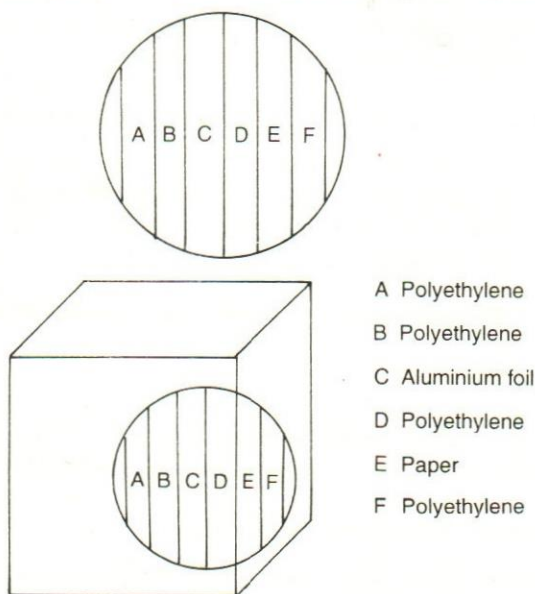


Fig. 1. Layers (& Materials) used in Tetrapackaging

milk, which contain no particles. And bacteria-killing is crucial because that, obviously, is what prevents the liquid contents of a tetrapack from spoiling although it is unrefrigerated.

Popularity of Tetrapack

The market for hygienically-packed Indian convenience foods has huge potential. Therefore, companies are focusing their local and global R & D activities on packaged liquid ready-to-consume food items. It is believed that food industry is probably going to be the industry of tomorrow. The possibilities are immense, given that no national brand has ever explored the market. About 85 billion packages of liquid food packed in tetrapack packaging were consumed worldwide in 1998 in 165 markets. Companies are producing aseptic packaging for preserving food items, which is not only cost-effective but also environmental friendly as well as energy-saving. Moreover it is easy to handle, use and store. With some 85 billion tetrapack packages produced world over of which 800 million are in India, tetrapack is fairly popular among manufacturers, retailers and consumers alike. It is in operation in more than 165 countries.

The market for hygienically-packed Indian convenience foods has huge potential.

Benefits of Tetrapack

- Tetrapack packaging has not only added life to the essential commodities segment, but has also made consumers aware of the importance of consuming hygienic products. Purity and hygiene are the upper most benefits of aseptic packaging.
- Tetrapacks give their liquids a shelf-life of four to six months.
- Affordable so that the price sensitive Indian market can use it.
- Tetrapacks are convenient and long lasting.
- Cost effective and environment friendly as well as energy saving.
- Tetrapack packages can be recycled by 'hydraulic pulping' in which the cartons are pulped in water separating the paperboard from the polythene and aluminium. While the paperboard can be reused, the plastic and aluminium can be burnt
- The pack is tamper-proof so that the food can be

transported and consumed without the fear of problems such as adulteration.

- Over 80 per cent of the material used to produce a tetrapack package is paper, which is biodegradable.

Limitations of Tetrapack

- Due to seasonability of cold drinks, companies will be deterred from producing to their full capacity throughout the year.
- Because of its complexity, consisting of several component packaging materials, tetrapack is very difficult to degrade.
- Since disposed tetrapack packages are more expensive than ordinary polythene and also require considerable input in terms of manpower and time, it is uneconomical for recycling units to process them.
- While only 30 per cent of tetrapack waste is segregated and recycled, the rest is either burnt or buried in landfills.
- Burning of the polythene layers in tetrapack releases toxic gases into the air, while the non-biodegradable polythene and aluminium layers persist in the soil if land filled.
- Several global packaging companies are eyeing the potential in India, which may lead to reduction in the margin of profit an Indian company may get.

Users of Tetrapack

It is expected by tetrapack producing companies that such a product will be popular not just with busy executives and harried housewives but also nonresident Indians and frequent travelers. All age groups, initially, took to tetrapack drinks right from the very young to the elderly. However, there was a noticeable skew towards children later. It was noticed that children had become the main customers—by choice. However, it is observed in India that the young adult does not like to be seen with a tetrapack with a straw in it, sipping a drink, which is small and sweet. To this huge market segment—the young adult—companies like Tetrapack India, Godrej, etc. offered a bigger pack, which is straw less, not too sweet to drink, and which fits their image.

There is a new campaign to popularize aseptic packaging for which schools will be the main focus. Some of the varieties of tetrapack like zip sip, a tetrapacked milk product is predominantly aimed at teenagers and young adults who perceive the need for a healthy drink, which is readily available for consumption when they are away

from home. There has been a rush of new tetrapack fruit drinks launched by companies like Godrej Foods in the past few months. The reasons behind this newfound aggression as described by a managing director of Godrej Foods Ltd. are the following:

- The low market growth in the fruit drinks market. The market growth in this industry is about 5 per cent and can, at most, grow up to 10 per cent in the near future. The growth has been slow here because of the onslaught of carbonated soft drinks, especially Pepsi and Coke.
- Also a fruit drink in India is not a natural habit and there is certainly lack of “imagery”, associated with fruit drinks—quite unlike carbonated soft drinks.
- In addition to the major users, children, to attract another market segment like the young adult, companies are offering tetrapack drinks that suit their needs.
- Availability of imported tetrapack technology enables companies to produce in a larger quantity and improved quality of tetrapacks that can be easily accessible and convenient to the end users.

There is a new campaign to popularize aseptic packaging for which schools will be the main focus.

Success Factors

As the 1980's experience shows, success in this tetrapack business depends largely on whether the tetrapacks rolling out of factories actually succeed as brands (rather than commodities). And that depends on how sharply their respective marketers are thinking about how to build a relationship with the target consumer. In other words given the competition in the broadly-defined arena of 'consumption fluids', offering clients production and distribution consultancy really won't be enough to assure success. Moreover, the companies are required to be flexible to meet the changing demands.

Past, Current and Future Scenarios

Past

The popularity of tetrapacks was confirmed by the success of Dhara and Frooti. The \$12 billion Tetra Laval Group had set foot in the country about 17 years ago. Tetra Pak with a 20 per cent stake in the venture had set up Hindustan Packaging Co. Ltd. (HPCL) to make the

patented aseptic packaging material that made tetrapack a generic brand name across the world. Some years back, ultra high temperature (UHT) milk in tetrahedron packs was launched. The milk could last for days on end without refrigeration, which permits storage by fridgeless homes. This lured other marketers to tetra packaging.

Current

Tetra Pak is currently operating in more than 165 countries and is concentrating on Fast Forward 2000 plus liquid food products apart from fortified milk and potable water. Tetra Pak has recently developed a novel early-to-handle, use and store Tetra Top Grandtab, which was introduced few months ago in Japan. Apart from this, the multinational has also introduced the Tetra Brick 5000B package, which is a cost effective family pack, aimed at large consumer groups. On the consumer front, now that the price-value equation of packaged health drinks is finding acceptance in large enough numbers to ensure economically viable volume, Tetra Pak feels it's the right time for tetrapacks to experience the boom, which has been missed a decade ago. Several global packaging companies some of which have successfully taken Tetra Pak on in many markets are eyeing the potential in India. Some of these are Combibloc (Germany), International Paper (US), and Elopak (Norway).

About 85 billion packages of liquid food packed in tetrapack were consumed worldwide in 1998 in 165 markets. According to Samsika Retail Parameter (Conducted by Mumbai-based, Samsika Marketing Consultants) in January 1999.

- Frooti (from the Parle Stable) leads the Rs. 400-crore fruit drinker market with a 67 per cent share,
- Life at 7 per cent
- Real at 3 per cent, and
- Jumpin at a low 2 per cent, while local players constitute the rest.

Promotional activities with respect to tetrapacks are designed for the following three-pronged target:

- To create awareness of the benefit of tetrapack packaging.
- Give the beverage companies an opportunity to promote their brands, and also
- Help push home consumption sales of the drinks.

Such opportunities help the processing and packaging companies to communicate the benefits of their packaging. Companies having wrapped up the first part

of their consumer awareness campaign, which commenced in August 1998, are now gearing up to launch another media campaign.

Future

Smart packaging has traditionally been seen as a bit of waste in India. But then, thirst is thirst and health is health. Admittedly, the price factor can be a major barrier with the existing market, thus companies will make efforts to extend awareness about the benefits of the packaging to rural markets, to grow the market thereby creating more volumes so that prices could be brought down. In this year, Indian market is expected to consumer one billion tetrapacks, which is almost twice the sales in 1998, which was 600 million packs. It is believed that the food industry is probably going to be the industry of tomorrow.

Smart packaging has traditionally been seen as a bit of waste in India.

Case Study

A study was attempted to:

- Assess the awareness level of consumers on the availability of tetrapack fruit drink brands in the market.
- Identify those brands of tetrapack fruit drinks that consumers are well aware of.
- Identify the major consumers of tetrapack fruit drinks.
- Investigate and determine the perception of consumers with respect to tetrapack fruit drinks in comparison with fruit drinks packed in other forms of packages and also find out possible modifications demanded in product by consumers.
- Make an assessment of retailers' perception about tetrapacks as a package.

The respondents selected to provide the required information for the intended objectives were grouped into two categories – the consumer group and retailer group. The reasons for selecting these groups are as follows:

Consumers are the ultimate users of the product. Companies manufacture products to satisfy the various needs of consumers. Companies continue producing the product only when they are sure that consumers are

purchasing and would be consuming their products even in the future. Consumers determine the survival of the companies currently launching their products to the market. Thus, understanding the needs, wants, attitudes, and feelings of consumers about the companies' products is critical concern of producers.

In relation to the project undertaken, the focus was on school and university students; because these are the active customer group frequently consuming tetrapack fruit drinks. The focus respondent group falls mainly in the range of 10-30 years old. The total sample size taken for this part of respondents was 100, whereby 50 were college students and the other half school students. To enhance the representative quality of the sample, considerable amount of time and effort was applied to approach respondents belonging to different localities.

Retailers are those business entities that directly sell the products to the ultimate users. Though packaged products are really satisfying and highly demanded by consumers, the producer will fail if they are not made available in the retail outlets, which are convenient to consumers. Retailers play a significant role in making the products of the companies available. Retailers select:

- those products, which are highly demanded by consumers,
- products, which take relatively smaller shelf spaces,
- products, which are convenient to handle and store
- those products, which are tamper proof, resistant to some possible perils, and
- products, which have adequate warranties and guarantees.

The higher the level of satisfaction with the features of the products, the greater the shelf spaces provided at retail shops for such products. Moreover, retailers are motivated to display the product at vantage points across the stores. Hence, there should be a concerted effort by companies to maintain rapport with retailers. To ensure sufficient availability of tetrapacks in retail outlets, assessment of retailers for information related to the mentioned factors becomes crucial. To this end, sample size of 36 retail outlets in northern region in major cities was taken.

Questionnaire Design

To collect the required information for the project questionnaires were designed with great care. There were two different questionnaires: One designed for

consumer survey and the other for retailer survey. They were structured and non-disguised and in pre-arranged order. The design process involved thoughtful deliberation, considerable time and effort in the following decision areas: Factual information, Quasi facts, Awareness, Opinions and attitudes, and Reasons.

The type of questions designed in both consumer and retailer questionnaires included: Rank order questions, Dichotomous questions, Multiple choice questions, and Open-ended questions.

Types of questions	Questionnaire for Consumer Survey (Quantity of Questions)	Questionnaire for Retailer Survey (Quantity of Questions)
Rank order	7	3
Dichotomous	5	7
Open-ended	4	7
Multiple choice	1	2
Total	17	19

The questionnaires were administered from April 20, 2000 up to May 12, 2000.

There are many products available in tetrapack forms such as milk, oil, powder form of fruit, drinks, and liquid form of fruit drinks. However, the study focused exclusively on those fluid fruit drinks packed in tetrapacks. The study was conducted to identify major consumers, the reasons for which they consume, assess their awareness level on the benefits and other attributes of tetrapack. Moreover, it tried to investigate the convenience of tetrapacks to retailers in several of its aspects. However, the scope of the project was limited to northern region with a specific reference to university and school students, and retailers. Though the scope of the study is too small to make generalizations on the whole population of consumers and retailers, it gives a basic insight on tetrapacks that can be of great value to undertake intensive further study on a larger scale.

Table 1: Total respondents

Age	21-30	31-40	Total
10-20	45%	2%	100%

Table 2: Educational Qualification

Elementary School	High School	Post-Graduate	Graduate	Total
20%	30%	15%	35%	100%

Analysis

Based on the study, it was found that all students are aware of at least three types of brands of tetrapack fruit drinks. Besides, the findings showed that almost all students have actually consumed the product and developed some attitude or image on tetrapack fruit drinks. Table 3 indicates the state of importance of advertising media pertaining to their effectiveness in promoting the product as perceived by students (consumers). TV-entertainment channels and newspapers are the most effective media in promoting the product as perceived by respondents. Table 4 indicates the state of importance being given to attributes pertaining to consumer decision to purchase. It was found that, freshness, nutritional value, purity and hygiene, and taste are the important reasons for consuming the product, while cost and availability are considered as the least important reasons. Table 5 shows the position of tetrapack fruit drinks as compared to other drinks as perceived by respondents (consumers). Tetrapacks assume a superior position in the attributes namely nutritional value, quality, purity and hygiene, taste, freshness, convenience of handling, safe and easy to carry, tamper proof, and environment friendliness as compared to bottled soft drinks and other drinks packed in flexible packs. However, it is considered costly by respondents. Table 6 also indicates the position of tetrapacks as perceived by respondents (retailers). Tetrapacks assume a superior position in the attributes namely safe and easy to carry, stacking on shelf, and convenience of handling as compared to bottled soft drinks. However, tetrapacks have lower demand from the side of consumers when compared to bottled soft drinks as perceived by respondents (retailers).

Conclusion

Tetrapacks play a major role in providing fruit drinks in the form of aseptic packaging. The study revealed that they are in a superior position in most of the product attributes. However they are considered as costlier viz-a-viz the quantity of drink being offered, and are not sufficiently available in some shopping places like other forms of drink. Hence the concerned organisation had better give emphasis to these.

Based on the findings of the study the following conclusions can be drawn.

Regarding awareness about the existence of tetrapack fruit drinks, the study revealed that all students are aware of at least three types of brands, which are available in the market. Majority of them came to know through TV-advertisements. It was shown that TV-

Table 3: Media effective for advertisement according to respondents' perceptual rating

TV-Channels	News Papers	Magazines	Wall hoarding	Others
85%	63%	62%	58%	3%

Table 4: Reasons for consumption of tetrapacks as perceived by respondents (consumers)

Factor	Percentage
Freshness	49
Nutritional Value	44
Purity and Hygiene	39
Taste	38
Convenience of handling	14
Availability	6
Cost	6

Table 5: Comparison of tetrapack fruit drinks against soft drinks and other forms of fruit drinks available in the form of flexible packs. (in percentages) as perceived by Consumers.

Factor	Tetrapacks	Bottled Drinks	Flexible Packs
Nutritional value	81	61	55
Quality	80	75	41
Cost	73	76	47
Purity & Hygiene	92	75	52
Taste	74	72	43
Freshness	87	69	51
Convenience of handling	85	66	45
Safe and easy to carry	85	58	37
Tamper Proof	84	66	49
Environment Friendliness	81	76	54

Table 6: Comparison of tetrapacks against soft drinks and other forms of fruit drinks available in flexible packs as perceived by respondents (in percentages) (Respondents = Retailers).

Factors	Tetra Packs	Bottled Soft Drinks	Flexible Packs
Convenience of handling	96	67	21
Safe and easy to carry	97	63	20
Stacking on shelf	97	64	20
Shelf life	74	95	17
Demand of Consumers	64	95	23
Tamper Proof	75	87	21

entertainment channels are the most effective followed by newspapers. The findings show that almost all students (97%) have actually consumed the product and have developed some image or attitude regarding

tetrapack fruit drinks. Mostly students consume tetrapacks during mid afternoon and lunchtime, while least consumption takes place early in the morning. About 85 per cent of the students' weekly consumption falls within the range of 1-10 units of tetrapack fruit drinks. And the most important reasons for students to consume tetrapacks in their order of importance are Freshness (49%), Nutritional Value (44%), Purity and Hygiene (39%), and Taste (38%). Hence, companies in order to promote the product, should look beyond creating awareness. They should emphasize on developing interest and motivating students to consume. Moreover, they had better strengthen the features valued by consumers and educate them on other crucial benefits that are overlooked or not perceived.

Tetrapack fruit drinks as compared to bottled soft drinks and other fruit drinks packaged in flexible packs are considered to be superior in their overall quality, richer in nutritional value, more pure, hygienic, and fresher than others, and also environment friendly. Moreover, both retailers and consumers believe that tetrapacks are in the uppermost position with respect to convenience in handling, safety and ease of carrying, and tamper proof as compared to fruit drinks packed in different forms available in the market. Though there exist variation in taste between tetrapack fruit drinks and bottled soft drink, yet tetrapacks are superior to others. In addition, the study disclosed that retailers believed tetrapacks to be the best of all others in stacking on shelf. The study revealed that tetrapacks are considered costlier as compared to others. Also they are less available and accessible in the market, have lower demand, less shelf life and less sales frequency as compared to the major competitor, bottled soft drinks.

When we come to the past and current prevailing price situations, it can be described as follows. The price configuration for the varied package sizes slightly differs among the different brands of tetrapacks available in the market. In addition, the study disclosed that there is slight difference in the prices offered by different brands for the same sized fruit drink packages. Moreover, there has been marginal increase in prices in all the different package sizes from 1998-2000. The study uncovered that fruit drinks of same type and size are being charged different prices in the same city by some retailers. This practice sometimes is true even for the same brand. Hence, concerned entities can remain attentive to this fact and ensure that uniform prices are applied for reasonably same products or else convey necessary adequate justifications for the variation.

The average quantity of tetrapacks ordered and sold in a period of one week by retail outlets is 1-2 crates each for 200ml and 25ml sizes, one dozen pieces each for 1/2

litre and 1 litre size packages. Majority part of the shelf space is occupied by 200ml and 250ml sized packages. It is shown that majority of the customers of retailers of tetrapack fruit drinks are 10-20 years old followed by customers less than 10 years old. Retailers believe that the form of packaging affects the price. The more appealing and attractive, safer, durable and stronger the package, the higher the price would be. Retailers believe that tetrapacks play a promotional role, do not take more shelf spaces and that the element of quality is attached to the drinks contained in it. It can be concluded that with an increase in the current level of advertisements on tetrapack fruit drinks, sales can be enhanced.

Retailers get the supply of tetrapacks from the dealers in the city. They enjoy guarantee and warrantee for product replacement in case of damage, leakage, spoilage, when the product expands, puffs and or expires even before the expiry date. From the currently existing package size options available in the market, 250ml is the most preferred package size. Majority of the consumers associate fruit drinks presented in the form of tetrapacks as costly items to purchase. Majority of the consumers are sometimes attracted by an appealing packaging. Companies need to strive to design pleasant looking packages to attract and motivate consumers to buy and consume the product. The findings uncovered that orange and yellow were the most preferred ones followed by green, red, and sky blue shades of colours. Study revealed preference for packages needing use of straw. However, both options are suggested to be provided. On the basis of the survey conducted and analysis made of responses of consumers and retailers, the following suggestions have been proposed.

- Offer drinks in tetrapacks in larger sizes.
- Enable visibility of drink through a slit.
- Enable use of straw as well as otherwise for all packages.
- Make packages slimmer and longer.
- Also introduce family sized (large) packages with handle.
- Increase circulation and availability of tetrapacks.

These suggestions could prove to be of great use if taken into consideration.

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Competitiveness of Indian Rubber under WTO

Gurdev Singh & S.R. Asokan

India is one of the major producers of rubber but the demand for rubber is more than supply. Fall in international prices of rubber has caused a fall in domestic prices and has adversely affected the income of rubber growers. The current effective tariff of 31.5 per cent is perceived as not enough to protect the growers. As the crop requires long gestation period farmers will not be able to respond to increased prices in the future. Therefore, taking the long term interest of both producers and consumers the paper calls for fixing a tariff band.

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India ranks fourth in production of natural rubber, Thailand, Malaysia, Indonesia being the other major producers. Of the total area under rubber during 1998-99 about 87.46 per cent was with individual farmers and 12.54 per cent under estates. Of the 9.70 lakhs farmers who cultivate the crop, 9.48 lakhs are small farmers with an average farm size of 0.42 hectares. Though supply of rubber is short of demand in the country, the gap has narrowed down from 25 per cent in the mid sixties to 9.5 during 1998-99 despite manifold increase in demand. Major consumption of rubber in the country is in tyre manufacturing (60 per cent), followed by footwear (12 per cent). As the economy is set to grow, demand for rubber is likely to go up in future.

The Asian currency crisis has caused a fall in rubber prices leading to cheaper imports in the last three years. Domestic prices have also fallen in tune with international prices and as a consequence, income of rubber growers has been adversely affected. As per WTO agreements, rubber is going to be placed under OGL which would make the import of rubber easier. Under the circumstances, whether to protect domestic growers or not is the issue. If unrestricted import is allowed, it would harm local producers and many may stop tapping or would even remove the crop. As rubber is a long duration crop and has six years gestation period farmers will not be able to respond to rise in international prices in the short term. Therefore, a prudent policy keeping in view the long term interest is necessary for which it is pertinent to know whether we have competitive advantage in cultivating the crop. This paper examines the competitiveness of Indian rubber and suggests measures that would protect the growers while at the same time not compromising consumer interests.

Area, Production & Productivity

Rubber is native to amazon forests of Brazil and was introduced in India by the British in late 19th cen-

tury. With the invention of pneumatic tyres, demand for rubber increased manifold and it resulted in expansion of area under the crop. The conquest of Malaysia and Japan during World War II left India and Sri Lanka as the only source of rubber for allied forces. Hence, the government encouraged growers to maximize production. The Rubber Board was constituted as a statutory body in 1947. The Board, since its inception, has been promoting expansion and modernization of rubber plantation by undertaking various development activities. As a result, area under rubber increased from 74,915 hectares in 1950-51 to 5,53,041 hectares in 1998-99 and production from 15,830 tonnes to 6,05,045 tonnes in the same period (Table 1). Yield per hectare increased from 284 kg in 1950-51 to 1563 kg in 1998-99. Production of rubber increased from a mere 15,830 tonnes in 1950-51 to 6,04,050 tonnes in 1998-99 an increase of 40 times. The increase in production was due to gains in productivity through introduction of new hybrid clones as well as expansion of area. Before independence, rubber plantations were confined to Kerala, Tamilnadu, Karnataka, Goa and Andaman and Nicobar islands. Its cultivation was extended to northeastern states in early seventies, to Andhra Pradesh, Maharashtra during eighties and to West Bengal during nineties. Kerala, however, continues to dominate with 85.97 per cent of area under rubber. Tripura follows, a distant second, with 4.36 per cent (Table 2).

Table 1: Total Area, Tapped Area, Production and per Hectare Average Yield of Rubber

Year	Total area (ha)	Tapped area (ha)	Production (tonnes)	Yield (kg/ha)
1950-51	74915	55800	15830	284
1960-61	143905	70253	25697	365
1970-71	217195	141176	92171	653
1980-81	284166	194245	153100	788
1990-91	475083	306413	329615	1076
1998-99	553041	387100	605045	1563
Growth rate (%)	16.8	15.6	98.00	11.9

Table 2: State-wise Area under Rubber

State	Area in ha	(% of total)
Kerala	469924	(85.97)
Tamil Nadu	18631	(3.37)
Karnataka	19323	(3.49)
Tripura	24120	(4.36)
Assam	10805	(1.95)
Other northeastern states	7607	(1.38)
Other states and Uts	2631	(0.48)
All India	553041	(100.00)

Supply & Demand

Despite tremendous increase in production of natural rubber during the last four decades, India has been a net importer of rubber. Barring some years in mid seventies when there was a slack in demand, supply has always been less than demand and hence rubber was imported. Import which was 25 per cent of consumption in 1965-66 declined to 20 per cent in 1979-80 13 per cent in 1989-90 and 9.5 per cent in 1998-99. However, in most of the years imports have been in excess of the shortfall of production resulting in considerable stock of rubber. In 1984-85 the stock of rubber with various agencies was 55,630 tonnes. It increased to 86,430 tonnes in 1990-91, 1,03,190 tonnes in 1995-96 and 1,87,965 tonnes in 1998-99. The Asian currency crisis and the high stock position led to crash in prices putting rubber growers under enormous stress. The price of RSS 4 grade which averaged Rs 49 per kg in 1996-97 fell to Rs 35.80 in 1997-98 and further declined to Rs 29.94 in 1998-99. To check this fall, the government intervened and started procurement of rubber. However it had only limited impact on prices as rubber cannot be stored for a longer period and the trade knew the stock position.

Import Policy

Natural rubber was in the Restricted List up to April 1997. Import was allowed against License or in accordance with a Public Notice and to exporters of rubber products against Quantity Based Advance License or Special Import License. However because of excess availability of natural rubber in the domestic market, import against Public Notice was disallowed during 1997-98 and 1998-99. Further imports against Advance License were banned with effect from February 20, 1999. As an alternative arrangement, exporters of rubber products are allowed to purchase locally procured rubber from the State Trading Corporation of India at the international price after surrendering import license. Though there is no restriction on export of natural rubber since 1992, exports continue to be nominal (1840 tonnes in 1997-98).

Though rubber prices in India were higher than international prices, they were highly correlated (0.936). A fall in international price of rubber resulted in fall in prices of domestic rubber. The tariff on imports of rubber was 25 per cent with a surcharge of 10 per cent and special additional duty of 4 per cent making the effective tariff 31.5 per cent. Although this gives some measure of protection, it is perceived as not enough to safeguard the interest of rubber growers.

The fall in domestic prices of rubber has reduced

the income of growers. Rubber being a plantation crop with long gestation period, growers cannot respond to changing prices either by reducing production or vice versa. As farmers have made huge investment in the initial period, switching to other crops in the middle of the economic life of their plantation would involve huge losses. As per the WTO agreement, rubber would be placed under OGL this year which would make import easier. Under the circumstances it is important to look into the economics of rubber production in the country and examine whether it is remunerative to the growers and they can absorb a further fall in prices.

Rubber being a plantation crop with long gestation period, growers cannot respond to changing prices by reducing production.

Economics of Rubber Production

Rubber is a plantation crop and has economic life of about 32 years. The tapping starts from seventh year and continues till 32nd year. Though costs are incurred from the first year no returns are realized for the first six years. Nevertheless, to work out the economics of rubber production, information on inflows and outflows would be needed for the entire economic life of rubber plantation. The costs and returns per hectare of rubber plantation were generated through discussions with officials of Rubber Board, rubber growers and other knowledgeable persons. Inputs used, output realized and prices determine the economics of any crop. As-

Table 4: Present Value of Costs for Rubber Production (Rs./hectare)

Particulars	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12-31	Year 32
Seed (cover crop)	7000	0	0	0	0	0	0	0	0	0	0	0	0
Fertilizer	2500	1200	1200	1000	1000	700	1200	1200	1200	1200	1200	1200	1200
Pesticides etc	325	750	1100	1125	1125	1125	1400	1400	1400	1400	1400	1400	1400
Labour	17050	7375	5325	4550	3500	3050	18330	18330	18330	18330	18330	18330	18330
Other materials	200	130	25	25	25	25	1050	1050	1050	1050	1050	1050	1050
Rent	1450	1450	1450	1450	1450	1450	1450	1450	1450	1450	1450	1450	1450
Transportation etc	0	0	0	0	0	0	180	220	270	296	318	324	324
Processing costs	0	0	0	0	0	0	2250	2750	3375	3700	3975	4050	4050
Felling trees	0	0	0	0	0	0	0	0	0	0	0	0	20000
Transporting wood	0	0	0	0	0	0	0	0	0	0	0	0	15000
Total	28525	10905	9100	8150	7100	67541	25860	26400	27075	27426	27723	27804	62804
Discounted value	24805	8246	5983	4660	3530	2745	9721	8630	7696	6779	5959	37407	717

suming no substantial change in technology, yield and output coefficients would not change much. Prices do change significantly over the years. Normally input prices are stable but output prices may be volatile. Rubber being a long duration crop farmers cannot respond to price changes by increasing or cutting output. Growers continue to harvest the produce as long as variable costs are recovered. So to work out the economics, a set of prices were used to take into account different scenarios.

Table 3: Yield Potential of Rubber in Kerala

Year	Potential Yield (kg/ha.)			Average (kg/ha.)
	Lower value of range	Upper value of range	Mid point value	
7	700	1000	850	900
8	900	1250	1075	1100
9	1100	1500	1300	1350
10	1300	1800	1550	1480
11	1500	2150	1825	1590
12-32	1800	2500	2150	1620

Terracing, digging and filling pits; planting seedlings and sowing cover crop are one time operations carried out in the first year. Fertilizer, plant protection and irrigation are repeat activities in a year and throughout the economic life of the plantation. Tapping starts from 7th year and continues up to 32nd year. At the end of the terminal year felling and logging are done.

The average yield of rubber in Kerala is taken for our analysis. The yield data was collected from the Rubber

Table 5: Per Hectare Annual Inflows from Rubber under Different Scenarios

Particulars	Year 1-4	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12-31	Year 32
a. Kerala yield (kg)	0	900	1100	1350	1480	1590	1620	1620
b. Value at Rs 30.13	0	27117	33143	40676	44592	47907	48811	48811
c. Value at Rs 40.91	0	10194	10834	11562	11022	10297	65670	65670
d. Wood value	0	0	0	0	0	0	0	835000
e. Subsidy	4500	0	0	0	0	0	0	0
f. Total inflows b + d + e	4500	27117	33143	40676	44592	47907	48811	883811
g. Discounted (f)	12848	10194	10834	11562	11022	10297	65670	10093
h. Total inflows c + d + e	4500	36819	44143	55229	60547	65047	66274	901274
i. Discounted (h)	4500	13842	14430	15699	14966	13981	89165	10293
j. Mid point yield (kg)	0	850	1075	1300	1550	1825	2150	2150
k. Value at Rs 30.13	0	25611	32390	39169	46702	54987	64780	64780
l. Total inflows d + e + k	4500	25611	32390	39169	46702	54987	64780	899780
m. Discounted (l)	12848	9628	10588	11134	11543	11819	87155	10275

Board and the average and mid point yield were calculated (Table 3). As costs incurred and returns realized are spread over the economic life of the plantation, their simple summation and annual averages would not reflect the real values. Therefore, time value of money is used to compute the present value and annuity of inputs and outputs. The annual costs for the economic life of rubber plantation is given in Table 4. Labour is a major cost item. Its use is heavy in the first year when preparation of land, digging and filling pits, planting, terracing etc are done. The labour input is low for 2nd to 6th year but increases from 7th year when tapping starts. The labour input increases again in the terminal year when trees are felled. The cost series is discounted at 15 per cent rate to compute present value of outflows. It comes to Rs 1,26,877 and the annuity worked out to be Rs 19,251.

Ruber yield is low in the initial years and increases for about six years to stabilize from 12th year. The price of rubber at Kochi was Rs 30,130 per tonne (1998-99) and a projected price of Rs 40,190 per tonne was assumed in our calculations. At the end of economic life, the trees are felled for wood. The wood fetches an income of Rs 8.35 lakhs. The rubber growers in Kerala get a subsidy of Rs 18,000 per hectare. To work out the annual average income flows the series is discounted at 15 per cent rate of interest (Table 5). The discounted inflow at Rs 30.13 per kg was Rs 10,194 in the 7th year and Rs 10,093 at the end of 32nd year. At price Rs 40.91 per kg, it was Rs 13,842 in the 7th year and Rs 10,293 in the 32nd year. When the mid point yield was taken and price of Rs 30.13 kg was considered, the discounted income flow was Rs 9628 in the 7th year and Rs 10,275 in the terminal year.

The net returns from rubber under three scenarios is given in Table 6. As no production of rubber is realized in first six years, the net returns are negative for this period. The negative net returns are high in the first year because of labour used in preparation of land and see-

Table 6: Net Returns under Different Scenarios and Their Present Value

Year	Net returns			Present value		
	S-1	S-2	S-3	S-1	S-2	S-3
1	-24025	-24025	-24025	-20891	-20891	-20891
2	-6405	-6405	-6405	-4843	-4843	-4843
3	-4600	-4600	-4600	-3025	-3025	-3025
4	-3650	-3650	-3650	-2087	-2087	-2087
5	-7100	-7100	-7100	-3530	-3530	-3530
6	-6350	-6350	-6350	-2745	-2745	-2745
7	1257	10959	-249	474	4121	-93
8	6743	17743	5990	2204	5800	1958
9	13600	28154	12094	3866	8003	3438
10	17166	33121	19276	4243	8187	4764
11	20184	37324	27264	4338	8022	5860
12-31	21007	38470	36976	28263	51758	49748
32	821007	838470	836976	9376	9575	9598
Present Value				14464	57647	38152
Annuity				2195	8747	5759
S-1 = Kerala Yield and price Rs 30.13/kg. S-2 = Kerala yield and price Rs 40.91/kg.						
S-3 = Mid point yield at Rs 30.13/kg.						

The farmers have made huge investments, switching to other crops in the middle of the economic life of the plantation would result in heavy losses.

dlings. The net returns become positive from 7th year when tapping begins. The annual net returns increase and stabilize from 12th year onwards. In the terminal year net returns increase substantially because of value of wood realized. Coming to the economics of the activity, the annuity value though positive is low at just Rs 2195. If subsidy is withdrawn, it goes down to Rs 425. At projected price and mid point yield, the annuity is Rs 8747 and Rs 5759 respectively. The average size of rubber plantation is 0.42 hectares and hence income from rubber is very low. If there is further fall in prices, it would affect the growers as the activity may not be remunerative. Since the farmers have made huge investments, switching to other crops in the middle of the economic life of the plantation would result in heavy losses.

Competitiveness

In order to examine whether Indian rubber could withstand the imports in the new liberalised scenario, nominal protection co-efficient (NPC) and Domestic Resource Cost Ratio (DRCR) were calculated. NPC measures the discrepancy between domestic price and reference price of the commodity. It is the ratio of domestic price to reference price. NPC more than 1 means the commodity is being protected and under free trade, price of the commodity would be lower. NPC less than one indicates competitive advantage and under import hypothesis, domestic product can compete with imports. The DRCR considers both tradeable and non-tradeable inputs as well as outputs and reflects the efficiency in the use of non tradeable resources. Non tradeable inputs and outputs are adjusted for market distortions through opportunity cost. DRC is the ratio of opportunity cost of non tradeable inputs net of opportunity cost of non tradeable outputs to the value of tradeable output net of tradeable outputs to the value of tradeable output net of tradeable inputs at reference prices. A value of more than unity would mean inefficiency in domestic resource use. That is, to produce one unit of foreign exchange, more than one unit of domestic resource is used. If it is less than one, resour-

ces are used efficiently and the commodity can be continued to be produced even if domestic price is higher than the border price.

For calculating NPC, Kuala Lumpur prices are taken and import hypothesis is made the basis for comparison at the Kochi port. It can be seen from Table 7 that NPC for 1995 was marginally less than unity but in 1996, 97, and 98 it was marginally above unity. It shows our rubber can compete with the imported rubber. However, NPC does not reflect the economics of rubber cultivation. A further fall in price would adversely affect the returns to the growers as net returns are already low even though NPC may be less than one. The DRCR 0.37 shows that the domestic resources are used efficiently. That is to earn one unit of foreign exchange, only 0.37 units are used. Therefore, even if the domestic price is higher than border price, the crop may be cultivated (Table 8).

Table 7: Nominal Protection Coefficient for Indian Rubber (Import Hypothesis)

Particulars	1995	1996	1997	1998
Border price (Rs./tonne)	51571	48857	37126	27639
Domestic price (Rs./tonne)	50730	51360	40002	30270
NPC	0.98	1.06	1.07	1.09

Table 8: Domestic Resource Cost Ratio of Indian Rubber

Particulars	Inputs		Outputs	
	Tradable	Non-tradable	Tradable	Non-tradable
Financial values	1922	13426	30270	1145
Economic values	2129	10890	27639	1373
DRCR = 0.37				

The current tariff level of 31.5 per cent is barely sufficient. As the competitiveness of the crop depends on international prices, freight rates and handling charges, a change in any of these factors would have positive or negative repercussion on Indian prices. Therefore, it is not possible to follow a strict tariff policy. Hence a tariff band should be fixed to protect the growers without compromising the interest of the consumers. The upper and lower bound may be in force depending on the international price, freight charges etc. □

Constraints Management – An Indian Case of Throughput Improvement

L.S. Murty

Management philosophies have evolved from mere statistical control techniques to more sophisticated systems like MRP, MRP II, ERP, JIT, TQM, lean production etc. However, globalization and liberalization have made competition severe requiring significant improvement in throughput and variety with a tight control on investment and operational costs. Constraints management approach can be used to meet these challenges. In this article, such an approach is briefly introduced and an Indian case study is presented wherein application of constraints management leads to significant improvement in throughput. It is hoped that sharing the experience of real-life cases like the one presented here would encourage managers to proactively pursue constraints management approach to improve performance.

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Management thoughts have evolved over time. There have been several schools of thought to structure and manage operations system. These are: statistical replenishment systems, material requirements planning (MRP) system, manufacturing resources planning (MRP II) system, enterprise resource planning (ERP) systems, group technology, cellular manufacturing systems, just-in-time (JIT) systems, lean production systems, agile manufacturing systems etc., to name a few. In recent times, a new school of thought has emerged: Constraints Management (CM). Constraints Management approach focuses attention on the constraints in the system and strives to maximise throughput while minimizing inventory and operating expense.

Constraints Management approach focuses attention on the constraints in the system and strives to maximise throughput while minimizing inventory and operating expense.

CM approach is a paradigm shift pioneered by Dr. Eliyahu Moshe Goldratt, a physicist. Worldwide, several organisations adopted this approach to tremendously improve the performance. However, their managers do not divulge the sources of the dramatic improvements for fear competitors will follow their path of improvements (Cox and Spencer, 1998). There have not been many Indian reported experiences of the application of CM approach. This paper is intended to fill that gap.

Constraints Management

The constraints Management thought began with a computer software package called OPT (Optimized Production Timetables which later came to be known as

Optimised Production Technology) developed by Goldratt in 1970s. This package is essentially a job shop scheduling software that uses DBR (Drum-Buffer-Rope) concept. In this method of scheduling, bottleneck resources are identified and a schedule is developed for maximizing their utilization. Later schedules are derived for the non-bottleneck resources from that of the bottleneck resources. In this process, the notion of process and transfer batches¹ are used. Process batch helps in maximizing the utilisation of the bottleneck work center and transfer batch in reducing the throughout time. The statistical variations are addressed using time and space buffers (as opposed to conventional quantity buffers).

The DBR concept is subsequently generalised as Theory of Constraints (ToC). The five steps adopted in ToC are:

- Identify the constraint (or bottleneck that is restricting the throughput) in the system
- Exploit the constraint to the maximum extent
- Sub-ordinate all the non-constraints to the constraint
- Elevate the constraint (de-bottleneck the constraint), and
- Return to step 1 (as a step towards continuous improvement)

Adopting a performance measurement system that consists mainly of three criteria – throughput, inventory, and operating expense, ToC when applied to shop floor management follows broadly the following principles:

- Do not balance the capacity – balance the flow
- The level of utilization of a non-bottleneck is not determined by its own potential but by some other constraint in the system
- Utilization and activation of a resource are not the same
- An hour lost at a bottleneck is an hour lost for the entire system
- An hour saved at a non-bottleneck is mirage
- Bottlenecks govern both throughput and inventory in the system
- Transfer batch may not and many times should not be equal to process batch

1. Process batch is the total quantity of a component a work center processes before it changes over to the next component. Transfer batch is the processed quantity that is moved at the same time from one work center to another.

- A process batch should be variable both along its route and in time
- Priorities can be set only by examining the system's constraints. Lead time is a derivative of the schedule.

Several books have been published elucidating the concepts and application of ToC to various contexts (Goldratt and Cox, 1993; Goldratt and Fox, 1986; Goldratt, 1990a, 1990b, 1994, 1997; Newbold, 1998; Umble and Srikanth, 1990). Recent books on Operations Management also give a good exposure on this subject. An extensive list of publications on ToC can be found at www.apics.org. The practice of Theory of Constraints came to be known as Synchronous Manufacturing or Constraints Management.

Thru-put Corporation uses constraint-based technology to hone in on bottlenecks and synchronize manufacturing to smooth material flow and eliminate waste. Refer Table 1 for some reported experiences of the application of Constraints Management.

Thru-put Corporation uses constraint-based technology to hone in on bottlenecks and synchronize manufacturing to smooth material flow and eliminate waste.

Table 1: Some reported experiences of application of Constraints Management

Company	Performance Improvement
Brence, Inc.	Increased on-time ship to 98%, rescued WIP by 29% and increased WIP turns by 90% while product demand has increased by 40%.
Blount, Inc.	Increased profits by 37% with only a 5% sales increase
Dirona	Increased on-time deliveries from 72% to 100%, reduced inventory 90%
Elecon Engineering	Reduced manufacturing cycle-times by 33% and reduced WIP by 27.5%
FMC	Improved on-time delivery by approx. 30% and cut WIP by 40%
Morgan Construction	Reduced piece part cycle time by 30%

Source: www.thru-put.org downloaded on April 21, 2001.

There are various alternative systems (like MRP and JIT) that lead to performance improvement on the dimensions of WIP, on-time shipment, manufacturing cycle time. Table 2 contrasts these systems on some

Table 2: Comparison of MRP, JIT, and Constraints Management Systems

	Material Requirements Planning (MRP)	Just-in-Time (JIT)	Constraints Management (CM)
Focus	Improved production planning and control	Elimination of all waste	Increased throughput and reduced inventory and operating expenses
Intended operating environment	Intermittent- or repetitive flow processes	Repetitive-flow processes	Intermittent- or repetitive-flow processes
Key features	Reduces inventory by supplying only what is needed when it is needed		
	<ul style="list-style-type: none"> Generates planned order releases based on the MPS, BOM, and, standard lead times Complex computer-based system with rich databases 	<ul style="list-style-type: none"> Reduces inventory by decreasing batch sizes and equipment setup times Emphasis on continuous improvements, TQC and active employee involvement 	<ul style="list-style-type: none"> Emphasizes 100% utilization of bottleneck resources Reduces inventory by limiting output of all resources to bottleneck capacity and using variable batch sizes.
Scheduling capabilities	<ul style="list-style-type: none"> Yields a production plan that may not be feasible and is time consuming to produce Scheduling on the shop floor is required Is a push system 	<ul style="list-style-type: none"> Shop floor activity is not scheduled directly but is activated by a pull system such as kanban Manual system Level daily production schedule 	<ul style="list-style-type: none"> OPT software generates a detailed feasible schedule quickly Uses both push and pull
Implementation	<ul style="list-style-type: none"> Requires vast amounts of accurate data Requires expensive software and hardware, Average total installation time: 5 years 	<ul style="list-style-type: none"> Requires reorganisation of shop floor, setup reductions, very reliable processes Average total installation time: 5 to 10 years 	<ul style="list-style-type: none"> Modest data requirements OPT software is expensive but can be installed in a relatively short time: organisational changes (e.g., changes in performance measures reward systems cost accounting systems) may take much longer

Source: Noori H and R Radford, *Production and Operations Management*, New York: McGraw Hill, 1995.

dimensions like focus, intended operating environment, key features etc. Bolander and Taylor (2000) provide a comparison of logic used by various scheduling techniques, namely, JIT, MRP, ToC and PFS (Process Flow Scheduling).

Most of the literature in this field contains attempts to illustrate the concepts through examples. Womack (1999) reports the experience of applying the concept of theory of constraints in a healthcare system. But there are few such real-life applications—particularly Indian—reported in literature. In the following section, an Indian case study is presented wherein the concept of constraints management is used in an Indian engineering manufacturing company to achieve high throughput with minimal investment in capacity and operational expense.

Case Study²

Background

Company Profile

XYZ Limited is a premier ISO-9000 public sector company in India and the second largest manufacturer of earthmoving equipment in Asia with 60 per cent market

share in domestic earthmoving industry. A three decade old multi-locational, multiproduct company, XYZ has vital applications in diverse sectors of economy such as coal mining, steel, cement, power, irrigation, construction, road building, defense and railways. It has expanded its product range to cover high quality hydraulics, heavy-duty diesel engines, welding robots and undertaking heavy fabrication jobs. With a commitment to total quality, reliability, XYZ is not only maintaining its leadership in earth moving industry in India, but also constantly breaking through new grounds in overseas markets.

Issues & Concerns

XYZ has three manufacturing units—each located in a different place. Each unit consists of several divisions. One such division—Engine Division—supplies engines to other vehicle or equipment manufacturing divisions. The demand for vehicles and equipment is growing and production requirement is expected to double in the coming 2 to 3 years. But shortage of engines is limiting

2. This case study is based on a project work done by a participant of a long duration executive education programme at the Indian Institute of Management Bangalore under the guidance of the author. The organisational details have been disguised to maintain confidentiality.

the sales. It has been observed from past experience that machine shop of engine division is not able to meet the assembly requirements. Therefore the engine dispatches are getting delayed. In order to be customer responsive, an analysis of throughput has been proposed with a specific focus on two categories of components—connecting rods and flywheel housing components³—that are often in short supply causing delays in engine assembly.

Engine Division

This division manufactures diesel engines for captive use of all XYZ's earthmoving equipment like bulldozers, dumpers, motor graders, excavators, loaders etc. The engine division produces around 18 varieties of engines out of four basic engine models (A, B, C and D series). Engine division is divided into following manufacturing areas:

Machine shop: Critical components like connecting rods, camshafts, cylinder blocks, cylinder heads and flywheel housings required for engines are manufactured here. Engine division machine shop is equipped with various high tech CNC machines, machine centers including flexible manufacturing system (for cylinder blocks machining). The machine shop is divided into camshaft line, connecting rod line, cylinder block transfer line, flywheel housing line, and cylinder head line. Also the shop is equipped with a sophisticated 3-coordinate measuring machine to certify critical parameters.

Assembly of engines: Assembly of engines along with bought out items is carried out.

Testing of engines: Testing of all engines and also endurance testings are carried out.

Existing System

A detailed study was made to understand the existing layout and manufacturing process, planning and scheduling system, and capacity utilization. These issues were as follows:

Layout and Manufacturing Process

The shop follows product layout and consists of five product lines. Connecting rod line consists of thirteen machines. The process plan (see Fig. 1) is the same for

of all types of connecting rods. There is a lot of backtracking in this line since the components revisit some machines in the process flow. The flywheel housing component line consists of six machines. These components also have similar process flow with fewer operations and do not involve backtracking.

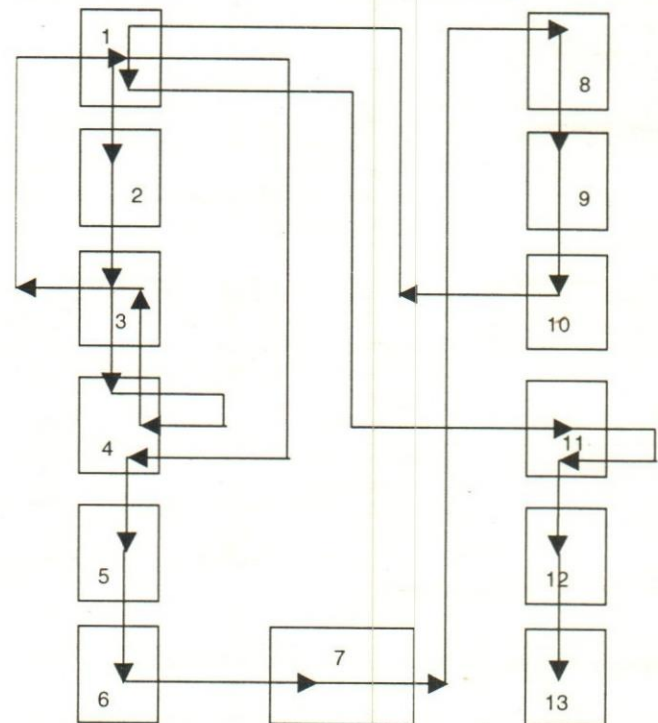


Fig. 1. Process Flow in Connecting Rod Line

Number in the squares indicates the machine number. There is a significant amount of backtracking in the component flow.

Planning & Scheduling System

The annual production requirement is projected by corporate planning in consultation with central marketing division at the corporate office. This requirement is then communicated to all equipment manufacturing divisions. The equipment manufacturing divisions send their schedule for equipment to engine division. On receipt of this, the planning department of engine division releases quarterly and monthly production plans to production department. The scheduling is then done by the production in-charge in association with the line-in charges based on past experience. Backlogs from the previous month targets are added to the present month. The divisional head conducts review meetings once a fortnight and a shortage list is circulated by engine planning department for follow up of shortage items. Currently the machine shop is not in a position to meet the requirements of the assembly schedules. Sometimes due to urgency of a particular component for a specific engine requirement, the running component is removed and urgent component is loaded in the line that disturbs the

3. Connecting rods are initial components required for the engine assembly. Flywheel housing line components are required at various subsequent stages of the assembly. Any delay in supply of these components results in stall of further buildup and causes delay of engine deliveries to other divisions.

on-going component. There seems to be no definite scheduling pattern in practice.

Capacity Utilization

Availability of all machines in the connecting rod line and flying wheel housing is in the range of about 50-85 per cent. However, productive utilisation of any machine is less than 50 per cent of the availability. Such low utilization despite reasonable level of availability of material and machines is an indication that the scheduling is inappropriate.

Productive utilisation of any machine is less than 50 per cent of the availability.

WIP Inventory

The current ad-hoc scheduling system made maintenance of WIP records virtually impossible. However stock verification conducted for the purpose of this study to get an idea of the WIP level revealed the WIP inventory in the connecting rod line and flying housing line to be 414 and 90 numbers⁴ respectively.

Analysis

A diagnosis of the system indicated that the major problems are in the areas of machine capacity, batch size, and availability of fixtures.

Machine Capacity

Monthly capacity requirement for future and availability for connecting rod line and flywheel housing line are as shown in Tables 3 and 4 respectively. Clearly machine 1 of connecting rod line and machine 1 of flywheel housing line are the bottleneck machines with capacity requirement almost equal to the requirement. Even though the capacity is almost equal to the availability capacity in connecting rod line at the bottleneck resource, the exact capacity available will be less than this because of the backtracking of components. If the horizon for scheduling is increased to two months, the requirements of all the engines can be completed with the existing facility and without any delay. The gain in the reduction of setup changes can be utilized to meet the requirements of other components.

4. Even though the value varies across the components, since the focus of the study is on the component flow, WIP is measured in terms of aggregate numbers.

Table 3: Capacity Analysis of Connecting Rod Line

Machine	Existing System		Monthly capacity required (hrs) ^α	Utilization with proposed system (%) ^β
	Availability (%)	Utilization (%)		
1	84	40	256	83
2	66	7	55	20
3	82	13	86	24
4	83	24	137	42
5	84	14	149	51
6	65	21	62	21
7	65	4	28	10
8	68	6	48	14
9	69	5	42	15
10	62	5	38	11
11	84	25	190	62
12	53	8	46	18
13	72	5	43	15

α: Availability is 262.5 hrs β: Availability assumed is 70%

Table 4: Capacity Analysis of Flywheel Housing Components Line

Machine	Existing System		Monthly capacity required (hrs)	Utilization with proposed system (%)
	Availability (%)	Utilization (%)		
1	86	47	255	84
2	84	28	187	77
3	80	25	121	51
4	66	18	64	18
5	85	28	160	73
6	79	29	203	65

α: Available is 262.5 hrs β: Availability assumed is 70%

Batch Sizes

Traditional approaches for batch size decisions do not distinguish between the setup at a bottleneck resource and that at a non-bottleneck resource. Even in line layouts, the batch sizes should be decided based on the effect these batch sizes have on the synchronous flow of components through the line. An analysis of the present batch size was carried out and it was found that batch size depends upon raw material availability and operational/cycle time of the component. Generally raw material availability is very good (hence is not a constraint). The quality loaded to the shop is more than the capacity of the machines for 1-3 months. A component may revisit the same machine again in its sequence of operations (backtracking). For example, the connecting rod after first operation on machine 1 comes back for seventh operation on the same machine. Hence the next batch selected on machine 1 should be completed before the first batch loaded completes the operations

between first and seventh operations. Otherwise either the machine will wait for the component or the component will wait for the machine.

The order under progress in the shop are split as and when any rush order comes. So there is no specific batch size that is operational, leading to difficulties in tracking an order and also monitoring the throughout time performance. In view of backtracking of the components, and order splitting, it was found that, all the models required in a month could not be completed. Hence based on the monthly production requirement and capacity available, a two-month cycle was considered. Accordingly, process batch and transfer batch sizes were determined using DBR principles.

Availability of Fixtures

Machine utilization also depends upon the availability of fixtures and tooling when multiple jobs can be loaded on the machine. In connecting rod line, this phenomenon is observed in case of machine 1, which has the highest utilization in line. Though the machine has eight loading stations, fewer fixtures are loaded to achieve the desired accuracy of machining dimensions. This not only calls for higher setup time on machine 1 but also makes the downstream machines wait for jobs from this machine. During the study, it was found that the number of fixtures for all the three operations being performed on this machine could be increased with few trials on the machine.

Machine utilization depends upon the availability of fixtures and tooling when multiple jobs can be loaded on the machine.

In flywheel-housing line, the drilling fixtures in particular are made common for several operations of same component, i.e., for a component having requirements of two set ups of drilling operations, fixtures are common. This increases the throughput time of the component, as the completed component can not be progressed even though machine is available.

Machine Component Allocation

In flywheel housing components line, even though both the machine 1 and machine 2 are identical, one is used for one type of components and the other for the rest of the components. This made machine 1 overloaded and machine 2 underloaded. So outputs in sets of engine components are not matched.

Proposed System

The analysis clearly established that capacity is not the immediate problem for throughput. Instead reasons like backtracking of components, batch sizes that require varying processing time on various machines and dearth of fixtures adversely affect effective machine utilization and hence the throughput. So appropriate use of scheduling based on constraint management principles can possibly help in increasing the throughput.

Backtracking of components, batch sizes that require varying processing time on various machines and dearth of fixtures adversely affect effective machine utilization and hence the throughput.

Since material availability has not been a problem in the past, it was assumed that material would be available as and when necessary. However, two scenarios were considered—additional fixtures not available and additional fixtures available. Capacity analysis indicated that a 2-month horizon would be appropriate and that the machines 1, 4, 5, and 11 of the connecting rod line are the bottlenecks. An application in Excel spreadsheet was developed linking the loading and sequencing of all the components to facilitate the scheduling exercise. Depending on requirements and capacity available, process batches were determined. For example, connecting rods of B and C series of engines are produced in one batch while others are produced in two or three batches. Using DBR logic and the Excel spreadsheet, detailed schedule for the two months was developed to complete all the components. Gantt charts were drawn to analyze the throughput for both the connecting rod line and flywheel housing line components. This exercise was repeated assuming availability of additional fixtures.

Results

Throughput: In connecting rod line, the throughput increased by 51 per cent over the existing production level using only the existing fixtures. However, when additional fixtures are used at machine 1, the total flow time reduced by 87 hours. In other words, the throughput increased by 76 per cent over the existing production level. In the flywheel housing line, the throughput increased by 57.5 per cent over the existing production level using only the existing fixtures. However, when additional fixtures are used and next available machine is used for loading (instead of the present practice of load-

ing on the same machine), the throughput increased by 72 per cent over the existing production level.

WIP Inventory: Using Gantt charts, the effect of the proposed scheduling system on the WIP inventory was analysed. For connecting rod line, the average WIP inventory reduced from the current level of 414 to 169 numbers. For the flywheel housing line, the reduction is from 90 to 30 numbers.

Machine Utilization: Utilization with the proposed scheduling system for both connecting rod and flywheel housing lines was analyzed. Utilization of bottleneck machines in both the lines has increased by 50 per cent for the availability considered. See Tables 3 and 4 for connecting rod and flywheel housing components line respectively.

Material Handling: It is observed from the study of the connecting rod line that currently material handling is being carried out with frequent changes in batch sizes of 18-19 nos. Hence material movement in the proposed system will not be a constraint. For the flywheel house line, provision and allocation of material handling facility is a requirement as the components handled are of heavy weights (from 20 kgs to 250 kgs). The proposed system calls for the transfer of batches in time from one work center to another very effectively. Hence material handling facility may have to be reviewed to ensure smooth flow of components.

Conclusion

XYZ was facing engine availability as constraint for its equipment sales. In turn, the availability of two categories of components—connecting rods and flywheel housing components—was found to be the constraint. A detailed analysis of the production process of these two components was carried out. Instead of the conventional solution of capacity expansion to solve this problem (which could be very expensive—one additional unit each of the four bottleneck machines together would cost about Rs. 200 lakhs), an appropriate scheduling system was evolved using constraints management concept. The net result is an increase of about 50 per cent in the throughput without any additional investment. However, with a modest investment in fixtures, the throughput could be increased by over 70 per cent. There have been corresponding improvements in the WIP inventory and machine utilization. In addition, the suggested system can be implemented immediately without major structural changes while making the throughput times shorter and deliveries to the downstream assembly lines reliable.

In this study, a horizon of two months was considered and the requirements over this horizon were

frozen. It is worthwhile to roll this MPS once every month to accommodate dynamic changes in the engine requirements. Also, setup time reduction (particularly at the bottleneck machines) can lead to further improvement in the performance.

Constraints management is an extremely powerful approach to effectively utilize expensive scarce resources. In these days of intense competition pushing the conflicting parity lines of cost, responsiveness, and variety, Indian industry has a lot to benefit from appropriate usage of this approach. It is hoped that sharing the experience of real-life cases like the one presented here would encourage the practicing managers to proactively pursue a potential approach to improve performance.

Constraints management is an extremely powerful approach to effectively utilize expensive scarce resources.

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News & Notes

India's Competitiveness

Each year the International Institute for Management Development, a Swiss business school, assesses how countries are doing in terms of their business competitiveness. IMD ranks 49 countries according to 286 criteria, in four categories economic performance, government efficiency, business efficiency and infrastructure. Some criteria are "hard" data, such as GDP. Others, such as executives' beliefs about the availability of good managers, are "soft" data intended to capture perceptions. As in 2000, IMD believes that America is the best country at fostering competitiveness, followed by Singapore. After a strong economic performance last year, Hong Kong ranks third among the countries in our chart (and sixth of all 49), up from eighth (and 12th overall) in 2000.

World Competitiveness Index 2001, selected countries

United States	1	Malaysia	29
Singapore	2	Brazil	31
Hong Kong	6	China	33
Ireland	7	Czech Rep	35
Canada	9	Mexico	36
Switzerland	10	Thailand	38
Germany	12	Slovenia	39
Iceland	13	Philippines	40
Israel	16	India	41
Taiwan	18	South Africa	42
Britain	19	Argentina	43
New Zealand	21	Turkey	44
Chile	24	Russia	45
France	25	Colombia	46
Japan	26	Poland	47
Hungary	27	Venezuela	48
South Korea	28	Indonesia	Overall ranking 49

India's Overall Performance

1997	1998	1999	2000	2001
41	38	42	39	41

India's Economic Performance

1997	1998	1999	2000	2001
16	30	32	23	23

India's Economic Performance

2001

Domestic Economy	33
International Trade	30
International Investment	32
Employment	19
Prices	6

India's Government Efficiency

1997	1998	1999	2000	2001
40	37	44	44	43

Government Efficiency

2001

Public Finance	45
Fiscal Policy	3
Institutional Framework	41
Business Framework	43
Education	49

India's Business Efficiency

1997	1998	1999	2000	2001
40	38	39	38	39

India's Business Efficiency

2001

Productivity	48
Labor Market	23
Financial Markets	30
Management Practices	44
Impact of Globalization	27

India's Infrastructure

1997	1998	1999	2000	2001
43	43	44	43	45

India's Infrastructure

2001

Basic Infrastructure	45
Technological Infrastructure	39
Scientific Infrastructure	37
Health and Environment	48
Value System	35

Source: The World Competitiveness Yearbook 2001. □

Book Reviews

"Corporate Crisis Management—Challenges for Survival" by S. Shive Ramu, Response Books: A division of Sage Publication India Pvt. Ltd. New Delhi, 2000, p. 260.

In the era of Internet and borderless economy uncertainty and crisis in organisations are the major issues, which professionals are facing. To compete in the fast changing market driven economy, professionals have to be conscious and efficient; otherwise it may be fatal or disastrous, resulting in complete disruption of operations and leading to enormous losses. Therefore, it is the need of the hour to realize the importance to redesign or reengineer and structure that can enable organisation not only to handle sudden crisis but also anticipate and prevent them well in time before it happens.

The book on "Corporate Crisis Management: Challenges for Survival" has been divided into four major themes and 11 chapters. Part one consists of 2 chapters, which focus on Environmental Management. The first chapter highlights the role of NGO's in changing the patterns of production and product design to result in more environment friendly products. Earlier their strategy was focused on influencing government to bring in more stringent regulation to control the activities considered to be environment unfriendly. Now they are targeting individual companies or particular products like automobile, chemicals, fire works, silicone implants etc. This way they have been able to bring about changes faster than earlier. In the new paradigm "Market based Environmentalism" (MBE), is adopted to meet the challenges and the activities of government have led companies to refocus their corporate strategies to eco-centric, environmental commitment, 'first mover advantages' and green alliances. The author has illustrated his point through various examples. He discusses the nature of disasters faced by business firms such as cyclones and flooding, citing the examples of Reliance and Citi Ban to illustrate how to get prepared to tackle such eventualities. Further five case studies dealing with operational disaster such as oil spills, toxic sludge are given.

Part two of the book deals with Corporate Social Performance (CSP). This part contains three chapters. Chapter 3 deals with corporate social responsibilities. The CSP viewed through two models—the stakeholder model and Corporate Social Performance model (CSP). Author illustrates CSP with examples of two air crashes having different reactions. Chapter 4 deals with the conceptual background to ethics and the various approaches to ethical issues. Author tries to integrate social responsibility with ethical issues, which leads to corporate ethics and setting up of moral standards appropriate for corporate action. There are two approaches to evaluate conduct—one is appraising the whole system and other is looking at the actions of individual agents operating under its rules. A corporate can incorporate social responsibilities through moral standards as a part of its ethos. Chapter 5 advocates corporate ethics at the work place through job safety, labour practices and workers' rights. In recent years sexual harassment has become an important issues related to the workplace. Author has illustrated this by giving examples of U.S., Japan, India and how various companies are attempting to reduce it. Another issue raised is that of human rights violation which leads to the introduction of company code of conduct.

Part III focuses on market protection and corporate image and consists of 4 chapters. Chapter 6 envisages the framework of what constitutes corporate image, corporate reputation and the impact of rumours on corporate image. The issue of image deals with how the company wants to be viewed while the issue of reputation deals with consumer's perception of the company. Reputation of any company depends on what it provides in relation to customer needs. Reputation consists of three elements i.e. trust, credibility and responsibility. This chapter deals about how a company can build its reputation and what are their characteristics. This has been illustrated by various examples from industries like Reliance, LTCB, etc. Chapter 7 is on the nature of boycotts and product recalls, bringing out the nature of crises in products and corporate responses with selected examples like Adidas, Coca-Cola,

Johnson & Johnson, etc. Chapter 8 focuses on market protection of piracy. Piracy and counterfeiting are common to drugs, entertainment and luxury goods industries. In music industry piracy is a vital problem. Selling of products in the market similar to products of leading companies like Coca-Cola, IBM, McDonald etc. can cost millions of dollars in loss of sales to the genuine manufacturers. This loss is estimated to be more than US \$ 25 billions a year, representing about 8% of world trade. These losses are due to unauthorised access, financial fraud, sabotage of data or networks, hacking, theft of information, robbers, and wrong advertisement.

Part IV focusses on Crisis Management and consists of three chapters. Chapter 9 deals with various types of risks and their management. The risks may be frauds, IT related risks kidnapping, extortions to financial risks. According to the nature of risks, insurance is offered from traditional type to new one. Some companies have started their own captive insurance companies in order to reduce payment of premiums. Risks arise because of political, socio-economic or financial causes, which may not be always predictable but through proper management it can be defused. Kidnapping and extortion, is prevalent in number of countries in various magnitudes. He has given the examples of India, Hong Kong, Thailand, Africa, Angola, etc. As a result, there has been a rapid rise in the private security industry to counter such risks. Chapter 10 highlights the response to a crisis technology related and market related, in a firm. Technology related crisis comes because of introduction of new technology or by modification of new processes in order to become more competitive and cost effective. This leads to the situation called construct crisis. Author has illustrated this with the example of biotechnology firm. The second aspect deals with competitive positioning of a company. In this regard case of Hyndai is illustrated. The other type of crisis is market crisis. Author has quoted the example of Coco-cola and Toyota and how these companies in Asia have been able to cope with the market crisis. Chapter 11 deals with crisis management. This chapter highlights the nature of response to crisis in an organisation. He describes four distinct areas of concern—the manner in which it arises, second the implicit assumptions of an organisation, the nature of top management, fourth aspect is that of marketing. All the aspects have been illustrated sufficiently with examples.

S. Shiva Ramu has lucidly put forth various points and views in an illustrative manner. At the end of each chapter summary issues to ponder over, case studies from all over the world and Indian experience are presented. This book is recommended for organisations, research scholars, students, professionals,

managers, trainers for adding to their knowledge and experience on various related issues.

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Soil Conservation and Watershed Management in Asia and the Pacific. by Asian Productivity Organisation, APO, Tokyo, 2000, p. 261.

Several scholars had been foreseeing that the next world war may be initiated as a 'water war'—a battle for survival of man who is so dependent on 'Punch Mahatva' (five basic elements) of which water and soil (earth) are two vital constituents. Soil and water are two indispensable elements for agricultural production. Their management and sustenance through conservation and rejuvenation is fundamental to agricultural development and enhancement of agricultural productivity. The inter-generation wisdom had ensured that livelihood operations in land use, water use, nutrition management, crop protection, storage, preservation and food processing were performed in the most eco-friendly manner. Local communities over the centuries evolved a moral code that governed their relationship with natural resources and a structure of responsibility through religious and cultural practices for ensuring their observance. However, of late, in many Asia-Pacific countries, watersheds have been badly affected by soil erosion caused by indiscriminate agricultural activities and environmentally harmful cultivation practices. Soil erosion is a quiet crisis and an insidious, largely man made disaster that is unfolding gradually. In many places it is barely recognised. Often the very practices that cause the greatest losses in the long term lead to bumper crops in the short term, thereby causing an illusion of progress.

The present publication is a compilation of the outcome of a Seminar organised by Asian Productivity Organisation on the subject in Republic of China. The seminar was organised with the objective to suggest ways and means for improvements in soil conservation and watershed management through studying the current status of development programmes and approaches adopted in Asian countries. This publication has been divided into four parts. Part I contains a summarized findings of the seminar. Part II contains four resource papers presented by experts on variety of topics like Planning for sustainable watershed management, Integrated watershed management—A learning process, Soil conservation extension—from concepts to

adoption, and Strategies of implementation of soil and water conservation in Taiwan. The resource papers provide a systematic overview of soil and water conservation activities in Asian countries.

Part III contains country papers presented by delegates of twelve Asian countries namely Bangladesh, Republic of China, Fiji, India, Indonesia, Islamic Republic of Korea, Malaysia, Mongolia, Philippines, Sri Lanka, Thailand and Vietnam. The country papers in general contain information regarding current status of these natural resources and their exploitation, impact of various developmental activities including deforestation and biotic interference, adoption of various soil conservation measures such as bunding, terracing mulching and growing Vetiver grass, water harvesting, storage, recycling and other water management measures, constraints and problems of technology transfer, watershed development perspective, policy issues and future strategies in the respective countries. The book provides an excellent opportunity to the reader to acquaint himself with the current scenario of watershed management in these Asian countries having lot of common experiences to share. Part IV of the book contains details about the seminar, its organisation and other information about the participants.

The book has raised certain critical issues that impinge on the subject particularly in the management of programmes initiated with government support. In several countries in the region, the subject is assigned a low profile and needs more efforts to promote general public awareness. While discussing future strategies it has been clearly pointed out that 'bottom up approach' by involvement of professional and interest groups including NGO's would help in promoting advocacy and elicit greater commitment for the sustainable exploitation of these natural resources. Several lessons can be learnt from Republic of China, which had committed a substantial amount of private investments besides public funds.

The book will be of great use to experts engaged in soil conservation and watershed management who will find it a complete source of information of the Asia-pacific region. The publication will be useful in generating public awareness and support for efficient use of soil and water resources.

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Accelerating Growth Through Globalization of Indian Agriculture by K.P. Kalirajan, G. Mythili, U. Sankar

(Eds.) MacMillan India Ltd., 2001, Pages 374, Price Rs. 495 (Hard Bound).

This book explores the opportunities and challenges in accelerating growth through globalization of Indian agriculture. The main thesis of the book is that globalization of Indian agriculture provides an opportunity to India, not only to increase her share in world exports but also to make agriculture a modern and dynamic sector via productivity raising policies and strengthening the two-way linkages between agriculture and industry. Globalization is also a challenge to policy makers in the sense that there is need for a change from the inward looking and state directed policy regime to an outward oriented and market-driven policy regime with adequate safeguards for food security and environmental sustainability.

The book is in two parts. Part a considers issues and strategies at the national level. It begins with an overview of the agricultural sector's policies and performance during the last five decades, explores its growth potential in a global setting, assesses its comparative advantage in terms of various measures, reviews the trade policy and then sums up the opportunities and challenges. India must undertake many agricultural reforms in order to avail of these opportunities. These reforms include both price reforms as well as non-price reforms. The existing policy package consisting of minimum support price (MSPs) for selected agricultural products, procurement of a few products by the Food Corporation of India (FCI) and other agencies, supply of foodgrains and a few other essential items through the public distribution system (PDS) and input pricing policy needs a thorough review.

India's agricultural trade policy regime in the past was dualistic. Exports of plantation crops and a few commercial crops were free from export restrictions, but exports of essential commodities, particularly food products were subject to bans, quotas and other restrictions. Hence, as reported in Chapter 4, most of these commodities were disprotected. India's comparative advantage, measured in terms of different measures of protection, are high for rice, fruits and vegetables, meat and marine products, leather and footwear and clothing and textiles.

Chapter on India and the WTO gives insight of the trade possibilities after WTO. Trade liberalization also provides benefits such as scale economies because of increase in market size; knowledge of demand characteristics in foreign markets; information about new technologies, processes and products; and cost reductions and quality improvements in products because of international competitiveness. Thus, opportunities do exist.

Also, in the Indian context, the gains from trade can arise because of: movement to the existing production possibility frontiers (due to technical efficiency); movement along the existing frontiers (because of new trading opportunities); and upward shifts of frontiers (due to learning, application of improved technologies and adoption of better farming practices).

Agreements on Technical Barriers to Trade (TBT), Sanitary and Phytosanitary Measures (SPM) and Subsidies and Countervailing Measures (SCM) may be used by some developed countries as barriers to imports from developing countries—this is one of the main challenges before Indian agricultural sector. Apart from development of rural infrastructure, modernization of port facilities and reduction in transaction costs for exporters, the government must play a proactive role in creating an enabling environment to meet the agreements on TBT and SPM. These challenges can be met by establishing testing facilities, certification, ecolabelling and joint ventures with the importing countries.

As Methane Desai (1999) observes, 'the logic of the global economy as well as India's interests dictate that India become proactive in its liberalization policies. India must liberalize not because it has no choice—but because it is the best choice. India must liberalize because that way alone can it become a rich and prosperous nation, that way alone is there any hope of conquering poverty'. He says that 'India has adopted a victim mentality when it really needs to adopt a winner mentality'.

Part B deals with agricultural performances, growth potentials and constraints at the state level. The agricultural performance of four states—Bihar, Karnataka, Punjab and Tamil Nadu—are reviewed and compared. Farm level data are used to measure technical efficiency and yield gaps for selected crops, and state level data are used to measure supply responses for a few crops. The last chapter provides an interstate analysis of agricultural growth prospects, to determine the inter-sectoral linkages—whether the growth of agriculture triggers growth of industry or vice versa. The conclusion shows that in some states agriculture triggers industry (e.g. Punjab), whereas in some other states it is industry which triggers agriculture (e.g. Karnataka); though for Tamil Nadu, the study has found that both sectors simultaneously influence each other.

Capital formation in agriculture did not grow at a desired rate and this has to be investigated further. The unscientific cropping pattern still practiced in many regions of the country due to various constraints including absence of proper credit or product markets has created major problems in the development process. In

relation to this, after the eighties there has been a sharp decline in the proportion of income from agriculture to total GDP. However, a corresponding decline in the proportion of work force engaged in the agriculture has not been recorded.

The agricultural income growth shows higher rate for Tamil Nadu and Karnataka after liberalization, though Punjab registered higher growth in the decade prior to liberalization. India's average yield in most of the crops rates below the world average yields and far below the highest yield rates obtained in some countries. Further, within India itself, we observe large variations in average yield rates among states. Even within a state, we observe large interfarm variations. Most farms do not operate on their production frontiers due to various reasons (Chapter 13). The state level studies probe into the factors responsible for technical inefficiency.

Supply response estimates give direction for planners to decide whether improvement in a commodity can be effected through price or non-price factors (chapter 14). They also indicate the extent of response as a result of changes in prices. Results for paddy in Tamil Nadu indicate that the response is getting stronger as compared to the pre-1970 period. For commercial crops like irrigated groundnut, the response is much more than that for paddy. The analysis for Punjab reveals that the low elastic ties in the recent period might be due to the fact that major changes in area occurred during 1967-80 in the Green Revolution period.

The editors of this book have put in tremendous effort in providing an exhaustive analysis of opportunities and challenges before Indian agriculture. The comparative study of technical efficiency of farms in four states is well referenced and provides valuable contribution in comprehending the interstate analysis. The book would be useful resource material for researchers, policy makers and policy analysts.

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Emotional Intelligence at Work—A Professional Guide by Dalip Singh, Published by Response Books, A Division of Sage Publications India Pvt Ltd., 2001, Pages 198, Price Rs. 195 (paper), Rs. 375 (cloth).

Emotional Intelligence or Quotient (EQ) is a more talked about topic these days compared to Intelligence

Quotient (IQ). The reason is simple. As the author says, while IQ contributes to only twenty per cent of a person's success or failure, it is EQ which contributes to the remaining eighty per cent. This fact is applicable not only to individuals but also to organisations. In fact, EQ is the most important determinant of the extent of professional and personal success in life.

In the book 'Emotional Intelligence At Work', the author first highlights the importance of EQ vis-à-vis IQ—he says that high IQ can at the best ensure your entry to a high profile job whereas for retention and further promotion/progress in your workfield, it is EQ which will play the role. There are so many examples of highly intelligent people who have failed miserably whereas many people with only average intelligence have scaled great heights and some have even reached the top of the ladder. In short, whether we speak about an individual or an organisation, it is EQ which contributes to the bottomline.

The author defines EQ as knowing what feels good, what feels bad, and how to get from bad to good. In other words, it refers to emotional awareness and emotional management skills which provide the ability to a person to balance emotion and reason, so as to maximise long-term happiness. He analyses the concept lucidly and the reader is given an insight into his/her emotions. Emotional Intelligence includes components like self-awareness, ability to manage moods, motivation, empathy and social skills such as co-operation and leadership. It is believed that 'learning difficulties' as well as various problems of maladjustment at the workplace have their origin in poorly developed emotional awareness in early childhood.

The most interesting revelation the author makes is that unlike IQ, which does not increase after adolescence, Emotional Intelligence is mostly learned and continues to develop throughout life, by life's experiences.

Why is it necessary to develop EQ? The reason is that people with high EQ are happier, healthier and more successful in their relationships. These people strike a balance between emotion and reason, are aware of their own feelings, show empathy and compassion for others and have high self esteem. High EQ is also needed for making the right decisions and solving problems. High EQ can lead to increased productivity, enhanced leadership skills, improved responsiveness and greater creativity apart from creating an enthusiastic work environment.

The author has outlined a method for developing Emotional Intelligence in an organisation. He has also talked about Emotional Quotient Management (EQM). He has included some case studies which make the reading more informative. The best part of the book is the inclusion of a EQ test which enables the reader to know where he/she stands as far as Emotional Intelligence Quotient is concerned. Written in a simple, lucid language, the book makes interesting reading and will be useful for any individual who wants to improve the effectiveness of his personal and professional life.

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People seldom improve when they have no other model but themselves to copy after.

— Oliver Goldsmith

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