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SMEs: A Comparative Analysis of India, Pakistan & Sri Lanka

G D Sardana & Sarath W S B Dasanayaka

The South Asian region can be termed as the cradle of small industry and small business. In spite of the various policy reforms, incentives and assistance offered by successive governments in India, Pakistan and Sri Lanka with the assistance of the private sector, non-governmental organizations and donor agencies, the small and medium enterprise (SME) sector suffers from many handicaps and problems while competing against large-scale enterprises. The growth of SMEs is mainly constrained by problems relating to both product and factor markets. Lack of institutional support and policy inertia has further reduced the potential contribution of SMEs to the national economy.

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Basic Profiles of SMEs in India

The small scale sector has played an important role in the industrial development, economic growth and distribution of income in the country. It has performed a vital role in the mobilization of capital, generation of employment, dispersal of industries, minimizing regional disparities of income and value addition. The units are localized on account of limitations of capital deployment, transport infrastructure and availability of resources. A report prepared by the All India Association of Industries (2002) points out that the sector accounts for 40% of the value added in the manufacturing sector, 34% of national export, and 7% of GDP. The Reserve Bank of India (2007) reports that the SSI employs 295 lakh people and its 123 lakh units account for an investment of Rs 188,113 crore, while the output was valued at Rs 471,244 crore in 2000-06.

The development of the small sector has therefore, been an important component of India's industrial policy over the last five decades. The development, growth and support to the sector has been governed, regulated and monitored by industrial policy resolutions as designed by the Government of India from time to time. The following sections bring out the salient features of the industrial policy related to small sector, evolved and implemented over the years. The perspective can be clearly demarcated in two time zones. The pre-reform period and the post-reform period. These are two distinct philosophies, approaches and policies related to the SME sector.

Pre-reform period

This period is characterized by regulation and protection. The policies centre on state controls on production, growth and use of resources. The state's involvement is visible in a dominant public sector as well as a regulated private sector covering both large and small

industry. Policy initiatives related to small industry, Bhavani (2006) explains, were built around two types of measures. Promotional measures sought to impart competitive strength to small units by improving their access to different markets and by providing infrastructure and common industry facilities. Protective measures sought to protect small units through a preferential treatment vis-à-vis large units through reservation of certain items. These measures are reflected in varying degrees in Industrial Policy Resolutions/statements from time to time.

Industrial Policy Resolutions/Statements, 1948: A watershed policy which lays down foundations for economic and industrial development in independent India. It recognized that the immediate objective was to establish a social order where justice and equality of opportunity shall be secured to all the people. It was recognized that the state must play an active role in the development of industries. The policy listed three groupings: industry to be under the exclusive monopoly of the central government; industry under the control and regulation of the central government; and basic industries of importance, planning and regulation of which was necessary by the central government in national interest. The policy recognises the importance of the small industry in the national economy. The government decided to set up Cottage and Small Industries Directorate with the main objective of giving a 'distinctly co-operative bias to this industry'. The support came to be extended through several fiscal subsidies, purchase preferences and promotional encouragement.

Industrial Policy Resolution, 1956: Coming eight years after the first declaration, and after the adoption of the Constitution of India, the policy is a major milestone and takes into account the Directive Principles of State Policy and the fundamental rights as enshrined in the constitution. The industrial policy classifies industries into three categories. The first category constituted industries, the future development of which was the exclusive responsibility of the state. The second category comprised of industries where private enterprise was permitted either on its own or with state participation. All the remaining industries formed the third category. The policy resolution called for continued support to the small scale industry through means such as restricting the volume of production in the large scale sector by differential taxation or extending help of direct subsidies. The policy laid the foundations which became famous in later years as license, permit quota raj. The larger units could not expand beyond a permitted limit of volumes and could not enter the domain of products manufactured by the small scale sector. The industry was provided simultaneous protection against cheaper exports through levy of heavy penalties and high custom duties.

Industrial Policy Statement 1973: It identified high priority industries where investment from large industrial houses and foreign companies would be permitted. There is hardly any significant additional provision for the promotion of the small scale sector.

Industrial Policy Statement 1977: Coming twenty years after the Industrial Policy Resolution of 1956, the statement takes notes of dismal growth of capital national income at 1.5 per cent, rising unemployment in the country, widening rural-urban disparities, stagnation of rate of real investment and a poor growth of industrial output limited to average of 3 to 4 per cent per annum in the previous decade. The government decided to provide deeper thrust to small industries. The initiatives came in the form of increase of number of reserved items; creation of District Industries Centres at district level to provide a single window for all formalities and redress of problems. Industrial Policy Statement 1977 is historical as it considers the small scale sector not only an important component for industrial development but an important instrument for creation of a just and equitable society.

Industrial Policy Statement 1980: The policy statement provides a further boost to the small scale industries through several supportive measures of increased financial and marketing support, increasing the list of reserved items, provision of incentives and introduction of a scheme for building up of buffer stocks of essential materials to assist the small sector.

Industrial Policy 1990: The policy is devoted to additional measures for the promotion of small scale and agro-based industries. Steps were taken to streamline formalities and record keeping, such as maintenance of registers, submission of returns so as to cut down bureaucratic controls and unnecessary interference. Small Industries Development Bank of India (SIDBI), an apex bank, was created to channel need-based higher flow of credit and the agro-based industry was accorded a priority in credit allocation from the financial institutions.

Post-reform Period: Since the early 1980s, there has been a perceptible change in the economic environment all over the world. The world economies started coming closer with a marked shift towards 'market orientation'. The information revolution and the internet have brought knowledge to the doorstep of the consumer. A customer now was better informed on availability of alternatives, the prices, performance and innovations. Industry could not sustain in isolation what happened

elsewhere. The WTO, in this respect, has played a significant role to break the trade barriers. India as signatory to the GATT agreement is committed to bring down its tariff rates to WTO targets. The Indian government thus ushered in the WTO regime reforms in 1991.

Statement of Industrial Policy 1991: The central government took a series of steps to bring about changes in industrial licensing, foreign investment, foreign technology agreements, public sector policy, act on Monopolies and Restrictive Trade Practices. It abolished industrial licensing for all projects, abolished all registration schemes, introduced delicensed registration, restricted public sector to a few industries, liberalized imports and removed quantitative restrictions on production and trade. It virtually reversed earlier policies on industrial development in general and small sector in particular, encouraged foreign direct investment, expansion of large industrial houses and the multinationals. Subsequent steps related to permitting large houses to take up products reserved for the small scale sector, large scale de-reservation of products, curtailment of exemptions and withdrawal of preferential policies for the small industry.

The Micro, Small and Medium Enterprises Development Act 2006: In India, till this act became operative, Small Scale Industry (SSI) had remained the most commonly used phrase to describe the small scale. In line with the world practice, this was changed to Small and Medium Enterprises (SME). The act is the latest to push forward the philosophy of the WTO regime. This has become operational from 2nd October 2006. Some of the important provisions include:-

- The word 'enterprise' replaces 'industry' in order to include services.
- It further makes sub-classifications such as micro, small and medium. These are defined in terms of ceiling on investment differentiated for the manufacturing and service enterprises (Table 1).

Institutional support to the sector

The office of the Development Commissioner (SSI) renders services in providing techno-economic and managerial consultancy towards technical upgradation, modernization, quality improvement, and installation of information technology. As a constituent of the Ministry of Small Scale Industries, Small Industries Organization (SIDO) under the Development Commissioner is the nodal development agency to coordinate and regulate the development of the small industry sector. SIDO came to be established in 1954 and through its large network of autonomous bodies provides services in areas of project development, tool rooms, and training institutions and focuses to provide support in getting financial credit, marketing of products and needs of infrastructure. Bhavani (2006) points out that consultancy services are mainly provided through 28 Small Industries Service Institutes (SISI) and 30 branch SISIs.

Training to technicians and workers is provided at 42 workshops. The National Institute for Entrepreneurship and Small Business Development, and National Institute of Small Industry Extension and Training provide management training. Promotional services are rendered through four Regional Testing Centres, eight Field Testing Stations, and ten Tool Rooms. The National Small Industries Corporation has been established to promote the sector at the central level.

Financial assistance is available from a variety of institutions. Some of the important ones include: Small Industries Development Bank of India (SIDBI), state level Financial Corporations, National Small Industries Corporation (NSIC), cooperative banks and various commercial banks both in the private and public sector. The NSIC has the main objective of providing machinery and equipment to small industrial units by offering them fiscal support on terms of long repayment period with moderate interests.

At the state level, Director of Industries, District Industries Centre (DIC), State Financial Corporation (SFC), State Industrial Development Corporation (SIDC) and State Small Industries Development Corporation (SSIDC) are the extended arms. DIC provides consultancy to the small scale to select plant and machinery, raw materials and the markets. SSIDC promotes the small scale sector through construction of industrial estates and other infrastructure facilities. SIDC helps in organizing capital and other infrastructure. SFC focuses on the capital needs.

Changing definition of the small industry

Different definitions of the small industry are followed in India for different purposes. The Factory Act defines a factory as small when it employ 50 workers or less if it uses power, or up to an employment of 100 workers if it does not use power. The Excise Department defines it in terms of turnover in order to consider excise duty exemption. SIDO has been defining the small industry in limits of investment in plant and machinery. The defining ceiling limit of investment has undergone changes over

the years. The changing profile of the definition up to 1999 has been detailed by Rakesh Mohan (2001). Updated information till 2006 from SIDO (2006) website is depicted in Table I.

Table I: SSI definition (India)

Year	Investment ceiling (Rs. Million)	
1951	0.5	
1966	0.75	
1975	1.00	
1980	2.00	
1985	3.50	
1991	6.00	
1997	30.00	
1999	10.00	
2006	2.50	Micro (Mfg)
2006	1.00	Micro (Service)
2006	50.00	Small (Mfg.)
2006	20.00	Small (Service)
2006	100.00	Medium (Mfg.)
2006	50.00	Medium (Services)

Table 2: Items Reserved for the Small Scale Sector (India)

Period / Year	Items Reserved	De-reserved Items
1967, April 1	47	
1970, Feb 1	55	
1971, Feb 24	128	
1971, Nov 11	124	4
1974, Feb 26	177	
1976, June 5	180	
1978, April 26	504	
1978, April 26	807*	
1978, April 30	806	1
1980, May 12	833	1
1989	836	
1998-99	821	15
1999-2000	812	9
2001-2002	799	13
2002	748	51
2003	673	75
2004	605	68 (net)
2005	586	19

* Figures revised from 504 on account of new classification

Policy of Reservation

The practice of reservation of items for exclusive manufacturer in SSI sector came to be provided in the Industries (Development and Regulation) Act 1951. Reservation has provided protective support to the SSI from competition from the larger companies. Rakesh Mohan (2001) has quoted status of reserved and de-reserved items up to period 1989. Updated information compiled from SIDO (2006) is provided in Table 2.

Growth of the Small scale industry: Throughout the decades of the 60s, 70s, 80s, the SSI has shown a steady and healthy growth in several aspects. The industrial policies right from the beginning laid stress on objectives of generation of employment, dispersal of the industrial units to minimize regional disparities and contribution to the GDP. The sector has played an important role towards these objectives. The number of units has grown at the rate of 6-10 per cent per annum. Growth of production has been an average of 15 per cent. The corresponding figures in the post reform era have not been that impressive. Statistics as per Development Commissioner,(2004), and Reserve Bank of India (2006), relevant to period 1973-74 to 2005-06 (Table 3).

Sickness in the SSI sector: The latest definition of sickness as advanced by the working Group on Rehabilitation of Sick Units set up by the Reserve Bank of India, (Report, 2004) considers that a small scale unit is sick when:-

(a) if any of the borrowal accounts of the unit remains sub-standard for more than six months, i.e principal or interest, in respect of any of its borrowal accounts has remained overdue for a period exceeding one year will remain unchanged even if the present period for classification of an account as substandard is reduced in due course; or

(b) There is erosion in the net worth due to accumulated losses to the extent of 50% of its net worth during the previous accounting year, and

(c) The unit has been in commercial production for the last two years

Small industry has always suffered from sickness. This has increased in recent years, especially during the post-reform period. Figures of sickness of such units which are financed by the commercial banks are available in reports of Reserve Bank of India (2006). The information as provided in Table 4, shows a number of units as well as amount outstanding. However, this depicts only

Table 3: Performance of SSI Sector (India)

Year	Units (Lakh nos.)	Production		Employment (Lakh nos.)	Production per employee (Rs.'000) at 1993-94 prices	SSI Exports	
		At 1993-94 prices	At current prices			Rs. (crore)	US $ million
1	2	3	4	5	6	7	8
1973-74	4.2	34200	7200	39.7	86	400	500
1974-75	5.0	36100	9200	40.4	89	500	678
1975-76	5.5	42500	11000	45.9	93	500	615
1976-77	5.9	46800	12400	49.8	94	800	857
1977-78	6.7	52800	14300	54.0	98	800	987
1978-79	7.3	58200	15800	63.8	91	1100	1303
1979-80	8.1	66400	21600	67.0	99	1200	1518
1980-81	8.7	72200	28100	71.0	102	1600	2078
1981-82	9.6	78300	32600	75.0	104	2100	2309
1982-83	10.6	84700	35000	79.0	107	2000	2116
1983-84	11.6	93500	41600	84.2	111	2200	2093
1984-85	12.4	104600	50500	90.0	116	2500	2137
1985-86	13.5	118100	61200	96.0	123	2800	2263
1986-87	14.6	133600	72300	101.4	132	3600	2851
1987-88	15.8	150500	87300	107.0	141	4400	3372
1988-89	17.1	169900	106400	113.0	150	5500	3790
1989-90	18.2	189900	132300	119.6	159	7600	4579
1990-91	67.9	84728	78802	158.3	54	9664	5386
1991-92	70.6	87355	80615	166.0	53	13883	5632
1992-93	73.5	92246	84413	174.8	53	17784	6140
1993-94	76.5	98796	98796	182.6	54	25307	8068
1994-95	79.6	108774	122154	191.4	57	29068	9258
1995-96	82.8	121175	147712	197.9	61	36470	10903
1996-97	86.2	134892	167805	205.9	66	39248	11056
1997-98	89.7	146263	187217	213.2	69	44442	11958
1998-99	93.4	157525	210454	220.6	71	48979	11642
1999-00	97.2	170379	233760	229.1	74	54200	12508
2000-01	101.1	184401	261297	238.7	77	69797	15278
2001-02	105.2	195613	282270	249.3	78	71244	14938
2002-03	109.5	210636	311993	260.2	81	86013	17773
2003-04	114.0	228730	357733	271.4	84	97644	21249
2004-05	118.6	251511	418263	282.6	89	–	–
2005-06	123.4*	275581*	471244**	294.9*	93	–	–

Source: RBI (2006).

Note: * indicates estimates. ** indicates denote production is based on April–September period of the year 2005-06.

a partial story of sickness. As per Khanna (2000), only 20 per cent of the units get the bank finance. Other units do not have an easy access to the commercial banks or the state financial institutions for several reasons. The SSI units lack in wherewithal to prepare acceptable project reports, have no assets to hypothecate, have no guarantors and are called upon to pay interest which as per Khanna (2005) is 8 per cent higher than changed to large scale. The units perforce arrange funds from private sources. As Reserve Bank list is generated from the list of defaulters to the commercial banks only, the real sickness numbers can be four times higher.

Impact of WTO regime on Small Scale Sector

The aftermath of 1991 has impacted the small scale

sector in a major way. The key elements of Indian policy for the SSI, Rakesh Mohan (2001) points out, small scale industry reservations, fiscal concessions by way of lower excise duties, preferential allocation of and subsidization of bank credit, and preferential procurement by the government, have ceased to be operative. Quantitative restrictions have been entirely removed effective from 2001-2002, thereby permitting large enterprises (both foreign and domestic) to produce and to import to India. As a consequence, it has resulted in the small sector moving away from a large host of its traditional items such as consumer goods, toys, footwear, readymade garments, ladies fashion wear, synthetic-woollens, artificial jewellery, tableware, glassware, cutlery, small industrial goods, electrical appliances, electric fans, bicycles, bulbs, CFLs, light fittings, decorative lights and many more. Cheaper imports are available from large multinationals which enjoy the benefits of the economy of size. Even the domestic large industry which sourced parts, assemblies and finished products from this sector for marketing the products under its brands has switched over to buy the same from foreign manufacturers, especially from China, Hong Kong, Thailand, Malaysia and Taiwan. A large number of small scale industrial units has on this account brought down its shutters and entered the increasing list of sick units.

Table 4: Sickness of SSI Units in India (Rs. Crores)

Year (end March)	Sick SSI	
	Units (units)	Amount O/S
1987	158226	1542.25
1988	217436	1979.85
1989	186441	2243.21
1990	218828	2426.94
1991	221472	2792.04
1992	245575	3100.67
1993	238176	3442.97
1994	256452	3680.37
1995	268815	3547.16
1996	262376	3721.94
1997	235032	3609.20
1998	221536	3856.64
1999	306221	4313.48
2000	304235	4608.43
2001	249630	4505.54
2002	177336	4818.92
2003	167980	5706.35
2004	138811	5284.54
2005 (Provisional)	138041	5380.13

Source: RBI 2006.

Tannan (2002) points out that one of the main objectives of the WTO agreements is to restrict governments from distorting the normal mode of commerce by way of subsidizing, dumping, discriminatory licensing policies etc. At the Uruguay Round, Tannan (2002) points out, it was decided to reduce tariffs, eliminate tariff escalations and dismantle non-tariff barriers including quantitative restrictions. It is under this background that one should examine the radically different provisions of the new policies. By raising the limits of investment and creating a 'global' grouping the government has diluted the traditional SSI. The law would cover 75 per cent of the country's industries and 80 per cent of the total workforce, (The Hindustan Times, 31st August 2005).

Profiles of SMEs in Pakistan

Definition of SME

Pakistan is considered as the cradle of SMEs, as more than 90% of industrial and business enterprises are SMEs. Every home has skills passed on from generations. The products are known for their workmanship, crafts, innovations attracting acceptance and high returns all over the world. The Pakistan economy has a high potential for growth with promotion and development of SMEs. However, the efforts launched by various political regimes at different times have remained focused on large enterprises. Most of the Pakistani government-led institutions established since the early years of political independence to facilitate business promotion, have been concentrating their efforts mainly on large scale industry. SMEs in Pakistan are hindered by economic slumps, tax policies, law and order problems, general risk aversion of banks, institutional malpractices, political instability, unskilled labour, insufficient and low quality production and lack of overall policy directions. Pakistan also does not have a uniform definition of small and medium enterprises applicable across the board (Table 5). Various government agencies e.g Small and Medium Enterprise Development Authority (SMEDA), State Bank of Pakistan (SBP), Federal Bureau of Statistics (FBS), and Provincial Labour Departments etc. use their own definitions. Absence of a single SME definition makes it difficult to identify target firms, align development programmes, collect data and monitor progress of SMEs over time. Recently SMEDA appointed SMEs working committee and vested power to come up with new definitions for SMEs, micro and large scale industries, in tune with market environment and more specifically to target incentives to promote and develop SMEs.

Data Analysis of Pakistan's SMEs

The Pakistan's SMEs database is very fragile and

Table 5: Definition of SMEs in Pakistan

Institution	Criterion	Medium Scale	Small Scale
Small and Medium Enterprise Development Authority(SMEDA)	No. of Employees Productive assets	Between 36 – 39 Rs.2 – 20 Million	Between 10 – 35 Rs.20 - 40 Million
SME Bank	Total assets	OverRs. 100 Million	Less than Rs. 100 Million
Federal Bureau of Statistics	No. of Employees	N/A	Less than 10 employees
State Bank of Pakistan	Nature of the business (ManufacturingTrade/Services) No. of EmployeesCapital employed Net sales value	Less than 250 employees Less than Rs. 100 million assets for manufacturing. Less than 50 employees Less than Rs. 50 million for trade/services. Net sales less than Rs. 300 million.	Less than 250 employees and less than Rs. 100 million assets for manufacturing. Less than 50 employees Less than Rs. 50 million for trade/services. Net sales less than Rs.300 million.
Sindh Industries Dept.	Nature of the business Total Investment (including land and buildings)	Handicrafts or manufacturing Capital investment less than Rs.10 million.	Handicrafts or manufacturing Capital investment less than Rs.10 million
Punjab Industries Dept.	Value of assets (other than buildings and lands.)	Less than Rs.10 million	Less than Rs 10 million
Punjab Small industries corporation	Capital investment (excluding lands and building)	Less than Rs 20 million	Less than Rs. 20 million
Pakistan Tax Ordinance (2005) than Rs.200 million	EquityTurnover		Less than Rs. 25 million Less

Source: SMEDA and Authors

unreliable due to many changes of organizations to carry out data compilation, survey unit definitions, partial sectorwise coverage with bias to manufacturing, the aggregative nature of the data, non-continuity of surveys, non-compilation of data on important aspects such as SMEs contribution to value addition and net exports and their innovation. Data could not be accessed in some parts of the country due to on-going conflicts. The most reliable data base is available from governmental three statistical bureaus (recently these three bodies have been amalgamated). However, according to available data base and evidences such as Economic Survey of Pakistan (2003-04), ILO/SMEDA (2002), Bari et al. (2003), and World Bank/SMEDA (2003), Pakistan is a natural SME economy and between 90% - 98% of its enterprises are SMEs. Pakistan industrial surveys cover all size of enterprises and therefore it is very hard to separate data for SMEs due to aggregative nature. Most of the enterprises/industries data at household level can be considered as micro or small scale industry and at establishment level data as pertaining to medium and large scale enterprises. Available data is mainly categorized regionwise (Punjab, Sindh, NWFP, Balochistan and Islamabad) and positioning as urban and rural-wise.

The latest available data on year 2000–2001 from the Federal Bureau of Statistics (2003) shows that geographically 65% enterprises are located in Punjab, 18% in Sindh, 14% in NWFP and another 3% in Balochistan and Islamabad. In categories 53% of enterprises are wholesale, retail, restaurants and hotels, 22% are community, social and personal services and 20% are in manufacturing. More than 96% of establishments employ less than five employees. This holds good for regionwise distribution as well. Ownership-wise more than 96% enterprises belong to individuals and this picture holds good for regions as well. Agewise, more than 90% of SMEs are less than 20 years old and this picture is true for both rural and urban areas (Dasanayaka, 2006).

A large proportion of industries concentrate on a few categories: 43% industrial establishment are in textile, apparel and leather, 20% in food, beverage and tobacco, 10% in wood and wood products, 10% in metal and fabricated metal sector and 8% in handicrafts and related other activities. This shows Pakistan's heavy concentration in textile, apparel and leather sector. This concentration can be seen in regional, rural and urban distribution. In terms of employment status more than

Table 6: Definition of SMEs in Sri Lanka

Institution	Criterion	Medium Scale	Small Scale
Sri Lanka Standards Institution (SLSI)	No. of Employees	Between 50 – 249	Less than 50
Industrial Development Board (IDB)	Value of Machinery	Between Rs. 4 Million to 10 Million	Less than Rs. 4 Million
Ministry of Industry, Tourism and Investment Promotion	Value of fixed assets other than land and buildings	Up to Rs. 16 Million	Less than Rs. 16 Millions
Federation of Chambers of Commerce and Industry of Sri Lanka	Capital employed	Between Rs.2 Million to 20 Million	Les than Rs. 2 Million
Ministry of Small and Rural Industries	Total Investment	Between Rs. Million 20 to 50 Million	Between Rs. 1 Million to 20 Million
Ceylon National Chamber of Industries	i) Value of assets other than buildings and lands. ii) No. of employees	Between Rs. 4 Million to Rs. 20 Million Between 10 -50	Less than Rs. 4 Million Less than 10
Sri Lanka Export Development Board (EDB)	i) Capital investment excluding lands and building ii) Annual export turnover	More than Rs. 40 Million More than Rs. 100 Million	Less than Rs. 20 Million Less than Rs.100 Million
World Bank (for Sri Lankan country studies and loan programmes)	No. of employees	Between 50-99	Less than 1-49
Dept. of Census and Statistics	No. of Employees	More than 25 (Year 2000) More than 10 (Year 2003/04)	Less than 25 (Year 2000) Less than 10 (Year 2003/04)
Task Force for SMEs Development in Sri Lanka (2002)	Asset Value excluding land and buildings value	Not exceeding more than Rs. 50 Million	Not exceeding more than Rs. 20 Million
Sri Lankan Apparel Industry, Task force on five year strategy (2002)	i) Export value ii) No. of Employees	Rs. 101 Million to 250 Million 1 - 100	Rs. 0.25 Million to 100 Million 101 - 250
The Dept. of Small Industries	i) Capital investment ii) No. of Employees	Between Rs. 25 – 5 million Between 100 – 50	Less than Rs. 5 Million Less than 50 employees

70% of employees are unpaid family workers, partners and self employed people and this is very clearly visible in Pakistan's household level enterprises and is truly valid for rural, urban and regional distribution of the units. Female participation is very less, both paid or unpaid, and also is participation in partnerships and self-employed areas. Overall female labour participation is 7% and 3% are unpaid, partnership and self-employed. In rural, urban households, as also regions, the same pattern of low participation of women can be witnessed.

More than 58% are running their business in rented buildings and this is true in urban units (74%). However, the majority of businesses in rural areas are conducted in owned premises. More than 99% establishment employed capital (land and buildings not included) is less than one million rupees. This picture holds true for rural, urban and regional distribution of units. More than 97% of Pakistan enterprises are earning less than 20 million rupees per year and this is true of regional distribution of units as well.

The Economic Survey of Pakistan (2003-04) reported that contribution of manufacturing sector SMEs amounted to: employment around 80%, GDP 30%, value added 30% and export earnings 25%. The same source shows that half of the total SMEs activity is concentrated in five sub-sectors: grain milling, cotton weaving, wood and furniture, metal products and art silk. For the past three decades, the fastest growing export industries have been dominated by the SMEs and export contribution from SMEs originates from a few main sub-sectors, such as cotton weaving and other textile processing activities, leather and surgical equipment. Micro, small and medium enterprises (MSMEs) contribute around 7% of the GDP, and 9% of agricultural GDP. This low share is due to the dominant presence of micro-enterprises in the three sub-sectors: services, manufacturing, trade and hotels. Al-

though the contribution of MSMEs to total GDP is not very high, it still represents almost 13% of the manufacturing sector and 11% of the trade and services sector. All the studies have stressed on importance of SMEs for Pakistan overall economy in many aspects and these have recommended developing SMEs to their full potential [Japan International Corporation Agency/IDCJ (2006) and Pakistan Institute of Development Economics/HEC (2006)].

Profile of SMEs in Sri Lanka

Definition of SMEs

In Sri Lanka there is no universally acceptable clear definition of SME, as different government agencies use different criteria. There are a number of different terms used to identify the SME sector such as: Small and Medium Industries or Enterprises, Micro Enterprises, Rural Enterprises, Small and Medium Activities, Cottage and Small Scale Industry, Informal Sector Alliances. The Sri Lankan SMEs are engaged in a wide range of business activities in agriculture, mining, fishery, industry/manufacturing, construction, tourism and services in rural, urban and estate settings by servicing local and international markets. Most Sri Lankan SMEs are a one-person activity or are run by a few family individuals, usually relatives, friends or business partners, who take most of the business decisions. Most Sri Lankan SMEs in the informal sector are reporting very low productivity and income; therefore owners and workers are the 'working poor,' but SMEs in the formal sector report very high productivity and efficiency and provide very high income (Dasanayaka, 2007a, b). This wide variation of diversity in Sri Lankan SMEs brings to the surface various types of influencing factors as assets, employees, skills, capital, turnover/revenue, sophistication, innovation, and productivity and growth orientation. Due to this complexity, it is very hard to define SMEs in Sri Lanka. Most of the definitions are designed according to organizational needs and SME interests. Financial institutions, public sector authorities, non-governmental organizations, trade and industry chambers, international organizations, researchers, SMEs service providers and consultancy firms have their own definitions based on their own criteria selection. The main criteria used are the number of employees, the size of fixed investment, and the nature of the business and the sector, i.e. formal or informal, in which the industry operates. Table 6 records some of the most popular definitions on SMEs as used in Sri Lanka.

In recent times, there is a growing emphasis on Micro, Cottage and Small scale Enterprises as instruments to promote employment. In most cases medium scale enterprises are out from the equation. Policy makers have stressed that micro, cottage (less than five employees) and small enterprises and not the medium scale enterprises should receive more government care and attention (Dasanayaka, 2007c).

Table 7: No of Industrial Establishments and persons engaged by districts of Sri Lanka – 2003-04

	Census of Industries – 2003/2004 Listing of Industrial Establishments			
District	Small Industries (Persons engaged less than 10)		Medium & Large Industries (Persons engaged 10 and more)	
	No. of Establish-	Persons engaged ments	No. of Establish- ments	Persons Engaged
Colombo	12,089	34,146	1,996	169,366
Gampaha	15,516	40,339	1,818	213,754
Kalutara	6,454	15,732	611	52,593
Kandy	8,100	19,447	645	36,803
Matale	3,321	6,995	193	11,991
Nuwara-Eliya	1,746	3,752	234	19,252
Galle	5,682	13,504	444	35,052
Matara	5,033	10,455	273	18,416
Hambantota	3,893	7,318	84	12,674
Jaffna	2,684	6,933	113	2,224
Mannar	413	1,083	20	336
Vavunia	567	1,417	37	1,177
Mulativu	492	1,456	36	630
Kilinochchi	441	1,188	25	732
Baticaloa	1,898	4,764	120	2,752
Ampara	3,682	8,627	174	5,297
Trincomalee	1,487	3,254	38	2,998
Kurunegala	16,943	37,868	877	48,384
Puttalam	5,930	16,451	737	25,491
Anuradhapura	4,581	9,653	205	12,656
Polonnaruwa	2,489	5,002	221	11,152
Badulla	3,142	6,639	201	10,607
Moneragala	2,261	4,352	60	5,506
Ratnapura	5,916	12,521	534	29,744
Kegalle	6,666	12,727	265	18,241
Total	**121,426**	**285,623**	**9,961**	**747,828**

Source: Department of Census & Statistics, Sri Lanka – 2004, Unpublished data

Districtwise distribution of SMEs and their employment

The Sri Lankan SMEs data base is very fragile and unreliable due to frequent change of survey unit definitions, partial sectoral coverage with bias towards manufacturing activities, too aggregative nature of the data, non-continuity of surveys, some parts of the country being not accessible due to ethnic conflict and multi- organizational involvement in SMEs data compilation, etc. The most reliable data base is made available from Census and Statistics Dept (CSD). However, this also does not provide specific contribution of SMEs alone. Normally CSD surveys cover all size of enterprises. In most cases, it is hard to separate data for SMEs. Table 7 shows the geographical distribution of SMEs as it existed in 2003-04. It is apparent, that most small scale industries are concentrated in Western Province based districts of Colombo (10%) and Gampaha (13%) and North-Western Province based district of Kurunagala (14%). Medium and large scale industries are concentrated mainly in Western Province based districts of Colombo (20%) and Gampaha (18%). In terms of employment generation from small industries, Gampaha (14%), Kurunagala (13%) and Colombo (12%) are the main districts and Gampaha (29%) and Colombo (23%) are the main districts in generating employment from medium and large scale industries. This clearly shows heavy concentration of Sri Lankan SMEs in well developed Western Province of Sri Lanka. This industrial location is worse in terms of large scale industries. According to the Central Bank of Sri Lanka Annual Report 2005, 80% of industries are concentrated in Western Province. SMEs are not developed at all in Northern Province districts of Jaffna, Mannar, Vavunia, Mulativu and Kilinochchi mainly due to on-going ethnic conflict and collapse of economic activities and infrastructure during last 25 years.

Employment distribution and value addition of SMEs in Sri Lanka

The ILO (1994) reported that more than 75% of the Sri Lankan labour force employed belonged to the SME sector. As Table 8 shows, 85% of industrial establishments are small scale, 12% are medium scale and only 3% are in large scale sectors. Altogether 96% of industrial establishments are in SMEs but their contribution to value addition is not as high as compared to large scale enterprises, and more importantly the contribution is decreasing over the years. Large scale establishments account for less than 4% of total establishments, but their contribution to value addition at around 80% in 1996 compared with 1983 data, is a significant growth trend.

Table 8: Relative Size of SMEs: 1983 and 1996 (%)

Size Group	1983			1996		
	Establish-ments	Employ-ment	Value added	Establish-ments	Employ-ment	Value added
Small	86.6	29.2	11.3	85.4	18.7	4.9
Medium	11.4	19.4	19.8	10.7	17.6	14.7
Large	2.0	51.4	68.9	3.9	63.7	80.4
All	**100**	**100**	**100**	**100**	**100**	**100**

Source: Department of Census and Statistics 1983 and 1996.

Table 9 depicts distribution of SMEs in types of industry and shows that a large proportion of industries (80%) are concentrated in four groups of industries which account for 80% employment generation. These industry categories are:-

i) Food, beverage and tobacco products
ii) Textile, apparel and leather products
iii) Non-metallic mineral products
iv) Mining

Table 9: Distribution of SMEs by Type of Industry - 1983 and 1996

Type of Industry	Establishment (%)		Employment (%)	
	1983	1996	1983	1996
Mining	11.6	12.5	9.0	6.9
Food, beverage, and tobacco products	35.5	33.7	36.8	38.4
Textile, apparel and leather products	19.8	19.3	23.4	24.2
Wood and Wood products	7.3	7.3	6.1	5.2
Paper and paper products	2.2	2.3	2.4	2.1
Chemical, petroleum, rubber & plastics	5.8	6.4	7.4	8.0
Non-metallic mineral products	12.1	12.3	8.9	9.2
Basic metal products	0.06	0.08	0.09	0.27
Fabricated metal products, etc	4.3	4.5	4.7	4.2
Manufactures n. e. s.	1.4	1.7	1.2	1.4
Total	**100**	**100**	**100**	**100**

Source: Department of Census and Statistics 1983 and 1996

One can also infer from the table that a general lack of dynamism and a stagnant nature in the form of non-

diversification of SMEs has come to pervade over the years. However, compared to other industry sectors such as mining and wood products, SMEs are highly active in terms of employment generation and value addition, compared to large-scale enterprises.

A critical analysis of constraints encountered by SMEs in the region

The specific promotion of SMEs came to light in India with the formation of SIDBI in 1956; in Sri Lanka in 1956, with the setting up of the Industrial Development Board, and in Pakistan the interest explicitly started in 1998 with the setting up of the Small and Medium Enterprises Development Authority (SMEDA). However, the major concern of the leadership in all the three countries has been to promote and encourage the setting up of large industries, even to the detriment of the small scale sector. The reasons are not far to seek. Large industry provides the GDP, considered as the single most representative index of the economic status of a country. SMEs are nowhere in the reckoning in contribution to the GDP. Therefore, all support has been provided to promote and encourage the large scale sector and the governments have gone all out to attract foreign investments. There is a clear heavy bias in favour of the large enterprises, although the national interests for poverty eradication, providing jobs to millions, demand focused attention to the SMEs.

In this connection, Sri Lanka has taken a lead to have identified the micro and the small units as more deserving of the assistance (Dasanayaka 2007a). The national antipathy in all the three countries is reflected in more ways than one. None of the countries can boast of reliable data in the form of regular surveys. All the three countries have created complex bodies to extend help, but these are deeply mired in bureaucracy.

The small-scale sector has suffered because of many reasons. Sardana (2001, 2004) refers to some of these as lack of financial control, poor leverage to deal with suppliers, lack of managerial expertise, lack of support from the financial institutions, non-availability of technological support and others.

Major causes of sickness as considered by SIDO (2006) include: Inadequacy of working capital, delays in sanction of working capital, gap between sanction of term loan and working capital; poor and obsolete technology, problems related to non-availability of raw materials, inadequate demand and other marketing problems, erratic power supply, labour problems, infrastructural constraints, poor management, inadequate attention to R&D, diversion of resources and inability of the units to face growing competition due to liberalization and globalization.

These reasons, which indeed are also the constraints faced by the SMEs, are linked to each other and form a vicious cycle of problems. It is very hard to identify the starting point of this vicious cycle. Inability to identify this starting point further hardens to break the vicious circle.

Finance-related constraints

Finance may be the start of the vicious circle for SMEs. Poor finance leads to outdated products and process technology, which leads to poor production and operation facilities, which in turn leads to poor quality products resulting in marketing problems, which leads to poor profitability, ending the circle again with a poor financial situation. Finance-related problems can be classified into four categories:-

- Non-availability of finance on soft terms
- Problems related to access to equity, bank loans, leasing, venture capital and other credit instruments
- High costs of borrowings
- Management of finance

High interest rates and collateral are the most cited issues. Most SMEs feel that they receive discriminatory treatment from the banking sector, compared to the banking services offered to large-scale enterprises. There is a general indifference and lack of trust which the banks and the financial institutions have when sanctioning loans. SMEs often complain that large-scale enterprises can easily access other credit instruments in the capital market, which SMEs are not allowed. Obtaining loans from the traditional financial market is very difficult due to excessive paperwork and high collateral, due to the high risk involved in SME finance. SMEs own characteristics such as problems of proprietorship, poor resource base, non-existence of economies of scale and scope etc. aggravate this situation.

SMEs get their finance from very costly informal market and finally they get into a debt trap. The small or micro enterprises (SE), in particular, including small-holders and local folks, suffer from lack of collateral securities. Most banks prefer land as collateral but in most cases more than 80% of land belongs to the government and land owned by SMEs do not have clear deeds to bank them as collateral (Dasanayaka and Nelson, 2007). In addition, banks always insist on well prepared business

plans and feasibility reports, which many SMEs do not have. Most banks prefer to provide finance for urban centres based SMEs rather rural based ones.

The third finance-related problem is the cost of finance. Lack of financial management experience and financial discipline, over ambitious business acceleration, lack of professionalism in business, non-separation of personal and enterprise expenditure, demonstration effects and unnecessary status quo expenditure such as expensive imitative lifestyle are some other reasons.

Marketing-related constraints

Marketing-related issues pose another major problem. The liberalized trade and the de-reservation of products have already impacted the small scale sector in a major way. The small sector products are simply priced out by the cheaper branded products which are essentially the result of economy of size. A large undertaking has the additional advantage of a brand, large budget for promotion and publicity, product positioning and geographical reach. A large unit has also advantages of wider reach of customers dispersed in diverse markets. Information on local preferences help larger units to customise products to local tastes.

There is lack of information, lack of networking and cooperation among SMEs and non-existence of linkages with large-scale enterprises. SMEs are left to find their own market with their limited contacts. In most cases, export houses act as middlemen, exploiting these SMEs. Workers and owners of SMEs stay poor, while making the export houses richer, while receiving only achievement awards.

Technological constraints

Technology refers to all aspects of product design, innovation, product development, processing technology, and engineering applications in storage, preservation, transportation and distribution. The main problem lies in the ignorance of identification of suitable technology, the importance of technology in product quality and productivity improvement, access to technology and sources of its availability. SMEs cannot opt for technology which is advanced, suitable for automation, or mass production because these exceed the investment restrictions under which a unit is called an SME. Poor selection of products and process technology, lack of standardisation and quality in products/services is frequent.

None of the three countries have taken any steps to set up any national commissions or centres which could render advice or counsel on technology. The universities, institutes of higher learning, the management schools, universities and research labs have hardly any interface with SMEs to render any assistance in these dimensions (Dasanayaka and Perera, 2005a, b). Besides, the technology domain is dynamic in character. Evolution and development of technology is a continuous process with large undertakings. Excellence in performance also implies that an organization has a planned programme of innovation, NPD, and market introduction of new products on a frequent basis. This in turn calls for investment in infrastructure, testing labs, R&D, and the product design. Hard pressed always for finances, these activities are a luxury which an SSI unit can ill afford.

Infrastructure constraints

Availability, quality, cost and reliability of good infrastructure such as telecommunication, water, electricity, transport (roads and rails) directly affect SME operations. SMEs located in rural areas are the worst sufferers. The impact is reflected in cost of products, competitiveness, efficiency, access to resources and markets, quality of products and delivery, service to customers. Another dimension of infrastructure lies is in pollution control, pollution disposal and environmental protection. Larger units can often afford to set up power generation plants, telecommunication network, logistics controls, and pollution disposal. The large volumes justify this investment. However, an SME is dependent entirely on the state to provide the basic infrastructure to run an industry.

Government apathy

Political leadership, the planners and the economists in all the three countries are unanimous in their views that the solution to the unique problems of large-scale poverty, rising unemployment, increasing imbalance in development and the widening gaps between incomes lies in the encouragement to the small-scale sector. As a matter of fact the importance of the small scale has been recognised in the three countries right from the early days of their political freedom. However, it is always the large-scale sector which has been the chosen goal while drawing up policies on investments, taxation, and availability of easy finance, exports and imports regulations, development of infrastructure and promotion of R&D.

SME entrepreneurs narrate bitter experiences when it comes to describe transactions with the banks, financial institutions, SME development agencies, export councils, customs, pollution control boards, electricity distribution and other government agencies. There is a general indifference and lack of trust which the banks and

the financial institutions carry towards a small industry in the sanctioning of loans. The barriers represented by government regulations and infrastructure services discriminate against SMEs because large firms can divide the cost and time on much larger output and income. As a matter of fact clubbing of the small and the medium industry has totally altered the concept of the small scale.

None of the countries even carry out regular census of the sector to identify problems or analyse reasons of sickness to determine corrective steps. India, as the most politically stable and advanced, carried out last survey only in 1993, showing the indifference towards this exercise. In most cases data on important parameters is either missing, or unreliable or outdated for any meaningful analysis. Frequent change of definition linked to the investment has made the survey exercise justifiably more difficult. The maze of SME developmental agencies in all the three countires represent typical bureaucracy, concentrating more on controls, regulations, locating defaulters, cancellation of benefits, levying of penalties, rather than helping in the problem resolution. SMEs, because of their sheer lack of power pulls in economic, social and political domains or in the form of organized trade associations, are always on the receiving end.

Management constraints

SMEs lack management skills to operate business in a professional manner, and also face labour-related problems. SMEs cannot afford to employ specialists. The generalists therefore dominate in the decision-making process. There is an excessive reliance on the judgment of the owners-cum-managers. There is an inherent high degree of imbalance of power in favour of the large suppliers and customers. SME managements therefore have always to be at the receiving end whenever it has to deal with a customer or a supplier larger in size as compared to itself. The regulatory staff can always find an excuse to bend it to their fancy. The proprietor is busier mending fences rather than concentrating on operations. This is as a result of a lack of any strategic planning.

Labour-related problems mainly arise from lack of skills to manage labour and due to inflexibility that exists in the labour market. There is shortage of skilled labour, and a preponderance of low skilled labour. Often the SMS-trained labour finds way to the large sector, aggravating the shortage [Central Bank of Sri Lanka (1998) and SMED (1999)]. Inherent inability to match the remuneration of employees who work in the large undertakings, results in an indifferent quality of manpower, especially at the managerial levels.

Recommendations and conclusions

The three nations are committed as a policy to implement the WTO charter which requires global trade practices, uniform and transparent, devoid of all protections and restrictions. The imports and the exports are not to be regulated. There are also no provisions of reservations of commodities for the small scale. The large, the medium and the small are expected to compete on equal terms. SMEs should clearly understand and accept that these decisions cannot be reversed and it is SMEs which will have to mould themselves into a new configuration.

A small industry, promoted as it is by an entrepreneur and his close friends as partners and often with the involvement of family members, has a unique advantage of high degree of involvement, commitment, and zeal to succeed. The family usually invests all that it has. There are usually no distinctions between private and business assets. Subjective and personal factors play a large role in decision-making. The personal stakes SMEs have in their businesses are much higher than those of corporate executives in their companies. This enhances the attendant risks and commits entrepreneurs even more strongly to the success of their enterprises. This spirit keeps the unit alive and struggle for survival. The future success of the SME is related to the exploitation of the strengths and the opportunities. The recommendations that follow consider this paradigm shift.

Initiatives by the SMEs

Products

Compared with large firms, SMEs have greater backward linkages to micro-enterprises, and forward subcontracting links to large businesses, making them an important linking and driving force in the economy. They face higher capital costs and pay lower wages. The salaries paid by SMEs reflect more accurately the true social costs. Consequently, SMEs should in principle use less capital and more labour per unit of output produced, at least so long as they avoid the labour costs implied by excessive union controls and labour law requirements. An SME excels when it comes to differentiating a product, cutting down the time of delivery, and customer service. Only a small unit has the flexibility to change the production run at short notice and accommodate a customer requiring an innovative product. Appropriate products for a small enterprise are the customised products, innovative products, fashion products, products requiring high workmanship skills, prompt response deliveries, and niche requirements.

The service sector with a strong focus on providing customer satisfaction through personal touch, values of empathy, customer care, and attention is tailor-made for the small industry. It is the small sector which dominates the call centres in India. With urbanization underway on a massive scale, there is a large scope for the small scale to step in and provide services in repairs, maintenance, IT-enabled services, architecture, health care, transportation, entertainment and hospitality sectors.

It is recommended that an SME should establish links or enter an alliance or a collaborative agreement with its partners in business (suppliers, original equipment manufacturers, dealers, market malls, superstores). This will help the unit to relieve itself of specialized functions as forecasting of demand, product development, frequent planning, frequent sourcing and even the worries of financial needs. Regular and steady orders can help to improve quality and efficiency of operations (Chaudhury et al. 2000). Automobile parts manufacturer have largely benefited this way in India. Industrial clusters at towns of Faridabad, Gurgaon, Pune, bear testimony to the success of the small sector due to collaborative efforts.

India and Pakistan suffer from massive illiteracy. The small sector can discover a major opportunity to enter the business of education providers. In India, this is becoming evident in the form of private schools, colleges, universities, schools of engineering, medicine and business management institutions, which are springing up in a large way to strike a commercial success.

SMEs in all the three countries suffer badly in projecting their problems to the public as well as the government. Lack of resources and leadership are often cited as reasons. Networking, clustering and cooperation among the SMEs in the form of powerful trade associations is necessary for them to be able to project the problems faced.

Initiatives by the state

The leadership in all the three countries accept that the route to solve the problems of unemployment and poverty lies with the small industries. The leadership is indeed quite vocal when it comes to expressing its support of the promotion of the sector. However the actions are poorly matched. There are more compelling reasons for the leadership to promote the sector. The economic rationale for assisting SMEs lies in facts that these units often use resources more efficiently than larger enterprises when market imperfections prevent them from maximising the benefits of their efficiency advantages. SMEs are an important contributor to pro-poor growth that the macro enterprises cannot match. Furthermore, most SMEs are managed by their owners and therefore have a greater incentive to manage the capital efficiently. An increase in the number of competitive SMEs should contribute to poverty alleviation. As the SME sectors grow, competition for labour (especially skilled labour) can be expected to push up wage levels. The poor will benefit from improved availability of goods and services and access to markets. In terms of employment creation, medium sized firms will be in the best position to expand if business development services and credit can be made more easily available. State initiatives in the following areas are therefore more justified.

As finance is the key problem for SMEs, strategies and policies are needed to address this issue. Some of these can be the promotion of leasing companies, venture capitalists and traditional banking system to provide credit supports, low cost credit negotiation and project monitoring, credit guarantee and equity investment schemes. Loan recovery acts need amendments to take into account the difficulties faced by the units in the recovery of their outstanding dues. There is a need to inculcate financial management skills among the SMEs.

The government should take initiatives to assist SMEs to be globally competitive through an entrepreneurial culture committed to sustainable growth. Here the government should take the facilitator's role rather direct interventions for SMEs. Changes in tax system, company acts, labour laws, duty anomalies, anti-dumping laws, government lands allocation, international agreements should be finalized with focus to help SMEs. Formulation of national policies may be desirable for each industry sub sector. Organizing public hearing meetings with SMEs are necessary to understand SMEs needs and problems over the time.

In providing, technology, training and skills to SMEs, government can take up a facilitator's role and assist NGOs and large public and private sector to provide these skills through various fiscal and monetary incentives. Technical, engineering and management-related faculties of the universities, institutes of higher learning, R&D establishments, largely under the control of government regulatory bodies, can be linked through regulations, with SMEs clusters. Setting-up of an SME technology development fund and technical service centres at the district level may be timely requirement to assist SMEs to access new technological developments and to improve existing technology.

Large organized business houses have their own strings and chambers to influence the policy making to

favour them. However, SMEs are a fragmented and disorganized lot fighting for a space in the sun. National interests demand a caring and helpful attitude from the state.

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Until you value yourself you will not value your time. Until you value your time, you will not do anything with it.

– M. Scott Peck

Focus

SMEs in Competitive Markets

Shambhu Singh

This paper is based on the Asian Productivity Organisation (APO) commissioned study on the Role and Adaption of SMEs under changing Industrial Structure. In India, a survey was conducted using both interview of selected enterprises as well mailed questionnaires to numerous SMEs to study the general trends.

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Scope and Methodology

The clusters and areas for the survey were selected so that a limited number of enterprises could reflect trends in the country as a whole. Therefore Ludhiana and Agra were selected in the northern part of India as major clusters for hosiery manufacturers and mechanical, leather, and metallurgical units, respectively. Similarly, Hyderabad in the south was selected for pharmaceutical units, while Chennai and Bangalore were selected to represent the south for metal forming, auto component, leather footwear, and electronics units. Chemical, plastic, and food processing units were studied in Mumbai, Pune, and Ahmedabad, representing the western part of India. Calcutta in the east, the largest center for leather goods and with a substantial ethnic Chinese population dealing in leather, was important both from the viewpoint of trading with Southeast Asia and as representing the eastern part of the country.

A total of 1,000 questionnaires were mailed to SMEs that had made investments in plant and machinery and were known to have an export orientation or exposure to international markets through the import of raw materials, intermediate goods, technology transfer, and joint ventures. The selection process was facilitated by information provided by the Small Industries Service Institutes (SISIs), which are field offices of the Development Commission for Small-Scale Industries (SSIs), Government of India, in consultation with various district industry centers and the state directorates of industries. Information on small units engaged in joint ventures was also provided by the Secretariat for Industrial Assistance, Ministry of Industry. Seventy SSIs in the leather, hosiery, metallurgical, automobile, and mechanical industries were interviewed on their premises. Of the 1,000 questionnaires mailed, 745 were returned. After validation of data, it was found that 500 could be used for processing. Hence, including the 70 interviewed units, the sample size was 570.

Ninety-five percent of SSIs in India operate at the lower end of the investment spectrum. While the major

Table 1: Investment by the SSIs surveyed (Rs100,000).

Industry	0-10	11-20	21-30	31—10	41-50	51-60	61-70	71-80	81-90	91-100	>100	Total
Auto	16	6	3	1	0	0	2	0	0	2	0	30
Mechanical	31	23	12	0	7	8	7	3	0	4	23	118
R&P	15	26	5	6	3	0	0	2	3	0	9	69
Fiber	0	6	4	0	4	5	3	0	0	0	0	22
Metallurgy	0	6	5	19	5	7	6	5	13	0	6	62
Textile	2	3	0	2	6	0	0	2	3	0	10	28
Packaging	7	2	0	0	0	0	0	0	0	0	0	9
E&E	8	7	17	6	0	0	0	0	9	8	26	81
Leather	40	5	3	2	4	3	0	0	0	0	3	60
Jute	0	0	2	1	0	0	0	0	0	0	0	3
Food	8	3	0	0	4	0	0	0	0	0	5	20
Chemical	9	12	11	4	3	0	3	5	3	0	8	58
Total	136	99	62	41	36	23	21	17	31	14	90	570

R&P, rubber and plastics; E&E, electric and electronics.

exporting units are in the higher investment category, even tiny ones export, some directly and others through merchant exporters. Some produce for other brands for direct export by the brand-owning units. In line with the objectives of the study, the SSIs selected did not conform to the general trend of investment observed in the SSI sector, since the tilt had to be toward units with higher investment and turnover, and to that extent the results are slightly skewed.

Objective of the study

To study the role and adaption of SMEs under changing industrial structure.

SSIs in India are defined by the amount of investment in plant and machinery, excluding investment in accessories and environmental protection equipment and measures. When the survey was commissioned, the investment limit for SSIs was Rs 30 million; that was subsequently reduced to Rs 10 million (US$1=approximately Rs 44 at the time of writing). Within the small-scale sector, tiny units are defined as those with investment in plant and machinery of Rs 2.5 million or less.

Medium-scale units are not defined in India. Generally, those with investment in plant and machinery of up to Rs 100 million are considered medium sized, although a unit with investment of Rs 200 million could also be called a medium-sized enterprise. As a result of the downward revision of the investment limit for small units, those with investment of more than Rs 10 million are now in the category of medium-sized industries. An exception is made in the textile industry subsectors of ready-made garments and hosiery, where the investment limit remains at Rs 30 million because of their export orientation and because continuous-hatch production of uniform quality is not possible below this investment amount.

In the sample of 570 SSIs, 480 had investment within the limit of Rs 10 million, while the remaining 90 had more (Table 1). These included 56 units within the previous SSI investment limit of Rs 30 million, and the remaining 34 had gone beyond the limit during the previous two years. In the automobile, mechanical, rubber and plastic, packaging, leather, and food subsectors, more than 505 units had investment of less than Rs 0.2 million. The main reason for this is the government policy of reservation for the manufacture of 812 items by the SSI sector. Large and medium industries can manufacture these goods only if they export at least 50% of their production. This promotional measure is one reason for the large number of tiny units engaged in the manufacture of these products. These units mostly cater to local markets or manufacture for larger enterprises.

Survey Results

Type of Ownership

In India more than 98% of SSIs are proprietorship or partnership concerns. However, among the units surveyed in this study, 39.1% were proprietorship concerns, 36.5% partnership units, 20.2% private limited companies, and 24.2% public limited companies (Table 2). This is because units in the upper investment segment are usually pri-

vate limited companies. Banks now prefer private limited companies, as compared to proprietorships or partnerships, when arranging financing. Hence the proportion of private limited companies vis-a-vis the other two categories is now increasing among units set up during the past eight to 10 years.

Another reason for the preponderance of public and private limited companies in this survey is that older units are converting to private limited companies to avail themselves of bank financing. All public limited companies are either within the investment limit of Rs 10 to Rs 30 million or have greater investment. These medium-sized units have become public limited companies for equity participation and to raise cheaper funds through equity issues, mainly when they opted for a joint venture with either a larger domestic or a foreign partner. This trend is more visible in specific industry segments like auto components, chemicals, metallurgy, and textiles. Interestingly, even some of large units in leather and footwear continue to remain private limited companies.

Brand Name Ownership

Except for SSIs in the packaging industry, all other survey participants reported having their own brand names. In some industrial segments, however, the ownership of brand name varies from 90% to 50%. The highest percentage of brand name ownership is in electrical and electronic industries, followed by the automobile, rubber and plastic, mechanical, and metallurgical industries. All 20 surveyed SSIs in food products had their own brands.

Table 2: Type of ownership of surveyed SSIs.

Industry	Proprietorship	Partnership	Private limited company	Public limited company	Other
Automobile	12	16	2	0	0
Mechanical	50	58	7	3	0
Rubber & plastics	21	29	19	0	0
Fiber	3	15	4	0	0
Metallurgical	49	12	11	0	0
Textile	18	7	3	0	0
Packaging	5	4	0	0	0
Electric & electronics	11	27	40	3	0
Leather	26	32	2	0	0
Jute	0	3	1	0	0
Food	8	0	5	7	0
Chemical	20	5	22	11	0
Total	223	208	115	24	0

Packaging enterprises do not tend to own brands because their products are generally made to order for specific consumers. In some instances, however, they also do subcontracting on behalf of larger companies. The leather, and particularly the footwear, sector is highly decentralized, and subcontracting and piecework constitute a significant portion of activities. Most leather units are very small and generally cater to larger buyers that sell footwear under their own brands; it is thus not possible for small artisan units to develop a brand name and market it. Large manufacturers or wholesale buyers generally handle marketing.

In general, except for food products, subcontracting is prevalent in all categories of industries including auto component manufacturing and mechanical industries. The absence of brand names in some cases is explained by the same phenomenon. For food products and electrical and electronic products, ownership of a brand name is necessary to pass the certification tests to enable marketing. If an electrical component manufacturer does not possess an Indian Standards Institute (ISI) mark, it cannot sell them on the market. In the electronic industry, however, the ISI mark is not mandatory, and since most electronic subcomponent and component manufacturers do subcontracting, the standard requirements are ensured by the vendees. In any case, electronic items manufactured by small units are not used by the household or industrial unit in cases where safety is a major concern. Therefore a high percentage of brand ownership is found in the electrical and food processing sectors.

Impact of the Global Business Environment

Advances in production technology are significantly affecting manufacturing SSIs to varying degrees. While 50% of the surveyed SSIs in the auto component sector reported that such advances had somewhat affected them, 64% in the rubber and plastic sector perceived that they had been significantly affected. The same trend was observed in the packaging industry, with 49% reporting that the impact had been significant. SSIs in metallurgy were nearly equally divided between those who had been significantly affected (44.2%) and not so significantly affected. Except for the electrical and electronic industries, in which only 33% of SSIs had been affected, moderate to significant impact was reported by SSIs in all industry segments. The impact on the packaging industry can be easily explained by the emphasis of buyers on internationally acceptable packaging quality so that they do not lose customers attracted by better packaging material. The increasing use of aseptic packaging and tetrapacks, which cannot be manufactured by

small and medium units, has also had an impact.

The sectors most affected by information technology (IT) were auto component manufacturers (45.7%) and the packaging industry (44.4%). Among SSIs in the mechanical industry, only about 43% felt very or somewhat affected, but 42% did not feel affected. Similarly, 62% of rubber and plastic SSIs had not been affected by IT. A significant portion of those in the metallurgical, textile, electrical and electronic, and leather and footwear sectors reported that they had been somewhat affected by IT. During interviews, the entrepreneurs from these sectors felt strongly that IT was definitely influencing them in both positive and negative ways. The negative aspects included short-term loss of market share because of people's awareness of quality and prices. The positive aspects, however, were providing access to more market information, being able to extend their customer base, and exploring new markets. Moreover, increasing access to the World Wide Web to disseminate information on technology and market trends, etc. has helped them to reach partners for product development and tap appropriate markets.

Numerous textile and electrical and electronic SSIs felt that IT had had no effect on them. This was mainly because such units generally cater to the low end of the market, domestically as well as abroad. The same can be said of the chemical industry, since 48%, of the enterprises surveyed reported that they had not been affected.

Global overcapacity and reduced demand have had a significant influence on manufacturing SSIs in the auto component, mechanical, rubber and plastic, fiber, metal, leather, chemical, and jute industries. A mean 26% of surveyed units felt that they had been significantly affected by global overcapacity, while 28% felt that they had been moderately affected. A significant 23% reported that they were not sure whether global overcapacity had affected them. When questioned about the effect of domestic overcapacity and reduced demand, 35% of SSIs felt somewhat affected, while 29% felt severely affected. About 20% were not sure, and the remainder reported that they had felt no impact on their operations.

Twenty-three percent of surveyed enterprises indicated that the Asian financial crisis had a significant effect on them, while an almost equal percentage felt that *they* had been somewhat affected, 28% not affected at all, and 25% were not sure. The industry sectors hardest hit by the Asian financial crisis were auto components (53%), mechanical (27%), rubber and plastics (27%), and leather (40°/,). SSIs in the fiber, jute, and food product sectors reported no impact, and those in chemicals, packaging, and textiles had felt a negligible impact.

The engineering-related enterprises, including the auto component and mechanical industries, were particularly affected since the Asian financial crisis resulted in lower demand elsewhere. Moreover, it apparently made Indian goods costlier in the domestic as well as in the international market. It should be noted that from 1995 the Indian auto components industry began to grow due to the establishment of manufacturing facilities by global auto companies including Ford, General Motors, Hyundai, Daewoo, Fiat, etc. The sudden plunge in the value of Asian currencies affected this sector significantly, because its products became more expensive and the export and domestic markets eroded substantially.

The case of leather industry is interesting because some leather units have manufacturing facilities located in Indonesia, etc., where all raw material imports became prohibitive during the Asian financial crisis and as a result the advantage of cheap exports disappeared. At the same time, the amount of footwear exported to those countries was reduced to a trickle, while elsewhere the low end of the market for cheaper footwear was lost to exports from Southeast Asia and other countries which could export at lower prices in dollar terms. The Asian financial crisis appears to have affected this industry most severely among those who had business interests in Southeast Asia. However, most entrepreneurs in the leather sector continued to explore alternative markets like Palestine, Israel, Turkey, and African countries while their loyal customers in Europe did not desert them because of previous commitments and orders in the pipeline. The leather goods sector also managed to tap the North American market successfully in addition to the traditional European market, which more than made up for losses in Southeast Asia.

The Mythical Threat of Liberalization

Trade liberalization was seen as a serious threat by only about 26% of the surveyed enterprises. About 29% perceived it as somewhat a threat, although not *very* serious, and another 25% felt that it was not an issue and that they were not affected. The remaining 20% were not sure. The perception that trade liberalization is either not a very major threat or actually only a minor threat is perhaps because the quantitative restrictions on imports had not been fully removed at the time of the survey and liberalization had not greatly affected the SSIs surveyed. Another possible explanation can be found in responses to the technology- and modernization-related questions,

which showed that most dynamic units *had* already started to prepare for upgrading.

Consumer Behavior Patterns

Changing consumer behavior had affected 35% of the surveyed units. While 24% felt that it was affecting them seriously, 18% had no idea whether it was having an impact, and the remainder were certain that it was having no impact on them. The majority of SSIs that felt that consumer behavior was not affecting them were in the electrical and electronic category, in which the small-scale sector is predominant in India and various items are reserved as the exclusive domain of this sector. Until full trade liberalization is achieved, this category of industry may continue to offer the same products and consumers may have little choice. Another feature of these Indian SSIs is their ability to cater to all pocket-books with varying quality, which makes them confident.

International quality management standards appear to be having a significant impact on SSIs in the mechanical and leather industries. Those in fiber, textiles, and jute did not report any such impact, however, because textile items are exported in large volumes, international quality standards are met, and management systems for maintaining quality are already in place. The fiber industry is similar to textiles with respect to quality standards', while jute is different because jute materials can be exported only after their quality is internationally accepted and the quality of jute itself is acceptable. Jute is gradually being replaced by alternative packaging material, however, and the jute industry is not certain if international quality standards affect the business. The auto component, mechanical, rubber and plastic, and chemical SSIs surveyed reported that such standards had a bearing on their activities to some extent. The export-oriented food enterprises already meet international standards and thus did not feel adversely affected by them. In summary, only 11% of surveyed SSIs believed that international quality management standards had had a significant impact on their business, while 27% felt that it had had a slight impact, 33% felt that there had been no impact, and 29% were not sure.

Contraction of Market Demand, Competition, and Oversupply

Thirty-two percent of the SSIs had experienced severe contraction of market demand domestically, while an equal number had experienced moderate contraction. Approximately 36% felt that there had been either a negligible or no contraction of demand. The sectors that had not felt any impact from this were mechanical, electrical and electronic, leather, and chemical industries, which can be attributed to their export orientation. Interestingly, except for textiles and jute, no other industrial sector had experienced severe or moderate contraction of market demand. The most vulnerable were the rubber and plastic and, to some extent, metallurgical industries. Electrical and electronic SSIs were equally divided between those that had experienced severe to moderate or no influence of reduced market demand.

Competition from other domestic products appeared to be having a severe impact on 36% of the SSIs surveyed, and those in rubber and plastics were the most vulnerable to this. The impact was moderate on 44% of the units, while about 21% reported slight or no competition from other domestic producers. A significant number of SSIs in the chemical and mechanical industries also felt that other domestic products offered tough competition.

Foreign and imported products had a severe impact on 24% of domestic industries, while 25% felt the impact to be moderate. A significant 51% did not consider such competition a threat because it had had no impact on them, especially SSIs in the auto component, mechanical, fiber, metallurgical, electrical and electronic, and leather industries.

Obtaining Finance

The high cost of funds was viewed as a problem by 47% of the surveyed units, 28%, reported that the impact of high interest rates was moderate, and the remaining 25% reported that interest rates had had very little or no impact on them. Similarly, 29% had experienced severe difficulties in obtaining finance, while 42% had experienced serious and 28% moderate difficulties. For 30% of the SSTs, there had been little or no difficulty.

The survey responses showed that particularly the auto components sector along with the mechanical, electrical and electronic, and chemical industries had experienced difficulties in obtaining finance. At the same time, these industries also believed that the high cost of funds had had only a slight or no impact on them.

This interesting phenomenon may have occurred because these industries are mainly either proprietorship concerns or promoted under partnerships by traditional industrialists along with technocrats. Typically, such units depend on the resources of entrepreneurs and their friends and relatives not only for initial establishment but

also for day-to-day operations and avoid incurring debt. Therefore it is not the huge profitability of the enterprise but the virtual lack of interest in liability which led to the survey responses. Additionally, when such SSIs are promoted by professionals with sound economic and technical credentials, their proposals are usually bankable and bank managers are enthusiastic, allowing them to obtain funding easily. Typically such units are in the high investment category and produce high-value items that enable them to absorb the impact of high interest rates. However, it is known that the majority of Indian SSTs, particularly those with low investment in plant and machinery, do not utilize bank credit facilities. The investment pattern clearly indicates that most SSIs in the auto component and mechanical industries have investment within the range of up to Rs 2 million.

Production Costs, Labor Scarcity, and Labor Relations

Thirty-nine percent of the SSIs surveyed reported that increased overall production costs had a severe effect on their business, and an equal percentage reported a moderate effect. Only 23% believed that higher production costs had very little impact on business. The mechanical industries were predominant in this category because they comprise numerous units undertaking job-lot work or large-scale subcontracting. The majority stated that increased costs of materials and parts had seriously affected their bottom line, and about 41% that they had been affected to some extent. Only 18% stated that the impact had been slight or none, of which the majority were in the mechanical and some in the chemical industries.

The availability of skilled workers was a severe problem only in rubber and plastics. Overall, only 13% of survey respondents felt that the lack of skilled workers was severe. About 35% believed that the problem was moderate, while the remainder had experienced no problems. Only approximately 7% had found severe difficulties in recruiting sufficient unskilled labor. Unskilled labor is cheap and abundant in India, and therefore SSIs reporting severe problems in this regard were mainly located in the industrially developed regions of western and southern India. Few SSIs in northern India reported this problem. The availability of skilled workers is a severe problem mainly in enterprises in the rubber and plastic sector because operations involve sophisticated computerized numerical control (CNC) machines.

Labor relations and union actions were not a problem for 74% of the SSIs surveyed. This can be explained by three main reasons:

1) Only 13% of the surveyed units employed 100 or more workers, while 38% employed a maximum of 20 workers (Table 3). The Factory Act provisions are different for enterprises employing fewer than 20 working without electrical power and employing fewer than 10 working with electrical power. When the provisions of the act are not applicable, there is little likelihood of unionization.
2) It is easy to replace unskilled workers. Most SSIs employ workers on piece-rate basis through contractors.
3) There is a general tendency not to engage workers over the long term except in the case of a few highly skilled workers. The turnover rate of the workforce is therefore high.

Comparison of Business Results in 1999 Compared with 1997–98

The SSIs surveyed reported that more than 47% had increased production by more than 5%, in 1999 compared with the level in 1997-98. Of these, 25.96% had increased production by more than 10%. The production level of another 29% varied within 5% of the 1998–99 level. SSIs in the jute (66.6%), rubber and plastic (45%), textile (39.2%), and automobile industries (35%) had increased production by more than 10%. Those operating in the food (37.5%), metallurgical (37.5%), and automobile industries (30%) had increased production by more than 5%. Only 24.0%, reported a decrease in production volume of more than 5%, of which 10.88% reported a decrease of more than 10%. Industry groups in which production decreased more than 5% were fibers (68.2%), mechanical (30.5%), textiles (35%), and chemicals (32.8%).

Survey data on sales revealed that they were higher in 1999 compared with 1997–98 by more than 10% in 132 of the 570 units, comprising 23.15% of the total. Although 25.96% reported an increase in production volume of more than 10%, only 23% reported an increase in sales of more than 10% in 1999. This indicates that SSIs had increased the volume of production partly by reducing their prices while some benefited by an actual increase in sales at prevailing prices. This trend was visible in some automobile, leather, textile, and metallurgical enterprises. On the contrary, only eight in the mechanical sector had increased production by more than 10% in 1999, while the sales of 13 increased by 10%.

A sales increase of 5–10% was reported by 22.8%

Table 3: Numbers of employees in the SSIs surveyed.

Industry	0-10	11-20	21-30	31-10	41-50	51-60	61-70	71-SO	81-90	91-100	>100	Total
Auto	14	8	1	1	0	2	2	0	0	2	0	30
Mechanical	17	28	21	11	4	5	8	12	0	0	12	118
R&P	12	16	12	4	6	2	3	0	1	1	12	69
Fiber	0	6	1	3	2	6	4	0	0	0	0	22
Metallurgy	5	11	19	13	6	0	12	0	0	0	6	72
Textile	0	0	0	3	0	5	6	5	0	3	6	28
Packaging	6	3	0	0	0	0	0	0	0	0	0	9
E&E	0	15	14	0	26	0	0	0	4	0	22	81
Leather	9	31	8	4	5	0	0	0	0	0	3	60
Jute	0	0	2	1	0	0	0	0	0	0	0	3
Food	10	2	0	3	0	0	0	0	0	0	5	20
Chemical	8	13	7	9	4	3	0	3	0	0	11	58
Total	81	133	85	52	53	23	35	20	5	6	77	570

R&P, rubber and plastics; E&E, electric and electronics.

of surveyed SSIs compared with 21.32% reporting a production increase, indicating that some enterprises that had increased production by more than 10% received lower prices for their products in 1999 compared with 1997–98. There were minor variations in the direct relationship between increased production and total sales in each industry group. The sales margin increased by more than 10% for 8.77% of surveyed enterprises and increased 5–10% for 17.89%. Sectors in which the margin had increased by more than 10% were automobile components (13.3%), metallurgy (13.3%), leather (18.3%), and chemicals (20.4%). Prominent industry groups in which SSIs had registered an increase in sales of 5–10% were rubber and plastics (45%), metallurgical (20.8%), leather (20%), and jute (66.6%). Those operating in the food, fiber, and packaging industries reported an unchanged or lower sales margin.

Growth in export volume of more than 10% had been achieved by 8.42% of surveyed SSIs, and another 6.84% had achieved an increase of 5–10%. Sectors in which enterprises had achieved significant export growth were automobile components (38%), metallurgy (27.7%), textiles (39.3%), and chemicals (17.2%). More than 70% of SSIs reported no change in export volume, including most in the leather and mechanical sectors, while 14.55'%, reported decreased exports, particularly in the fiber and electrical and electronic sectors. Only 10% of the respondents stated that they had better access to export markets than the competition, while 26% stated that they had equal access. A large percentage of SSIs felt that their access was not good or that they were not sure. Twenty-four percent of metallurgical SSTs and 20% of those involved in food processing believed that they had better access. In contrast, none of the leather industry SSIs believed that they had better access than their competitors.

In value terms, exports had increased by more than 10%, for 6.84% of industries. Thirty percent of surveyed SSIs in the leather, 32% in the textile, 20% in the automobile, and 12% in the chemical sectors had increased their export value by more than 10%. Another 8.97% had increased their export value by 5–10%. Those achieving the highest increases were in the mechanical (18.6%) and metallurgical sectors (22.2%). However, even if SSIs in the leather industry did not report any change in volume, export value changed significantly. As compared with 15.61% of units achieving export value increases of more than 15%, 18.77% of respondents stated that export value had decreased by more than 5%. In more than 12% of respondents, a decrease in export value of more than 10% had occurred.

Products manufactured by SSIs are price sensitive. Ideally SSIs should be able to charge higher prices based on increases in the costs of raw materials and wages. Only 29% of the SSIs reported an average selling price of more than 5% and more than 53% reported the same price (plus or minus 5%) in 1999 compared with 1997–98. The remaining 17.89% of units sold their products in 1999 at a price 5% lower than the average price in 1997-98. Enterprises in the leather, rubber and plastic, and packaging industries sold products at prices more than 10% higher in 1999 compared with 1997-98. Those in the automobile (30%), metallurgical (61%), electric and

electronic (21%), and chemical (19%) industries sold products at prices 5-10% higher in 1999, while 19.5% of mechanical and 34.5% of chemical industries received prices 5-10% lower in 1999 compared with 1997-98.

Comparisons with Competitors

Technology is one key to achieving advantage over competitors, and 17.2% of the respondents were of the opinion that they had better access, while another 48% felt that they had equal access to various technologies. Mechanical (37%), metallurgical (35%), leather (33%), chemical (29%), and electrical and electronic (24.7%) SSIs had better access to technology than their competitors. Only 26% of survey participants felt that their access to knowledge was not as good as that of competitors.

Finance is the lifeblood of any SSI. Access to finance depends not only on the financial strength of the individual unit but also on the location. Units located in and around metropolitan cities generally have better access to finance than those in small towns and in rural and less developed areas. Fifty percent of respondents felt that they had equal or better access to finance than their competitors, 34% felt otherwise, and the remaining 16% were not sure. The ratio was more or less the same in all the industry groups. The responses are not sufficient to draw conclusions, as there is no evidence to confirm that easy access to finance was available from banks and commercial lending institutions. As pointed out above, many small units do not approach banks for funds. Those who did not feel satisfied may have faced difficulties with bank lending and their percentage is significant. Dependence on own finances or better acceptability of professionally run SSIs by banks does not imply that there are no problems on the finance front.

Worker skills affect the quality of output and thus are important in achieving superiority over rival products. More than 28% of survey respondents felt that their workers' skills were better than those of competitors, while 45.8% felt that they were equal. Only 15.6% of the units felt that their workers' skills were not better than those of their rivals.

Information Technology (IT), the latest option for gaining an edge over competitors, is being increasingly used by SSIs in India. In this survey, 24% of the units felt that they were using IT better than their competitors, while another 44% felt that they were on par with their competitors. Only 12% of SSIs felt that their ability to use IT was less than that of competitors, while 20% were not sure about their ability compared with their rivals.

Most of the survey respondents were of the opinion that their production technology was as good as or better than that of competitors. Only 15% felt that their technology was inferior to that of competitors. In the mechanical industry, 37% of the SSIs felt that their technology was not as good as that of their competitors. This could be because these enterprises produce a vast number of products and are spread over the length and breadth of the country. Moreover, 56% of the sampled units had investment in plant and machinery of less than Rs 3 million. Many were established in the late 1960s and early 1970s and had not invested heavily in technology upgradation. Those SSIs felt that they were using inferior technology. Of the three jute industry SSIs that participated in the survey, two felt that their production technology was not as good as that of competitors, while the third unit was not sure. This perception was also due to the reasons mentioned above.

In terms of product quality, 91.7% of SSIs felt that their quality was better than or equal to that of competitors, and only 6.3% felt that their quality was lower than that of competitors. The exceptions again were the mechanical industry SSIs, among which more than 20% of respondents considered their product quality inferior. None was in a position to invest in a wide range of quality CNC machines because of the high investment required. They also feared that such investment would remove them from the SSI category and thus deprive them of the benefits of reservation and fiscal incentives currently available. In the jute industry, one of three units considered its product quality inferior to that of competitors. Although 33% appears to be significant, the smallness of the sample size led to volatile results.

Product design and development are essential for all industry groups. Thirty-eight percent of surveyed SSIs felt that their product design and development were better than those of competitors. Nearly 70% of metallurgical and 55% of electrical and electronic SSIs responded that their design and development were superior. Half of the surveyed enterprises indicated that they were as good as their competitors in this area, and only 7% that they were not as good, particularly those in the fiber industry (27.2%) where the competition is mainly from Korea and Thailand, the mechanical industry (8.4%), and jute industry (33%) where the Republic of China is the toughest competitor. The remaining 4% were not sure about their design and development capabilities compared with those of competitors. More than 50% of those unsure were chemical SSIs, because they use standard chemical combinations and established production processes that require few design inputs.

Product range is important for attracting buyers. More than 38% of SSIs surveyed felt that their product range was wider than that of their competitors, and the metallurgical and electrical and electronic SSIs again reported a higher percentage than the average. Forty-seven percent of respondents considered their range to be equal to or as good as that of competitors. Less than 10% considered their range not as wide as that of competitors. Some SSIs in the mechanical (18.6%) and chemical (17.24%) sectors felt that their range was not as good as that of competitors.

Product image is another important criterion for customers. About 35% of the sampled units believed that their product image was better than that of competitors, including 61.1% of metallurgical and 44.41 of packaging SSIs, while only 14% of those in the textile and rubber and plastic industries and none of those in the jute industry felt the same. Thirty-eight percent believed that they enjoyed the same image as rivals, and 17.8% that their product image was inferior. Those reporting an inferior image were in the mechanical (30%) and textiles (25%) sectors. It was generally agreed that Korea, the Republic of China, and Thailand enjoyed better product images in these sectors.

In terms of price, 32% of SSIs surveyed considered themselves better than their competitors. More than 50% of metallurgical units, 45% of electrical and electronic units, and 35% of food units replied that their prices were better than those of rivals, while none of the fiber and jute units gave that reply. More than 54% of SSIs matched the prices of competitors. This was expected, as only 5% of sampled units could not provide value for money as compared with their rivals, while 8%, were not sure about their pricing. Among leather units, 18% did not consider their pricing good. Most of the footwear units expressed concern about the low-priced Chinese footwear inundating the market at the expense of their better-quality products. The majority of SSIs not sure about their pricing were in the leather (26.6%), chemical (16%), and mechanical (8.4%) sectors.

Higher productivity and lower unit costs enhance the capacity of SSIs to withstand competition. Overall, only 13.7% of survey respondents believed that their profit margins were better than those of their rivals. Fifty-five percent of food product units, 22% of metallurgical units, and 16.9% of mechanical units felt that their profit margins were higher, as did the majority of the fiber, textile, packaging, jute, and chemical SSIs. Productivity was judged to be the same as that of rivals by 51% of respondents. The percentage was higher at 70.8% in metallurgical SSIs and lower at only 10% in food product SSIs. About one-fourth of units did not consider their profit margins to be less than that of their competitors, including approximately 40% of those in the mechanical, electrical and electronic, and food sectors.

Most SSIs in India sell their products in the domestic market. In the survey sample, although almost all units had some export orientation, they earned their bread and butter domestically. Twenty-three percent of all respondents believed that they had better access to the domestic market than competitors, those involved in the manufacture of rubber and plastic products (52%) and metallurgical industries (45%) reported that they had better access to the domestic market, and another 47% felt that they had equal access. However, respondents in the mechanical (28.8%), automobile component (20%), and leather (20%) sectors indicated that their access was less than that of competitors. Overall, more than 15% were not sure about their domestic market access, particularly in the leather (38%) and chemical (34%) industries.

The responses appear slightly ironic. While most respondents reported that their productivity was either higher than or equal to that of competitors, a significant proportion did not consider their market access to be as good. This may have been due mainly to the way the question was framed. The respondents who were not interviewed were not clear as on competitors' status in terms of market access and the status of imported products. This may represent an aberration and should be seen more as a reference to domestic competition, since most respondents did not seem to be overly worried about imports.

Utilization of Production Capacity

Table 4 shows the capacity utilization by the sampled units during the three years prior to the survey. Those utilizing less than 30%, and more than 90% of their capacity both decreased in number, while those utilizing 70-80% of capacity increased. By industry, there was

Table 4: Changes in capacity utilization by survey respondents (%), 1997-99.

Year	Less than 30 %	30-50 %	50-60 %	70-80 %	More than 80%
1997	6.84	22.98	40.35	24.20	5.61
1998	5.09	23.68	41.05	26.14	4.04
1999	4.73	24.56	40.35	27.01	3.33

increase in capacity utilization in the automobile, metallurgical, textile, electrical and electronic, and food sectors in 1999. A decrease in capacity utilization was reported in the mechanical and fiber industries. No appreciable change occurred in other sectors.

Implementation of Activities and Plans for the Subsequent Three Years

The responses of SSIs regarding the implementation of various activities during 1995-97 and 1998-99 were based on fact, while those concerning activities to be implemented during the subsequent three years appeared to be lacking in seriousness. The majority of SSIs that had not implemented any changes stated that they would be doing so in the next three years. Moreover, some dynamic units that had already implemented significant changes also proposed to do so in the subsequent three years.

Production capacity expansion was undertaken by 13.85% of units during 1995-97 and another 17.72% expanded their capacity in 1998*99. Expansion was undertaken during 1995-97 by SSIs in the fiber (50%), automobile (33%), mechanical (16.95%), rubber and plastic (18.84%), electrical and electronic (13.58%), and food product (20%) sectors. However, none of the respondents in textiles, packaging, leather, and jute had undertaken expansion. In 1998-99, 45.85% of metallurgical, 23.5% of electrical and electronic, and 20.7% of chemical SSIs had expanded capacity. In total, 70.53% of the units stated that they would undertake capacity expansion during the subsequent three years.

Capacity was reduced during 1995-97 by 3.5% of respondents, and 6.8% units reduced capacity in 1997-98. The industries in which capacity reduction occurred were automobile components (seven respondents), mechanical (nine), rubber and plastics (seven), fiber (four), metallurgical (eight), electrical and electronics (16), leather (five), and jute (one). No respondent in the textile, packaging, food, and chemical industries reported undertaking capacity reduction during 1995-99.

Although 8.77% of the SSTs surveyed added new production lines during 1995-97, 13.68% did so during 1998-99. The metallurgy (3.88%), electrical and electronic (13.6%), and chemical (27.6%) were the main industries adding new product lines during 1995-97. During 1998-99, SSIs involved in the automobile component (26.7%), electric and electronic (25.9%), leather (20%), and chemical (27.6%) industries added new product lines. A total of 56.14% respondents stated that they planned to add new product lines during the subsequent three years.

SSI units in the automobile component (five respondents), rubber and plastics (six), packaging (seven), electrical and electronic (three), leather (one), and chemical (four) industries shut down some of their production lines during 1995-97. These totaled 26 enterprises, and another 37 shut down production lines during 1998-99. Few SSIs except in the mechanical, fiber, and food product sectors stopped some production lines during 1998-99. Although about 61% of enterprises stated that they planned to discontinue some product lines, it appears that based on past trends few would actually do so.

Modernization is necessary for SSIs to produce goods without obstacles. Of survey respondents, 6.31% had modernized machinery and equipment during 1995-97, and 12.8% had done so during 1997-98. By sector, 53% in the chemical, 24% in mechanical, 23%, in automobile, 23% in electrical and electronic, and 35% in food industries had modernized machinery and equipment during 1995-99. Seventy-seven percent stated that they would modernize during the subsequent three years. At least 4% had neither modernized their machinery and equipment during the previous five years nor intended to do so during the next three years.

Production processes had been renovated by 9.12% of units during 1995-97 and by 13.86% during 1997-98. By sector, 63% of automobile component, 15.9% of rubber, 18% of metallurgical, 22% of electric and electronic, 21% of leather, 35% of food, and 65% of chemical SSIs had renovated their production processes during the five years prior to the survey, although none of the fiber, textile, packaging, and jute SSIs had done so during the same period. Those that proposed to renovate their production processes during the subsequent three years totaled 76.7% of survey participants.

Developing and marketing of new products had been undertaken by 8% of the units during 1995-97, mainly by those in the automobile component, electrical and electronic, leather, food, and chemical industries. Only 8% of survey respondents had developed and marketed new products during 1995-97, while 23% had done so during 1998-99. Most of the industry groups except for the mechanical, packaging, and jute industries had developed and marketed new products during 1998-99. There were plans to develop and market new products by 66% during the subsequent three years. Based on these responses, the majority were really serious about developing and marketing new products.

Packaging plays an important role in product sales. During 1995-97, only eight SSIs in the metallurgical, four in electrical and electronic, and nine in chemical industries developed and marketed new packaging for their products. During 1998-99, 14.4% of respondents developed and marketed new packaging. Textile, leather, and jute SSIs had not developed new packaging, however. Sixty-two percent of respondents planned to renovate the packaging of their products during the three years after the survey.

Ten percent of surveyed SSIs had entered new markets during 1995-97, while 18.24% had done so during 1998-99. Those in the fiber and food product industries had not found new markets during the preceding five-year period; in contrast 68% of the metallurgical, 41% of chemical, and 37% of electrical and electronic SSIs had managed to enter new markets during the same period. More than 70% of all participants proposed to enter new markets during the subsequent three-year period. On the other hand, 20% of automobile component, 28% of textile, 7% of electrical and electronics, 8% of chemical, and 6% of rubber and plastic SSIs had withdrawn from some markets during 1995-97. Of the total survey sample, 12.5%, mainly in the automobile component, mechanical, textile, leather, food, and chemical sectors, had withdrawn from Southeast Asian markets during 1998-99, and 57% proposed to withdraw from some markets during the subsequent three years.

Alternative marketing channels had been adopted by 4.6% of SSIs in the automobile, rubber and plastic, fiber, and chemical industries during 1995-97, and 9.64% of the total had done so during 1998-99. Sectors that had not adopted alternative marketing channels were rubber and plastics, textiles, packaging, and leather, although a total of 73% of enterprises proposed to adopt them during the subsequent years. e-commerce is seen as the latest marketing tool. Very few SSIs had ventured into e-commerce during the five years prior to the survey. Only 28 (comprising nine in the automobile, six in the mechanical, four in the rubber and plastic, six in the metallurgical, and three in the chemical industries) had engaged in e-commerce during that time. SSIs have thus only recently realized the importance of e-commerce, and 76.8% of the enterprises surveyed proposed to venture into e-commerce during the subsequent three years.

Most of the SSIs had not changed their organizational structure during the previous five years. The 28 that had were in the automobile component (seven respondents), mechanical (four), metallurgical (six), textile (four), electrical and electronic (six), and chemical (five) sectors. However, some 78% stated that they would change their organizational structure during the next three-year period. This appears highly unlikely, because SSIs are reluctant to revamp their organizations. Similarly, very few SSIs had changed their financial structure during the previous five years. Only 12 had done so during 1995–97 and 24 during 1997–98. In general, the dynamic units that had changed their organizational structure had also changed their financial structure. Although more than 81% of the SSIs proposed to change their structure during the subsequent three years, it is highly unlikely that they would be able to do so.

Recruiting more technicians and engineers is related to production capacity expansion. In general, SSIs try to optimize the utilization of their existing skilled labor/technicians before recruiting new employees. Thus new recruitment is not directly proportional to capacity expansion. During 1995-99, 180 of the surveyed units had undertaken production capacity expansion, while only 59 had recruited more technicians and/or engineers. The remaining units had utilized their existing workforce. This indicates that these units had improved employee productivity. Although 79% of enterprises planned to recruit more technicians and/or engineers, this appears highly unlikely in view of the trend in enterprises that had undertaken production capacity expansion during the five years prior to the study.

Very few SSIs, comprising less than 5% of the total, had found new sources/suppliers of materials and parts during 1995-97, although more than 16% had done so in 1998-99. Those in the automobile, electric and electronic, leather, and chemical sectors were the main seekers of new sources or suppliers of materials and parts. However, 72% of the surveyed units planned to seek new sources during the next three years.

During 1995-97, only 15 units, in the automobile component (four respondents), metallurgical (four), electric and electronic (five), and food product (two) industries, had formed new business alliances for technology acquisition or development. That number nearly tripled during 1997-98. Apart from those industry sectors, SSIs that had entered into business alliances for technology were involved in the mechanical, rubber and plastic, leather, and chemical sectors. Respondents in all sectors indicated that they had plans to forge new business alliances in relation to technology during the subsequent three years.

Very few SSIs surveyed (23) had entered new business alliances for financial reasons during 1995-97 and most of those supplied products to the collaborating units.

Financial collaboration generally took the form of equity participation, although technical collaboration was also reported. Under the current industrial guidelines, large enterprises can invest in up to 24% of the equity of SSIs. During 1997-98, 41 units had formed financial alliances, mainly those in the automobile component, mechanical, leather, and metallurgical industries.

SSIs generally lack the skill to market their products, particularly in international markets. Only 3% of enterprises surveyed had formed new business alliances for marketing during 1995-97, however. During 1998-99, the percentage increased to more than 9 and more than 76% had plans to enter into new marketing alliances during the subsequent three years. Numerous SSIs seeking to enter international markets were seeking marketing arrangements with partners.

The findings described above are generally in conformity with the trends elsewhere m terms of export volumes, values, and pricing in both the domestic and export markets. The capacity expansion undertaken and dropping of certain production lines, particularly by the auto component, metallurgical, mechanical, leather, and electric and electronic industries, is indicative of the dynamism of the SSIs surveyed and show that they attempt to hedge against risk. Despite the impact of the Asian financial crisis, these industry segments have been able to maintain or even increase exports, which confirms their confidence in product quality.

The case of the leather industry is particularly fascinating. While the leather sector, particularly around Chennai (Madras) and Calcutta was affected by the Southeast Asian currency meltdown, neither volume nor value was affected despite the fact that alternative markets were not explored. This suggests that buyers elsewhere preferred the products of the Indian SSIs and were willing to pay more for superior quality. It is thus not surprising that SSIs in this sector planned to introduce new products, enter new markets, add more capacity, and form new business alliances.

The results from SSIs in the auto component, electric and electronic, and chemical industries confirm their coming of age. The auto component sector can satisfy the demands of the auto majors that have established manufacturing facilities in India, while the electric and electronic industries are meeting domestic demand both for direct consumption and the component and subcomponent assemblies for large exporting units. In the chemical category, paint and dye manufacturers have improved considerably to meet both domestic and export demand. The pharmaceutical sector has not only increased its exports of bulk drugs but also managed to create a niche in ready-to-use capsule and tablet forms, particularly exported to CIS countries. The pharmaceutical units have established joint ventures with European firms for technology transfer and buy-back arrangements.

Business Strategies for Enterprise Survival and Success

Capacity expansion and/or reduction was identified as the most important business strategy for 22.72% of the SSIs surveyed, and 27.19% believed that they were quite important. Changes in capacity were ranked as most important for 57% of metallurgical industries, 45% of rubber and plastic industries, 36% of electric and electronic industries, 44% of packaging industries, 32% of textile industries, and 40% of food product industries. They were rated as quite important strategies for chemical (53%), leather (48%), metallurgical (30%), textile (43%), electric and electronic (30%), and rubber and plastic (23%) SSIs. Capacity changes were not viewed as so important for 24% of the units, including those in the mechanical (55.1%), rubber and plastic (29%), and electric and electronic (27%) sectors. This business strategy was not relevant for 21% of surveyed SSIs, since their survival depends more on producing for and supplying to larger enterprises with which they tend to have permanent relationships. A conspicuous feature was that capacity expansion and reduction were not relevant for any SSI in the auto component sector, or for 21%, in the mechanical, 21%, in the leather, and 28% in the chemical industries.

Changes in business or product lines were regarded as the most important strategy for 17% of all SSIs surveyed and as quite important for more than 39%. Thirty-three percent of those in the automobile component, 35% in metallurgical, 29% in chemical, 22% in packaging, and 35% in food product industries considered changes in business product lines as the most important survival strategy. It was considered quite important by SSIs operating in rubber and plastics, electric and electronics, fiber, jute, and chemicals. The remaining 4.40% of survey respondents, particularly those in the mechanical, rubber and plastic, electric and electronic, and chemical industries, did not regard changes in business or product lines as relevant to their success or survival.

Changes in process, technology, and equipment were identified as the most important strategy for 31% of SSIs surveyed. They were viewed as particularly important for 45% of rubber and plastic industries, 47% of metallurgical industries, 42% of textile industries, 89% of packag-

ing industries, 42% of electric and electronic industries, and 50% of food product industries. Such changes were regarded as quite important by 33.5% of respondents and as not so important or relevant for 35.5%. Sixty-eight percent of the mechanical and 57% of the chemical SSIs did not consider this aspect as important/relevant. The interest of most of the packaging industry SSIs in this strategy can be explained by their declining performance due to the availability of newer and more attractive packaging. On the other hand, the mechanical and chemical sectors employ well-established technologies and equipment and hence appear less interested in this aspect of technology upgradation.

Cost reductions and productivity improvement were stated to be the most important survival strategy for 41.6% of SSIs, and 36% believed that they were quite important. Most of the units in the metallurgical, packaging, and jute industries felt that these were very important, while those in other sectors, with some exceptions, considered them very important. Less than 10% of respondents did not consider cost reductions and productivity improvement important, and 13.15% felt that they were not relevant for them (49% of mechanical, 26% of leather, 23% of automobile component, 20% of chemical, and 17% of electrical and electronic industries). It was determined during interviews that the majority of SSIs that did not consider cost and productivity as relevant were export oriented, had buyers who demanded large volumes, and had thus previously optimized their production lines with technical support from importers. Moreover, with their order books full, other considerations like exchange rate fluctuations, etc. affected their survival and success more than other factors.

Indian SSIs have not yet utilized e-commerce to a great extent. However, awareness of the importance of e-commerce for survival exists. More than 17%, surveyed SSIs in all sectors except for jute felt that taking advantage of e-commerce was most important, and 38% considered it to be quite important. Only 13.5% felt that e-commerce was not so important and 38% that it was not relevant for survival. Most SSIs that considered e-commerce not so important or relevant were those catered to local markets in and around their place of production or sold products directly to customers for use as intermediates. Those engaged mainly in exports had fixed and committed buyers and e-commerce was not viewed as relevant since they did not want to expand capacity.

As expected, marketing strategy was believed to be the most important or quite important strategy by 39% and 34%, respectively, of surveyed SSIs. All in the metallurgical, packaging, and jute industries considered marketing to be very important. Enterprises with marketing tie-ups or acting as ancillaries, particularly in the mechanical, electric and electronic, leather, and chemical industries did not consider this aspect important, since they were not involved in direct marketing.

The availability of timely finance is essential for the operation of industrial units. The lack of adequate financing can hamper the production process and result in loss of orders, which may ultimately lead to enterprise sickness. That is why more than 30% of the units considered their financial strategy as the most important and 35% considered it as quite important. The 36% of respondents that did not consider finance to be so important were mainly in the metallurgical, rubber and plastic (48%), electric and electronic (25%), food product (35%), and chemical (41%) industries.

In India abundant labor is available, but skilled labor can at times be scarce. Therefore 26.14% of SSIs considered personnel/human resources strategies as very important and 44.4% as quite important. Personnel/human resources strategies were very important for metallurgical, leather, automobile component, electric and electronic, fiber, rubber and plastic, and food product industries. Only 8.5% considered human resources strategies as simply important, although 21% considered them not relevant. Those SSIs employed very few skilled laborers and had no problems in meeting personnel requirements.

Business alliances were felt to be the most important strategy by 30% of respondents, while 36.32% considered them quite important. Rubber and plastic, electric and electronic, leather, metallurgical, jute, and packaging industries considered business alliances very important. Forty-nine percent of mechanical, 26% of electric and electronic, 40% of food product, and 53% of chemical industries did not believe that the formation of business alliances was important and relevant.

Usefulness of Government Services to SSIs

In India, most services to small enterprises are provided by the union government through the offices of the SISIs and other specialized agencies. Most facilities are located in the major cities/towns. Due to the size of the country, it is not feasible for the government to make available all facilities to all SSIs, and numerous facilities may not be easily available to them. Some SSIs in this survey stated that facilities were not available at their doorsteps. Some state governments also provide certain services.

Information services are provided to SSIs by SISI offices. Among survey respondents, 20.3% were of the opinion that information services provided by the government had been very useful and 38.3% quite useful. Only 8.4% of the units felt that these services had not been useful. None of the SSIs in the automobile component and food product industries stated that information services had not been useful. In the chemical sector, the greatest percentage of respondents (22%) reported that government services had not been useful because specialized services catering to the pharmaceutical industry are not common among government institutions.

Production technology training was considered as very useful or quite useful by 49% of the SSIs, while only 9% found it not useful. More than 41% of SSIs stated that training courses were not available to them, however. SISIs provide production skill training to SSI entrepreneurs. Of the 67% of survey participants to whom production or skill training was available, 21% felt that it had been very useful and 32% quite useful. Industries that did not consider the training useful included automobiles (36%), mechanical (23.7%), metallurgical (18%), and chemical (24%). None of the fiber, textile, and leather SSIs reported that the training had not been useful.

Because SSIs in India are mainly proprietorship and partnership concerns, they are not conversant with modern management practices. SISI offices provide industrial management training to SSI entrepreneurs. In the present survey, 21% of respondents had found that training very useful, 32% quite useful, and only 14.5% not useful. By sector, 93% of leather, 63%, of rubber and plastic, 72% of fiber, and 67% of metallurgical SSIs con-sidered management training had been useful for them.

Tool rooms set up by the union government and some state governments provide training in tool design, and 46.5% of the surveyed enterprises believed that training was useful, with one-half considering it very useful. Only 10.6% did not consider it useful. Tool design training was not available to more than 42% of the surveyed SSIs. Design training was considered useful by 98% of the leather, 48% of electric and electronic, 68% of metallurgical, 60% of textile, and 52% of rubber and plastic SSIs. Although few SSIs use IT and information management to promote their businesses, SISI offices have been offering training in these areas for the past few years. Small enterprises are now aware of their importance. However, these training courses are only available in a few locations. Among survey participants, 16.8% found the courses very useful and 34.3% quite useful. Only 6.8% of the SSIs felt that they were not useful. IT and information management training was not available to 41.8 of SSIs surveyed.

Similarly, production and design consultancy was available to only 41.5% of SSIs. Of those, 20.3% considered the consultancy services to be useful, 19.2% quite useful, and only 7.1%, mainly from the automobile component, mechanical, metallurgy, and rubber and plastic industries, felt that they were not useful. SISI offices also offer management consultancy to SSI., and this was available to 52% of survey respondents. Forty-four percent stated that these services were useful and only 8% that they were not useful. These services were considered very or quite useful by 63% of automobile component, 68% of metallurgical, 61% of rubber and plastic, 77% of leather, and 44% of electric and electronic units.

Production and process development centers undertake R&D in various industrial sectors, and those facilities were available to 46% of SSIs surveyed. Only 8.4% reported that the centers were not useful. Industry groups that considered the R&D centers very/quite useful were leather, electric and electronics, and metallurgy.

More than 65,000 branches of various commercial and public banks provide loans to SSIs in India. Loans provided to SSIs were very useful for 14% of those surveyed and quite useful for 44%. Only 9% did not consider the loan facilities useful. The reasons mentioned in interviews were the paperwork and red tape required for obtaining loans. In some cases, banks refused to consider applications and rejected them because the projects were not thought viable.

Banks can obtain guarantees from the Deposit Insurance and Credit Guarantee Corporation for loans to SSIs, especially tiny units. Recently, the government has started a Credit Guarantee Fund Scheme to cover loans up to Rs 2.5 million made by public-sector scheduled commercial banks and selected regional rural banks. Only 13% of the SSIs surveyed believed that credit guarantees were very useful, while 33% felt that they were useful. Only 13.8% considered credit guarantees not useful. Such guarantees were not available to 32.3% of the respondents, however. The National Equity Fund Scheme operated by the Small Industries Development Bank of India provides for equity participation of up to 25% of the project cost in projects budgeted at up to Rs 2.5 million. Only 4.7% of the SSIs in this study found equity funding to be very useful, 31.3% stated that it was quite useful, and 51.5% that it was not available.

General marketing support is provided through the Purchase and Price Preference Policy of the government

for SSI products. SSIs must make efforts to obtain this support, however, and the majority do not try. Eighteen percent of surveyed enterprises found the marketing support very useful and 24.0% quite useful. Such support was not available to 44% of the units, and 14% did not believe that the marketing support was useful.

Export promotion for SSIs has been accorded priority in the export promotion strategy, which includes simplification of procedures, incentives for higher production of exports, preferential treatment of SSIs in access to market development funds, etc. Products manufactured by SSIs for export are displayed at international exhibitions free of charge. SSI respondents in this survey reported that the export promotion services offered were very useful (9.9%) or quite useful (28.5%). Only 14.1% stated that they were not useful. These remaining SSIs had not taken advantage of the services, but acted on their own and through friends to tap the international market.

Subcontracting exchanges have been opened in SISI offices and with industry associations to register spare capacity of manufacturers and to match the requirements of large enterprises with the unused capacity available in SSIs. Subcontracting facilities were believed very useful by 13.8% of survey respondents and quite useful by 17.6%. The facilities were not available to 48.9%, and another 20% did not consider subcontracting exchanges useful.

e-commerce support is provided mainly in the form of programs to promote the concept among SSIs. Ten percent of the SSIs stated that those programs were very useful and 17.3% quite useful, while 11% indicated that they were not useful. Since e-commerce is a recent development, the awareness programs were not yet available in all locations, and 61.6% of the respondents had no access to them.

Infrastructural Support

In India, infrastructure support to industry is provided by the union government as well as the state governments. Rail transport, port facilities, and telecommunications are developed by the union government, while electricity supply, industrial water supply, industrial estate operation, etc. are state responsibilities. Road networks are developed and maintained both by the union and state governments. Effluent treatment facilities are generally constructed by individual enterprises with support from the United Nations Industrial Development Organization (individually or collectively) and by state governments.

About one-third of surveyed SSIs had complaints concerning road transport. The major problem is the lack of all-weather paved roads to market centers. More than one-third were not satisfied with railway transport, citing the lack of availability of railway wagons and the inability to book full wagon loads. Related problems are delays in delivery, damage to goods shipped, and the long time required for arrival and release of goods in the case of shared wagons. Medium-sized enterprises with higher turnover can participate in the railway "own a wagon" scheme and appear to be happier with rail transport since they have some control over the movement of their goods. Delivery is also much faster (even within 24 hours) because these wagons are attached to express goods trains and are not shunted aside at smaller stations for goods from other wagons to be unloaded.

The time required at ports to ship and unload goods was the main reason for 60% of surveyed SSIs to state that port facilities are poor. Some believed that cargo handling should be mechanized to the extent possible. However, most expressed satisfaction with facilities like inland container depots from which their shipments can be dispatched to ports by rail or road under customs seal. Individuals are no longer required to be present at the ports or airports to complete customs formalities, saving both time and money.

Telecommunications facilities in India have improved tremendously during the past decade, particularly in the metropolitan areas and towns. With cell phones penetrating into semiurban and rural areas, fewer SSIs reported that telecommunications facilities were poor.

Warehousing and distribution facilities were considered poor by half of the SSI respondents. Most were not able to invest in setting up those facilities and expected the government to do so.

The lack of adequate power is one of the major causes of underutilization of production capacity. The problem is more acute in rural and less developed areas of the country. More than 50% of SSIs stated that the electricity supply is poor and as a result they were forced either to shut down production or use diesel generators, which increased the cost of production and caused losses in the majority of cases. Some enterprises reported low operating margins for this reason alone and were surviving on extremely thin margins, occasionally barely recovering the cost of production. Although many foreign companies have tied up with Indian ones to set up power plants in the country, improvement in the availability of power will take some years.

Industrial estates have been set up by most states, although some are not being maintained properly. The estates have been handed over, in most cases, to associations of the enterprises located in them for maintenance. Unfortunately, the associations do not appear to take that responsibility seriously, and despite the poor conditions of the roads and other infrastructure on the estates they have not made collective efforts for improvement. They continue to think that the panacea for all their problems is the government and its resources. This was one of the main reasons why 42% of SSI participants in this survey had a poor perception of industrial estates and more than 72% felt that effluent collection and treatment facilities on the estates were poor.

All the survey respondents felt that general effluent collection and treatment facilities were poor. The shortage of water in some states was the reason why more than 50% of the units stated that industrial water supply is poor. This is mainly because water supply facilities have not been expanded with increasing demand due to industrialization. Establishing effluent treatment plants is primarily the responsibility of the individual units, and most SSIs have not done so. They expect the government to bear the financial cost. State governments have, in some places, particularly in clusters, helped SSIs to set up common effluent treatment plants (CETPs). But it is not possible for state governments to set up CETPs to meet SSI needs everywhere.

Leather and chemical units have been particularly affected by their failure to meet environmental standards. One cluster of leather training units near Chennai (Madras) is on the verge of closure due to pollution problems, while chemical and pharmaceutical units in Kusaiguda near Hyderabad are also under similar threat. Industry clusters that were able to foresee impending environmental disaster in the vicinity of clusters under threat of closure and anticipate the CETP size required have established independent companies for CETP operation. This was done partly with the help of union and state government subsidies, but most of the funding came from the enterprises' own resources and money borrowed collectively from banks. Similarly, the pharmaceutical industry near Hyderabad is now in the process of increasing the capacity of the CETP using its own resources.

Conclusions

Data on investment, especially in the automobile component, mechanical, rubber and plastic, packaging, and leather and footwear industries, reveal that 5Q5 of the 570 surveyed units had investment of less than Rs 2 million, which was mainly attributable to the policy of reservation of 812 items for manufacture exclusively by SSIs and prohibiting large and medium industries to manufacture those items without a mandatory export obligation of 50% of production. The structure of ownership indicates that 98% of SSIs are proprietorships or partnerships. Enterprises with greater investment generally are private limited companies. At the same time, there is a trend for medium-sized enterprises, especially those with investment of Rs 10 to Rs 30 million, to register as public limited companies to allow them to raise equity or funds through strategic alliances, joint ventures, and partnerships (foreign and domestic).

Except for those in the packaging industry, most of the SSIs participating in the present survey had their own brand names, with the highest percentage in the electric and electronic sector, followed by the automobile, rubber and plastics, mechanical, and metallurgical sectors. Surprisingly, in the food product sector most of the respondents had their own brand names. Except for food product SSIs, subcontracting was prevalent in all categories, including those in the automobile component and mechanical industries. The absence of brand names in such industries is explained by the high incidence of subcontracting. Conversely, brand names are more common where mandatory certification is required, such as for electrical appliances.

Advances in production technology appear to have significantly affected manufacturing industries, ranging from 50% in the automotive sector to 64% in rubber and plastics, 49% in packaging, 44% in metallurgy, and nearly 33% in electric and electronics. The sectors most significantly affected by IT are automobile component manufacturers and SSIs in the packaging and mechanical industries. Conversely, the majority in the rubber and plastic industries and a significant proportion in the metallurgy, textile, electric and electronic, and leather and footwear sectors appear to have been only marginally affected.

Global overcapacity and reduced demand appear to have had a significant impact on the automobile component, mechanical, rubber and plastic, fiber, metallurgy, leather, chemical, and jute industries. Sectors most significantly affected by the Asian financial crisis were automobile components (53%), leather (40%), mechanical (27%), and rubber and plastics (27%). The engineering industries (auto and mechanical) were particularly affected by the crisis, which resulted in lower demand elsewhere and also simultaneously made Indian goods costlier. In the case of the leather industry, the crisis affected

it dually: for units with manufacturing facilities overseas such as in Indonesia, the cost of raw material imports became prohibitive, thereby affecting exports; and at the same time, footwear exports to other countries were reduced because demand shrank in the face of very cheap footwear exports from affected countries in Southeast Asia.

The full impact of trade liberalization was not revealed in the survey, mainly because quantitative restrictions on imports had not yet been fully removed in India. Simultaneously, it also appears that in anticipation some progressive SSIs had started preparing for such liberalization through the introduction of technology and forming alliances.

Changing consumer behavior had had some effect on SSIs, which was more apparent in sectors with fewer reserved items, and conversely in sectors such as electric and electronic products in which the majority of the items are reserved for small manufacturers. International quality standards appear to have had a significant impact on the mechanical and leather industries. In the case of fiber, textiles, and jute, little impact was felt.

Nearly one-third of the surveyed enterprises reported that they had been severely affected by contraction in market demand. Competition from other domestic products had had a severe impact on 36%, with the most vulnerable being the rubber and plastic industries, followed by the chemical and mechanical industries. Foreign and imported products had had a severe impact on one-quarter of the SSIs surveyed. However, sectors that discounted such threats were mainly related to auto components, mechanical industries, fiber industries, and leather industries.

The high cost of funds was a problem for nearly one-third of SSIs. The data revealed that the auto, mechanical, electric and electronic, and mechanical industries found difficulty in obtaining finance. Access to financing by SSIs depends not only on the financial third, along with other strategic considerations affecting operations, including availability of timely finance and of skilled labor.

The majority of SSIs found information services provided by the government through the SISIs to he useful, including production technology training, production skill training for entrepreneurs, tool room training, and production and design consultancy. Forty-five percent considered management consultancy services to be relevant to their needs. Export promotion through government agencies and the promotion of e-commerce were appreciated. However, roads and railway transport were reported to be inadequate and port facilities to be poor. Most of the surveyed units expressed satisfaction over facilities like inland container depots and telecommunications facilities. Warehousing and distribution facilities were cited as very poor. The lack of adequate power was seen as a major factor causing underutilization of capacity, with the problem more acute in rural and less developed areas. All surveyed units reported that effluent collection and treatment facilities were poor, and 50%, stated that industrial water supply was poor.

(This paper is taken from the book SMEs in Competitive Markets, APO, 2002.)

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The stoical scheme of supplying our wants by lopping off our desires is like cutting off our feet when we want shoes.

– Jonathan Swift

Policies, Performance and Evaluation of SME Export: Experience of India

C.T. Benjamin

The emergence of small enterprise as a key player in economic development, particularly in developing economies, has been recognised all over the world. In India, the government has attached great importance to this sector. which has grown phenomenally over the past five decades. The term small and medium enterprise (SME) is used in a broad perspective and includes all activities such as industry, service and trade. The industry sector covers both modern and traditional activities. The modern segment comprises the small and medium manufacturing industries and the traditional segment consists of activities like handicrafts, handlooms, village industries, etc.

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SSI in India

The SSI, which constitutes a major segment of small enterprise development, represents one of the fastest growing sectors of the Indian economy. At present, it contributes 40 percent of industrial production and about 35 percent of national export. There are about 3 million small scale industrial units employing nearly 17 million people. The small scale sector covers a surprisingly wide range of items accounting for about 7,500 products. In fact, the range is so wide that there is hardly any product that is not either directly or indirectly sourced from the SSI sector. They constitute both traditional items, which are the specialties of Indian handicrafts and artisans and at the same time, the modern, sophisticated, and technologically advanced products that can compete successfully in the international market. They include mass consumption products such as leather, plastics, rubber, wood, paper, ready-made garments, etc., and such sophisticated products as color television sets, computers, electronic calculators, and digital measuring instruments.

In a span of two decades, i.e. between 1971/72 and 1991/92, the total export from India increased by 27.3 times, while that from the SSI sector increased by 89.56 times. While during the last 8 years the total exports increased by 3.2 times, SSI exports increased by 3.56 times. This shows that although export growth of the SSI sector was higher, it has not been able to maintain the earlier impressive trend after 1991/92. However, this does not belittle the role of SSIs as the dominant export sector of the economy.

Handicrafts

The unorganized sector of the Indian economy consisting of small scale industries, handicrafts, handlooms, powerlooms, sericulture, coir, etc., dominates the export scene of India and accounts for about 60 percent of the country's total exports. Ranked after SSIs, handicrafts

play a very important role and make a significant contribution to India's export particularly through the export of gems and jewelry and hand-knitted carpets.

India's Share in the World Export

Despite the significant contributions made by the unorganized sector towards the total export of the country, it is a fact that India's share in the world export is very low at about 0.5 percent.

The total export of the country has been hovering around US$33 billion between 1995-98 and is targeted to rise to US$37 billion by the end of 1999/2000. However, this constitutes only an insignificant and small fraction if we compare the same with world exports that were US$3,730 billion in 1993/94 and are expected to go up to US$5,500 billion by the end of the year 2000. Thus, by March 2000, India's share in the world export will not be more than 0.67 percent. India is a member of the World Trade Organization (WTO) and the measures that it takes to increase its exports have to be in conformity with the rules laid down by it. Efforts will have to be made to double the volume of India's exports in the next five years, if India wants to become a significant global player.

The task becomes more difficult as the country has been losing ground in the export of primary products and traditional items, and because of the fact that the large scale industrial sector's attention and energies have so far been focused more towards the internal than the international market. Competition is increasing day by day, and the task is becoming more daunting because of the increasing manufacturing efficiency of the developed and newly industrialized countries, greater emphasis on quality, higher investment on export promotion the world over and the emergence of fortified trade blocks. In such a scenario, it is but natural that the attention is drawn towards the SSI sector because of its past excellent performance and its vast potential of significantly contributing towards export from India. However, before analyzing and assessing the prospects of the SSI sector in this regard, it would be imperative to know the reasons for India's failure in recording an impressive export growth rate in the last few years.

The Poor Performance of India's Export Growth

The economy faced deceleration in export growth in three successive years up to 1998/99. Indian export growth slowed down from 5.6 percent in U.S. Dollar terms in 1996/97 to 2.1 percent in 1997/98 and suffered a decline of 4 percent in 1998/99. The poor performance is the result of a combination of different factors.

The East Asian crisis, global demand deceleration and decline in domestic industrial production are some of the reasons for the dismal performance on the export front. An economy survey in 1998/99 has identified the following factors as responsible for this state of affairs:

A decline in the growth of world trade. Import growth of the advanced economies, which are India's major trading partners has been declining sharply from 18.2 percent in 1995 to 3.7 percent in 1996 and further to 2.5 percent in 1997;

A reduction in export prices of major items of manufactured goods. World prices of manufactured goods, which constitute three-fourths of India's total export, have declined cumulatively by 14 percent in the last three years;

An appreciation of the rupee in real effective exchange rate terms in 1997 against currencies of major trading partners;

- The massive depreciation of the currencies of East Asia. This has affected the price competitiveness of India's exports in sectors such as synthetic yams, finished leather, fabrics and processed minerals. Other items like textiles, automotive parts, chemicals, iron ore, machinery and electronic goods have also been affected; and
- Domestic factors such as growing infrastructural constraints, high transaction costs, and restrictions on agricultural exports are some of the other important factors that have adversely affected the supply of exportable surplus.

India's Membership of the WTO and its Implications

India was a member of GATT and its successor organization, the WTO, which came into being on 1 January 1995. By virtue of membership of the WTO, India automatically became entitled to *most favored nation treatment* from all WTO members for its exports and for its participation in this increasingly rule-based system aimed towards ensuring more stability and predictability in the governance of international trade. However, at the same time it has become incumbent on India to conform to certain stiff conditions as indicated below:

- As a member of the WTO, India has bound about 67 percent of its tariff lines, whereas before the Uruguay Round of the GATT only 6 percent of

the tariff lines were bound. For non-agricultural goods, ceiling bindings of 40 percent ad valorem on finished goods and 25 percent on intermediate goods have been undertaken. The duties are required to be brought down in six equated installments to the committed bound levels by March 1, 2000 for industrial products other than textile items. As regards textile items, the phase out period extends up to March 1, 2005;

- Quantitative restrictions on imports for 2,300 tariff lines have to be phased out because of improvement in the balance of payment. An agreement has been reached to phase out quantitative restrictions over a period of 6 years beginning in 1997; and
- Agreement on tightening of the regime on intellectual properties establishes certain minimum standards relating to availability, scope, use and enforcement of intellectual property regimes and extends the basic principles of non-discrimination and transparency in these spheres.

The WTO and the agreements under it are going to affect every economic activity whether it is agriculture, trading, service or manufacture. World markets are opening up with lowering of tariffs and dismantling of other restrictions in developed and developing countries. Enlightened and perceptive entrepreneurs have greater opportunities to benefit from the comparative advantages possessed by them. Domestic markets will be subject to increased threats because of lowering of tariffs leading to freer entry of foreign goods and because of foreign companies establishing manufacturing bases locally. Whereas the developing countries will have greater opportunities in the sectors in which they have cost-based comparative advantages, e.g. textiles, agriculture, etc., the developed countries will benefit by opening up of the service sector and tightening of the intellectual property regime. Export markets will become tougher because of competition among developing countries with similar comparative advantages.

Every company, whether serving domestic or international markets, will have to undertake an internal exercise to identify factors affecting its international competitiveness in terms of cost as well as quality. It will need to examine if it can stay competitive in the market if the product becomes freely importable and/or tariffs are further lowered. Further, the international trade is increasingly becoming knowledge-based. The entrepreneurial abilities and qualities will come to the fore in the new emerging environment. The concepts of liberalization of international trade, deregulation and privatization of internal economy have now been strengthened and legalized under WTO.

The choice of a direction other than that dictated by the new developments is fraught with dangerous consequences. The countries that have understood this have moved swiftly forwards fine-tuning their domestic and international trade policies creating a winning environment for their businesses.

The Performance of SSI's Export

Today, the SSI sector produces a wide range of items, numbering about 7,500. The items that play a dominant role in terms of exports are ready-made garments, leather products, processed food and marine products, engineering goods, electrical and electronic goods, plastic goods, basic chemicals and pharmaceuticals, etc.

The share of the SSI sector in the export of certain items is as high as 100 percent. In 1997/98, the sector accounted for 100 percent of the country's export of sports goods, 90 percent of ready-made garments, 55 percent of finished leather and leather products, 65 percent of processed food, 57 percent of marine products, and 60 percent of basic chemicals, pharmaceuticals and cosmetics. In the case of engineering goods, and chemicals and allied products, its share was 26.86 and 5.59 percent respectively.

An analysis of the performance of SSI exports reveals some disturbing features that must be given due consideration while formulating any plan for the growth in the future. Some of these features are:

- During the 5-year period from 1992/93 to 1997/98, the share of the SSI in the manufacturing sector has declined from 54.44 to 52.84 percent. The most striking decline is in the case of leather and leather goods where the share fell from 80 to 58 percent during the period.
- Within the sector itself five items alone accounted for 85.56 percent of total exports. These items are ready-made goods (37.24 percent), leather products (7.34 percent), basic chemicals (14.63 percent), engineering goods (9.9 percent), and marine products and processed food (16.45 percent). This shows a lack of diversification and consequent instability.
- The share of the SSI in some of the emerging

areas such as electronics, engineering goods and plastics is very low in the manufacturing sector. There are many other items which still remain to be tapped, particularly glass and ceramics, marble and tiles, and paper and wood products.

- Even in respect of those items that account for a significant share of export, their share in total global export is almost negligible. Leather products, which have a great potential, currently account for only 3 to 4 percent of the global exports.
- Similarly, India's share in the total export of fruits and vegetables, and processed food is extremely low despite the vast potential existing in these areas. This could be gauged from the fact that about 30 percent of the fruits and vegetables produced in the country are going waste and less than one percent of the total production of these items is being processed.
- Most of the export of India is going to the established markets of developed countries, where not only the competition is tough, but where also trade blocks are. As a result, there is need to explore the potential and viability of new markets in Asia and Africa.
- Of the total value of production within the SSI sector the share of export is not significant. In 1998, the total value of production in the sector at current prices was Rs.4.65171 trillion whereas the value of exports stood at Rs.444.42 billion which is about 9.5 percent of the total production.

In fact, export from the Indian SSI sector presents a paradox of a high share in national export and a low share in the sector's production. While the share of the SSI in the national exports is 35 percent, the share of SSI export in its total production is as low as 9.5 percent. This means that over ninety percent of SSI production is directed to the domestic market. About 95 percent of SSI units belong to the category of tiny/micro enterprises where investment in plant and machinery is less than Rs.500,000. Because of a low capital base of this segment, the level of the technology used is low am " a traditional type. This affects the productivity as well as the quality of products and :,.id. their competitiveness. In this context, it is worthwhile analyzing the factors that have helped the SSI sector to grow so far.

One of the factors is the existence of a healthy market at lower and middle income levels where sizeable demand for low prices and low quality products exists. Only in a very small segment of SSI units is the level of capital investment high, the level of technology used comparatively high (although it may not be state-of-the-art technology), and as a result productivity is high, quality of products is reasonably good, and they are able to compete on their own in the domestic as well as in export markets.

In fact, the number of SSI units that are engaged in production of exportable goods may not be more than forty to fifty thousand, out of over 3 million SSI units in the country. With the opening up of the Indian economy because of economic reforms and because of India's membership of WTO, the survival of the captive market at lower middle-income level is now in jeopardy. As a result of placement of a large number of items under open general license, removal of quantitative restrictions, lowering of tariff rates and a host of other measures in the wake of economic reforms, the degree of protection enjoyed by the SSI sector has considerably narrowed down and is further expected to be curtailed.

The Indian SSI Sector at a Crossroads

One cannot deny the fact that because of these developments, the SSI sector finds itself at a crossroads. With domestic markets becoming increasingly competitive and the export markets difficult to capture, the SSI sector cannot survive in the changed scenario unless it adopts competitiveness as the *mantra,* exhibits aggressive selling techniques, concentrates on the quality aspects of its products and assumes export orientation.

With a change in strategy from growth led export to export led growth, it has become essential to provide for better integration of small industries with large industries and to attend to the basic problems adversely affecting the functioning of SSI units relating to credit, infrastructure, technology, marketing and information.

Challenges for the SSI Sector

The current economic reforms have ushered in many challenges before this sector. While some of the challenges are related to its small size, others are because of the type of technology used and its location in rural and remote areas and some arise on account of their difficulty in obtaining adequate and timely credit and because of lack of infrastructural facilities. These challenges are as follows:

- Increased competition particularly in the consumer goods sector;
- Inadequate access to institutional credit, delayed delivery and higher cost of credit;

- Vulnerability in terms of access to technology information and advanced management practices;
- Inadequate standardization of products, components, parts, sub-assemblies, etc., which discourage linkages between small and large units; and
- Predominance of a large number of rules and regulations procedural bother and their inability to cope with them.

While economic reforms have brought the small sector face to face with competition, they have at the same time presented certain opportunities in the form of access to better technology, increased availability of raw materials and components, and also an opportunity to diversify and restructure with the dismantling of the control regime. The natural advantages of quick response, flexibility and innovativeness possessed by this sector will help it to convert the challenges into opportunities.

However, to what extent it will be able to take advantage of the opportunities depends on the solution to some of the major bottlenecks that this sector faces: inadequacy of finances, lack of adequate infrastructure, high cost of production, lack of information particularly on market conditions in India and abroad, and inferior quality. In addition, there are problems arising out of cumbersome export formalities and procedures, which the units, lacking necessary infrastructure will find difficult to cope with.

Inadequacy of finances

The timely availability of adequate credit is the prime requirement of any export oriented SSI unit or for that matter any economic unit. According to a special committee appointed by the Reserve Bank of India, the supply of credit to the SSI sector has been extremely inadequate from institutional sources. Commercial banks, which meet the working capital requirements of these units, provide only 8.1 percent of their total output by way of working capital, as against the norm of 20 percent prescribed. In the case of tiny units, the supply of credit from the banks was not more than 2.7 percent of their output. Availability of credit plays a very important role in the successful working of an unit. Credit should be affordable, adequate and timely. The problems of credit become more serious because SSI units do not have access to other sources of finance such as the capital market.

No doubt, this sector suffers from certain inherent weaknesses. The major disadvantage of small enterprise in a competitive environment is lack of resources. They have limited access to capital and face higher capital costs. They also have handicap arising out of their poor resource-base, and their inability to avail economies of scale.

A recent study has revealed that not more than 14 percent of SSI units avail themselves of bank finances. It is essential to have a comprehensive credit scheme targeted at SSI exporters. A special line of credit for SSI units needs to be introduced and procedural bottlenecks need to be removed. One of the major problems faced by SS units in the domestic market is the problem of delayed payment. This reduces the availability of capital and also hampers export compliance. This problem could be solved to a great extent by discounting of small firms' receivables from large units by banks and financial institutions under what is popularly known as *factoring services.* To encourage financing of risk prone ventures, there is need for popularizing venture capital fund.

Lack of adequate infrastructure

Lack of adequate infrastructure, particularly in the field of power supply, communication network and telecommunication facilities affect production, its cost and delivery. Frequent disruption in power supply adversely affects productivity, particularly in precision and high technology outputs. Demand for reliable power supply reflects the increasing awareness of small enterprises in maintaining their quality and competitive edge. Similarly, lack of adequate telecommunication facilities is proving disadvantageous to SSI units in the highly dynamic and hi-tech using international market.

High cost of production

The SSI sector in India, uses a wide spectrum of technology ranging from traditional to state-of-the-art. Since 95 percent of SSI units are tiny or micro enterprise they use traditional, local technology and this affects the productivity, quality and competitiveness of the products. Export promotion and technology upgrading is synonymous since it is the door to improving quality and reducing costs of production. As small units mainly concentrate on serving local markets, they prefer to rely less on sophisticated technologies and more on simpler processing techniques.

Lack of information

Linked with technology upgrading and exploration of markets is the issue of availability of timely information, the arrangements for which are extremely inadequate at present. The issue has assumed greater significance as

a result of the recent telecommunication revolution, with applying hi-tech for market research and looking for business opportunities as a more cost effective substitute for exploratory personal visits abroad.

Inferior quality

Packaging plays a very crucial role in present day marketing, especially export marketing. That is why it has been called *the silent salesman.* Packaging technology has undergone vast changes in recent years and this is based on the recognition that each item needs special attention on account of its nature, volume, content, purpose, and that packaging must be cost and environment friendly. Packaging is both a science and an art and requires special training and awareness. India faces a formidable hurdle in meeting and matching the packaging requirements of its exportable products in the world market. The international market with deep-rooted forces of competition does not respect the inadequacies of the exporting countries. According to a United Nations' study, 30 percent of total exports earnings from the developing world are lost because of poor packaging.

Conclusions

The economic reforms launched in India in 1991, have brought about far-reaching economic and structural changes in all sectors of the economy, particularly in industry, trade and finance, as well as taxation. The thrust of these measures has been to make the economy internationally competitive. The liberalized policies of the government have thrown open most of the industrial sector to large and giant international companies. The liberalized policies of the government provide the small and medium industries challenges and opportunities. The challenges come in the form of competition and reduced protection, whereas opportunities are in the form of better technology, availability of a variety of raw materials and components, guaranteeing better quality and means of higher efficiency and productivity.

As a result of globalization, the Indian economy and society, and the context for both small and large business are undergoing rapid and fundamental changes. These changes are expected to continue in the 21st century. Globalization is a major force that will modify and mould the environment for small and medium business and entrepreneurship over the next decade and beyond. The competition from abroad is bound to place strong pressure on small and medium business in terms of efficiency, price, quality, cost-control, marketing expertise, customer satisfaction and innovativeness. There will be fundamental changes in customer expectations and the way markets operate.

The next decade will also see an increase in the connectivity between and among organizations and markets. Changes in technology, markets and values will encourage the evolution of new types of firms.

Small enterprises that rise to the challenges are poised to make an enormous contribution to the economy well into the 21st century. There will be less of a role for enterprises that are not adaptable to change.

(This paper is taken from the book Export Orientation for Small and Medium Enterprises: Policies, Strategies and Programs APO, 2001.)

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Appreciate everything your associates do for the business. Nothing else can quite substitute for a few well-chosen, well-timed, sincere words of praise. They're absolutely free and worth a fortune.

– Sam Walton

Feature

Improving Organisational Effectiveness Through ERP Systems: The Case of International Tractors Ltd (Sonalika Group)

Ranjit Singh, Roopali Batra, Birender Agnihotri & Kawaljeet Singh

New dynamics of business have lead companies to employ Enterprise Resource Planning (ERP) solutions to carry on the smooth operations. The case of ITL highlights the efforts towards the process of integrating the operations through the implementation of ERP solution at Sonalika group's division of International Tractors Ltd (ITL); and also helps to evaluate the impact of this technological decision on performance and productivity. This paper focuses on the manufacturing giant at their Hoshiarpur plant in Punjab. An endeavor is made to present a unified framework of overall streamlined activities with the use of ERP and its supporting technology at ITL, which led to enhanced decision capabilities and numerous benefits for the organization as a whole.

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Enterprise Resource Planning (ERP) can be defined as a system of using information technology to link the various functions such as manufacturing, inventory control, accounting, human resources etc. across an entire company into one completely integrated system. Its aim is to facilitate information sharing, business planning, and decision making on an enterprise-wide basis.

ERP enjoyed a great deal of popularity among large manufacturers in the mid to late 1990s. Earlier ERP packages used to come in different forms and in a non-integrated fashion, but slowly the need was felt to integrate various segments of an enterprise in terms of both the back office and front office operations into one fully automated and integrated business solution. The current era of globalization, marked by cut throat competition, rampant growth of businesses, changing business requirements and large databases, and the new upcoming concepts like Supply Chain Management (SCM), Just in Time (JIT) and to order manufacturing, have today made ERP more or less a compulsory addition. In short, the new and changing business dynamics where each and every organization is striving to reach the top, has forced the companies to employ ERP solutions to improve their organizational effectiveness and growth through smoother, well planned and interlinked business operations.

Earlier, only global organizations, multinational companies and large corporations with multi-country operations considered that ERP solutions were necessary for them. However the times have changed. Today even a small company, if it is looking at the global market, has to implement ERP solutions to thrive in this turbulent business world where there is a glut of companies battling to acquire even a small portion of global business.

ERP Systems: A Total Software Solution

Various studies have been conducted since the last decade and it has been observed that every organization, whether operating in India or anywhere else in the world, needs smoother operations to sustain the company's growth curve. In order to achieve this objective, there is a need of implementing a 'total solution' of Enterprise Resource Planning (ERP) across multiple business units, with each component having an impact on every other component.

These components are typically grouped into 'subsets' that direct their functionality at different business operations such as financial accounting, treasury, controlling, investment management, production planning, materials management, plant maintenance and service management, quality management, project system, sales and distribution, human resources management and business information warehouse.

Nowadays companies are looking for multi-lingual, multi-currency, multi-facility and multi-manufacturing capabilities (Davenport, 1998). A chaotic environment has been caused by these multi requirements, such as requirements of common platform, common databases, and common business practices for all the concerns of the organizations. As a result of this, the companies are anxiously looking for advance means and management practices to increase their competitive lead and they have realized that an integrated approach can have a tremendous payback if companies choose such integrated solutions properly and vigilantly.

Each of those departments typically has its own computer system optimized for the particular ways that the department does its work. But ERP combines them all together into a single, integrated software program that runs off a single database so that the various departments can more easily share information and communicate with each other.

ERP System: Changing the way of doing business

ERP vanquishes the old stand-alone computer systems in finance, HR, manufacturing and the warehouse, and replaces them with a single unified software program divided into software modules that roughly approximate the old stand-alone systems. Finance, manufacturing and the warehouse all still get their own software, except now the software is linked together so that someone in finance can look into the warehouse software to see if an order has been shipped.

The value of the ERP system for an organization can be evaluated by considering it as system capable for improving the way a company takes a customer order and processes that into an invoice and revenue which otherwise may be known as the order fulfillment process. The companies undertake ERP to integrate financial information, integrate customer order information, standardize and speed up manufacturing processes, reduce inventory and standardize HR information. ERP is customarily referred to as back-office software and basically it does not handle the up-front selling process. It takes a customer order and provides a software road map for automating the different steps along the path to fulfilling the order.

People working in these different departments can see the same information and can update it. When one department finishes with the order it is automatically routed via the ERP system to the next department. To find out where the order is at any point, the concerned person can log in to the ERP system to track it down. As a result of this new system, the order process moves through the organization, and customers get their orders faster and with fewer errors than before. ERP can apply these same capabilities to the other major business processes, such as employee benefits or financial reporting.

The advent of the ERP systems have changed the role of the customer service representatives from just being typists involved in entering someone's name into a computer or hitting certain keys, to becoming intelligent business people. Certain important information that affected the decisions of different departments as well as the customers and was earlier very difficult to obtain, can now be easily acquired online. For example while deciding whether or not to make a new deal with an old customer, ERP systems because of its integrated nature, automatically checks with the customer's credit rating from the finance department to find out whether or not the customer has paid for the last order yet. Similarly while deciding whether or not the company will be able to ship its new order on time, ERP automatically checks from the warehouse and reports about the product inventory levels. Such an integrated system has not only enhanced the skills of customer service representatives but also employees in the warehouse who can now just relax by putting all the information online rather than maintaining inventory records in their books or memorizing the figures. This will further help the customer service representative's check the inventory levels online and tell the customer whether or not the requested item is in stock or not. This system has further enhanced the organizational accountability, responsibility and commu-

nication, resulting in improving the overall organizational effectiveness.

Companies expect ERP to revolutionize their business. However, there is a need to realize that its contribution is optimizing and improving the way things are done internally rather than with customers, suppliers or partners. ERP may bring a dramatic change and create value, but only by affecting the existing "back office" processes such as order management rather than by creating new revenue opportunities. In fact the companies need to understand that ERP is more a cost of doing business to make the company operate more efficiently than something that offers dramatic payback. A Meta Group study of 63 companies a few years ago found that it took eight months after the new ERP system was implemented (31 months total) to see its benefits. The median annual savings from the new ERP system is nearly estimated to be $1.6 million—while the ERP projects at big companies can cost $50 million or more.

Benefits of ERP

Enterprise Resource Planning (ERP) systems help integrate all the primary business applications. All these applications in an ERP suite share a common set of data that is stored in a central database. A classic ERP system provides all applications for accounting and controlling, production and materials management, quality management, plant maintenance, sales and distribution, human resources, and project management.

The main benefits of ERP are: -

- It facilitates company-wide integrated information system covering all functional areas like manufacturing, sales and distribution, payables, receivables, inventory, accounts, human resources, and purchases etc.
- ERP by performing the core corporate activities efficiently and by increasing the customer service helps augment the corporate image of an organization.
- It helps in bridging the information gap across the organization.
- ERP helps in complete integration of systems not only across the departments in a company but also across the companies under the same management.
- ERP allows for automatic introduction of latest technologies like Electronic Fund Transfer (EFT), Electronic Data Interchange (EDI), Internet, Intranet, video conferencing, E-commerce, etc.
- It eliminates the business problems of material shortages, productivity enhancements, customer service, cash management, inventory problems, quality problems, prompt delivery etc.
- It addresses not only the current requirements of any company but also provides an opportunity for continually improving and refining the business processes.
- ERP provides business intelligence tools like Decision Support Systems (DSS), Executive Information System (EIS), reporting, data mining and early warning systems (Robots) for enabling people to make better decisions and thus improve their business processes.

Use of ERP packages in corporate world: Present scenario

Way back in the 1990s ERP was developed and implemented by many companies as a tightly integrated system, but most vendors' software has since become so flexible that companies can now install some modules without buying the whole package. Many companies, for example, now install only an ERP finance or HR module and leave the rest of the functions for some other time. A number of ERP packages and vendors are popular with companies around the world. Some of the most renowned ERP packages include those by SAP R/3, ORACLE, and RAMCO. SAP R/3 is the most widely accepted ERP package having nearly 70% of the ERP market with a total of 2000 customers in the world. Manufacturing companies specifically for functions such as financials, logistics and HR find SAP R/3 more suitable while Oracle is preferred by companies generally for its excellent financials and data management and advance database capabilities such for data warehousing. RAMCO on the other hand is found more appropriate for the process industry such as textile industry.

The implementation of ERP packages in the corporate world offer extraordinary challenges to information technology professionals and the organizations impacted by the implementations. A successful implementation can reap vast rewards in terms of organizational strengths and efficiencies, while a failure can drain an organization of people, funds and vitality. Any system implementation is a special event since it involves the entire organization; it brings together different technologies, people, procedures, ideologies, and leads to sweeping changes throughout the organizations.

In order to successfully implement ERP in an organization, there are several things that the companies find of great importance. First and foremost, they have found it very important to get the support from not only all the people that are involved in implementing ERP, but also the people that will actually use the ERP software. Secondly it is essential to create a proper solution vision at the beginning of the implementation track, so that everybody within the organization knows why ERP is being implemented. Third and last it is very important to test the ERP hardware and software rigorously and to ensure that the end-users are ready to use ERP before going live, because there are many known projects that failed because of a lack of support and ERP knowledge.

In the current scenario it is observed that the most common reason for companies shirking multimillion-dollar ERP projects is that many times they discover the software does not support one of their important business processes. For removing this problem, companies often change their business process to accommodate the ERP software (which is termed as Business Process Re-engineering or re-structuring). This means deep changes in long-established ways of doing business and a drastic change in important people's roles and responsibilities. For reengineering business processes, before implementing ERP, the organization need to analyze current processes, identify non value adding activities, redesign the process to create value for the customer and then develop in-house applications or modify an ERP system package to suit the organizations requirements. This would be a customized solution considering the organizations structure, culture, existing IT resources, employee needs and promises relatively less disruption to routine work during the change program. It is likely to have a high probability of implementation. But the reengineered process may not be the best in the class, as the organization may not have access to the world-class research and best practices. Another option available with companies is of implementing ERP package with minimum deviation from the standard settings, i.e., "one size fits all". The organization has to amend its current work practices and switch over to what the ERP system options offers so that all processes in the company conform to the ERP model. This option offers a world-class efficient and effective process with built in measures and controls and is likely to be quickly. However in this option also there are certain problematic issues to be resolved. While selecting the standard process from the ERP package, there are chances that employees would lack process ownership and orientation. Other than technical issues like organization structure, culture, lack of involvement of people can lead to major implementation difficulties and full benefits of standard ERP package may not be achieved. Situation may arise that after implementing ERP, the organization may have to reengineer its processes. Thus the selection of an appropriate ERP package suitable to a company's requirements and its effective implementation is what matters for any company in the present era, otherwise ERP implementation could become a costly mistake instead of a blessing.

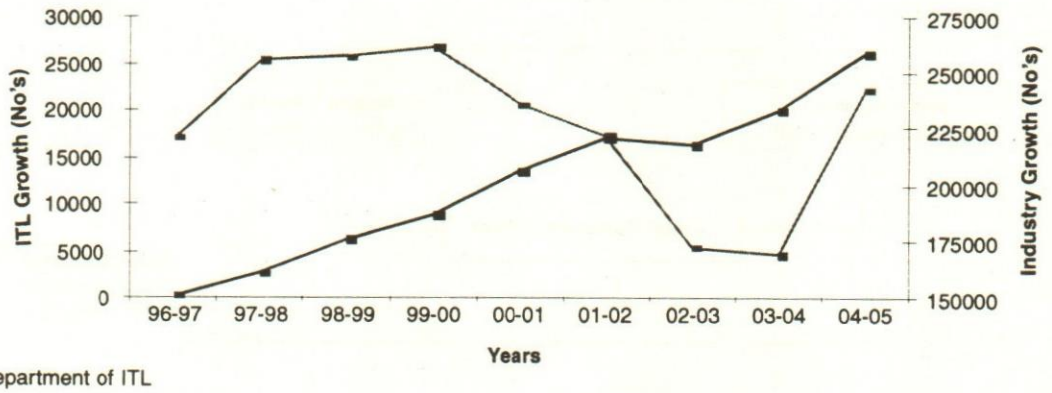
Methodology

Information technology has provided a total solution to the complex, diversified and chaotic business operations in the form of a single software solution termed as Enterprise Resource Planning (ERP). However, the study of ERP implementation initiatives in any business organization is a complex phenomenon, which requires a detailed comparative study of different ERP packages, drastic changes in the technology architecture for ERP implementation as well as a complete and radical change in the prevalent business practices of any organization. To study in detail the ERP implementation initiatives in terms of the challenges faced regarding the changing technology and changing business procedures and practices as well as explore the benefits derived to an organization, the case study method of qualitative research has been adopted here. In the study an in-depth interview was conducted with Mr Birender Agnihotri, AGM (Systems) of the Electronic Data Processing Department (EDP). Similarly, interviews were conducted with the SAP Administrators and Programmers working in the EDP department of ITL. Visualizing Information Technology (IT) as a tool for achieving better, smoother operations and enhancing organizational efficiency, the Sonalika International Tractors Ltd. endeavored to implement Enterprise Resource Planning (ERP) in its division of International Tractors Limited (ITL) in Hoshiarpur district of Punjab. The implementation of ERP systems at ITL and the organizational changes faced by ITL to successfully operate the new system, is discussed in detail in the form of a case study presented below.

Case Evidence: Introduction to International Tractors Limited (ITL) - A Part of Sonalika Group

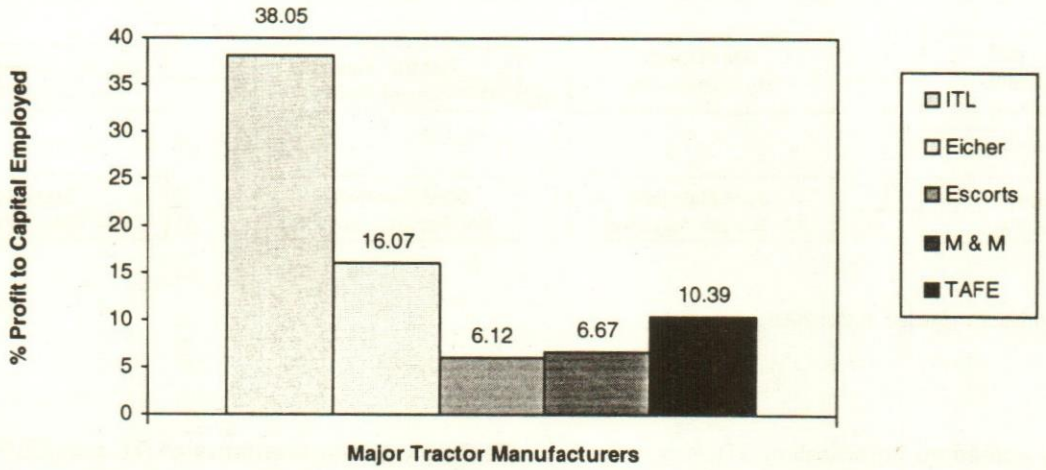
The Sonalika Group has been contributing to the green revolution in India since 1969. It is one of the top five tractor manufacturers in India. Apart from tractors, its product line includes multi-utility vehicles, three wheelers, engines, hydraulic systems, casting, forging, brake system, automotive components manufacturing and various farm equipment and implements. Its market share in farm equipments is 80 % in India and the total turnover of the group is INR 2500 crores per annum. The group

Graph 2.1: ITL VS. Tractor Industry



Courtesy: EDP Department of ITL

Graph 2.2: Comparative Return on Capital Employed



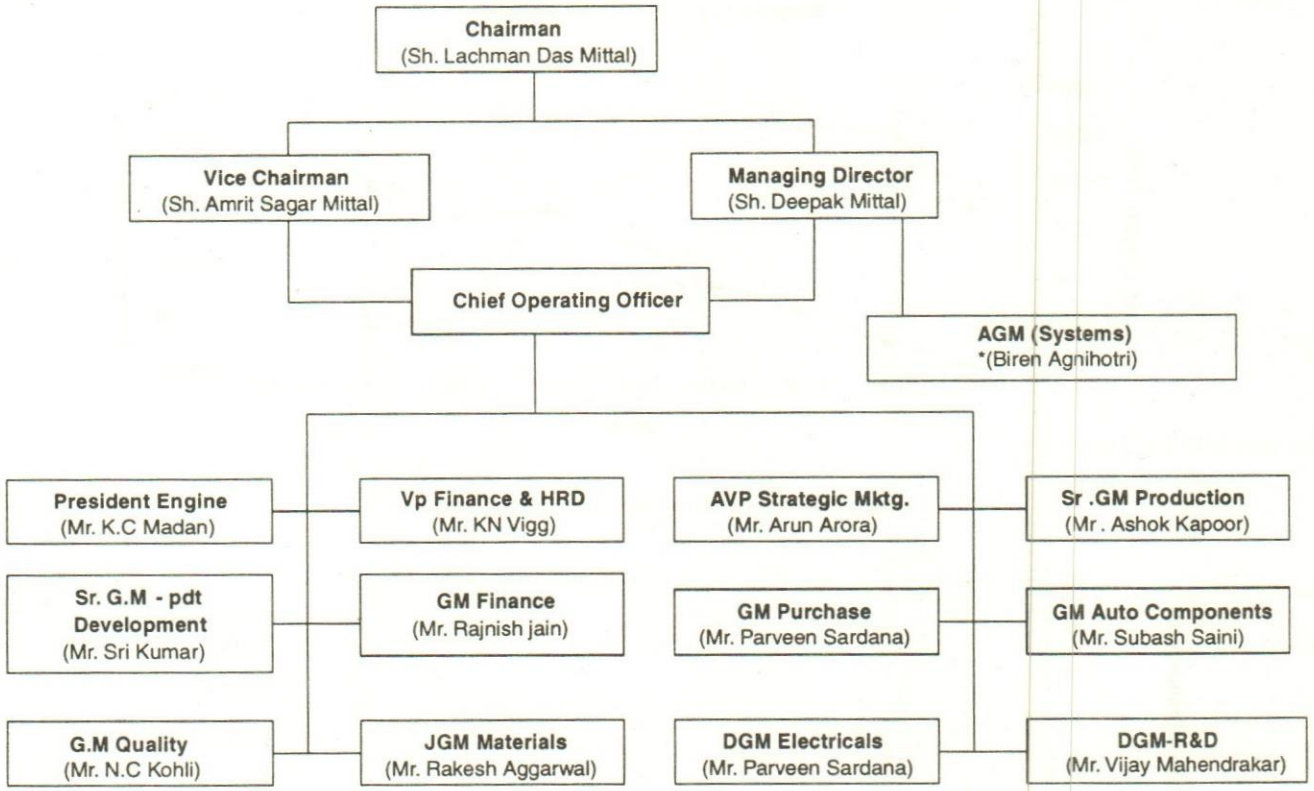
Courtesy: EDP Department of ITL

operates with some big names as its financial partners such as 3I, CBC, MG Rover (UK), Renault Agriculture (France). The company has state-of-art manufacturing facilities spread in acres, located in the pollution free suburbs of Punjab and Himachal Pradesh. The products of Sonalika have created a niche for themselves not only in India but also in foreign markets including France, Zimbabwe and many of the South Asian countries.

An average growth rate of 30% makes it one of the fastest growing companies in India and it also happens to be one of the very few *debt free* companies in the world. The company works on the maxims of low production cost and clean and safe environment. These efforts have fetched the company many accreditations like ISO 9001:2000 and ISO 14001. The Sonalika group includes:

- International Tractors Limited (ITL)
  - o Tractor Division
  - o Engine Division
  - o R&D Division
- Sonalika Agro Industries
  - o Agricultural Machinery
- International Cars And Motors Ltd (ICML)

The Sonalika group entered the automobile sector in 1996 initially through M/S International Tractors limited, with the range of tractors up to 60 hp, the most suitable segment for Indian market. International Tractors limited (ITL), a flagship company of Sonalika group, is among the top three companies in the tractor industry in India. The total land area covered by ITL is 40 acres and it has a total manpower of 1500 people.



(* as per the information collected in Oct,2006)

Fig. 1. ITL Organization Structure

Like every esteemed organization, ITL has a steering and energetic team, which is shown in Fig. 1. Chairman Lashman Dass Mittal, Vice Chairman Amrit Sagar Mittal and Managing Director Deepak Mittal lead the organization.

Comparing Sonalika to other tractor manufacturing companies

International Tractors Ltd. with the Sonalika brand of tractors has been certified as ISO 9001 issued by International Standards Organization. This certification can be earned only by those organizations who can establish and demonstrate strict compliance of quality systems as prescribed under ISO 9001 (highest level of certification) in the area of design and, development, manufacturing and marketing functions. Sonalika has also been certified as ISO 14001, which is another golden feather in the company's cap and another stamp of quality. ITL's overall performance in the field of tractors manufacturing as compared to other tractors manufacturing giants is shown in the graphs.

Technology requirements of ITL and ERP implementation to meet these requirements

As the size of industry grows day by day, its technology requirements also enhance. In fact with the advent of new-fangled technologies, every organization is keen to take advantage of these. Bearing this in mind, ITL has performed certain checks on its already implemented systems and compared it with the latest technologies prevailing in the Information Technology field.

Problems of legacy systems: The rationale behind ERP systems

Prior to the implementation of the ERP solution at ITL, the company was using a legacy system based on FoxPro, and Novel NetWare based communication methods. The company targeted the legacy system for carrying out some basic level requirements such as some sort of simple reporting, and for capturing data generated by each department of the organization. However, as the business of the company was increasing day by day and

the business processes were becoming cumbersome, the legacy system became an unviable solution. Though the legacy system had its own advantages within its own boundaries and scope but with passage of time, it became unsuitable for the manufacturing giant, ITL. Following were some of the shortcomings of the existing system:

- Fiddling with the data by the employer.
- Lack of flexible reporting.
- No standard operating practices.
- No provision of making speedy changes in the system.
- Poor security.
- No emphasis on business intelligence.

Moreover the company was using Novel NetWare networks for data and resource sharing and these types of network practices posed some sort of compatibility problems with other technologies such as Microsoft. As a result of this system, the company could not upgrade the existing systems and move to the state of the art Information Systems packages available in the market. Thus all these shortcomings of the legacy systems led to the implementation of an integrated software system, which can provide business intelligence and support to the various departments of the organization at one desk.

ERP Implementation Process Initiatives at ITL

International Tractors Ltd. (ITL) was one of the earliest organizations in the manufacturing sector in northern region to successfully implement SAP R/3 Enterprise Resource Planning (ERP) System. While there have been some attempts by other organizations to implement ERP, the effort at ITL was considered significant because for the first time it encompassed the entire operation of an integrated downstream manufacturing company, covering nearly 32 locations across the country. This was certainly a bold technological step by ITL Managing Director Deepak Mittal and its financial partners (3I, CBC, MG Rover (UK), Renault Agriculture (France)). The following motivational factors were considered while taking the decision of ERP implementation:-

Technical Factors

- Common platform requirements.
- Obsolescence of legacy systems.

Operational Factors

- Process Improvement
- Data Visibility
- Operating Cost Reductions

Strategic Factors

- Y2K Compliance
- Multi-Site Standardization
- Customer Responsiveness
- Decision-Making Improvement
- Need for Efficiencies and Integration
- Business Restructuring

A small team of 10 people was constituted with representatives from each department of ITL such as Finance, Sales and Distribution, and Information Systems, who were required to map the existing business systems (legacy systems) vis-à-vis the future needs characterized by customer focus, resource-optimization, integration, and flexibility. The team concluded that it was imperative to replace the existing legacy systems with a state-of-the-art ERP system. As a result of this, SAP R/3 implementation was initiated at ITL in 1999, by the most renowned name in software development i.e. Siemens Information System Limited (SISL), a division of Siemens Software. The whole project was put into operations after the diligent efforts of nine months. With this achievement, ITL was also ranked among one of the largest ERP implementations in the northern region.

Preference of SAP R/3 over other ERP software

During the nine month process of ERP implementation, the challenge for the team of expertise was to select the most suitable ERP package. This process of evaluating and selecting the most appropriate ERP software is a complex task. It should be a fact-based process that brings you to a point where you can make a comfortable, well-informed decision. The selection process should be based on your own strategy and business process model.

As part of the selection process, the Information System (IS) plan team mapped all the major processes in ITL through a series of process workshops conducted with the help of people identified as possessing expertise and conceptual insights in their business areas. The team also developed a detailed requirement list.

This list served the purpose of pre-selecting/validating the ERP products for detailed evaluation, while some other scripts were also used in the final evaluation of the

product. A detailed technical selection process was undertaken to find the 'best fit' ERP package for current and future needs of ITL. As a result of the selection process, SAP/ R3 software was selected for implementation.

The selection process of SAP R/3 is discussed in Table 1. Initial investigation by the company resulted in a long list of available vendors who provide ERP packages, but final comparisons were made between three most renowned ERP vendors SAP R/3, ORACLE, RAMCO. The Comparison is shown in Table 1 given below.

SAP R/3 was finally selected because of the following main reasons:

- World's 70% of ERP systems market is with SAP. In India itself it has more than 2000 users as compared to other systems such as RAMCO, which has just around 1000 users.
- As SAP has a global presence, the standards, languages and terminologies of SAP remains the same globally. ITL being multinational organization needs to interact throughout the world and SAP R/3 perfectly fulfills this requirement of global interaction.
- SAP offers huge R&D lab support. ITL can thus take benefits of this huge support whenever it faces any technical problem with SAP R/3 ERP systems in the organization.
- Moreover SAP R/3 is very suitable for manufacturing organizations.

Four-Phase SAP Implementation Process

The process of SAP implementation at ITL was conceived in four phases, that is *Pre-Implementation Phase, Go-Live Phase, Post Implementation Support Systems, And Dead Support Systems.* The implementation of the

Table 1: Comparisons of SAP R/3, ORACLE, RAMCO

Vendor	SAP R/3	ORACLE 's OED	RAMCO
Functionality			
Business Functionality	• Fit with current requirement of ITL for all departments. • More BPR oriented	• Little BPR oriented • Not found fit for all the processes of ITL such as manufacturing, logistics, Material Management	Little BPR Oriented.
Technology	Technology and R&D advancements are possible. ABAP, Java, XML development tools are used,Client-server environment	PL/SQL, XML development tools are used.Easier to install, maintain and use.Lacking in providing deep vertical functionality	Little R&D advancements are possible as far as manufacturing industry requirements are concerned
Industry Specifics	More Manufacturing industry specific for functions such as Financials, Logistics, HR,	Excellent at Financials and other applications.Excellent at Data management and advance database Capabilities such for data warehousing.	More Process Industry specific such as textile industry, as group owns and operates several modern textile mills and the same solution is used at these and several other plants
Vendor Credentials	Captured world's 70% of ERP market. More than 2000 customers in world		
Security	Authorization is customized as per the requirements of ITL		
Flexibility	Flexibility Methods of processing. Methods can be easily shifted from one to another	Flexibility in Web applications, workflow and reporting.	
Origin	*Global Origin.* Uses same formats and terminologies and communication methods worldwide	*Global Origin* but for only specific operations and applications	*Indian origin.* May not be well versed and compatible for other ERP products.

whole project was headed by Mr Birender Agnihotri (A.G.M Systems).

Pre-Implementation Phase

In the pre-implementation phase as discussed earlier a detailed selection procedure went around to choose the best fit ERP package and for this reason an in-house team was made from the various departments of the ITL. The team comprised of 10 people from each of the departments like Finance, sales and distribution etc. Various studies were conducted such as Business Process Re-engineering, AS-IS study (meticulous study of existing business processes at ITL was made, and various business functions were enumerated and mapped to give details), TO BE study (the team decided what we want our business processes to finally look like) etc. The team put forward a detailed list of requirements and based on these requirements comparisons were made between some renowned ERP vendors and finally SAP R/3 was selected and ASAP (Accelerated SAP) Methodology was adopted. In this type of methodology all customization required was done at company end and the training was done at client end which helped in implementing the whole ERP system in surprisingly a short span of time. This also helped in reducing the total cost of implementation.

The second step of the pre-implementation phase was to build an operator team who is actually going to operate the system. This team was named *Operator Team and* was given detailed demonstrations of the SAP R/3 working by using different means such as power point presentations, manuals and lotus notes etc.

Go-Live Phase

The previously described phase finally led ITL towards this final moment: The go-live phase. Go-live meant to turn on the SAP R/3 system for the end-users, to obtain feedback on the solution and then ultimately monitor the solution. It was also the moment where product software adoption came into play. ITL also adopted the BIG-BANG product software adoption methodology according to which one fine day suddenly; ITL shut down all its legacy systems at once and started working with the new ERP technology.

Post-Implementation support

In this phase all the problems identified in the functionality of the system in the go-live phase were rectified to make the system ready for further use. Go-live phase did not mean to sit and relax; depending on the scope of the ERP implementation exercise, several options were explored in this phase to further maximize the gains from the system implemented.

Dead Support System

This was the phase when the SAP R3 ERP system became finally ready to be used as a completely real time operational system.

After all the above stated phases of SAP R/3 implementation, ITL came up with an entirely new integrated system overcoming the drawbacks of the Legacy systems just within the time span of nine months and system was actually in operations. The modules of SAP R/3 implemented in ITL are highlighted in Table 2.

Table 2: SAP R/3 Modules coverage at ITL

R/3 Module	Process Areas
FI/AM	Financial accounting including GL, AP, AR, treasury and asset management
TR-CM	Cash management
IM	Investment management
CO	Cost center accounting, product and services costing and profitability analysis
PS	Project systems
MM	Materials management - Purchasing, inventory management
PM	Plant maintenance and service.
SD/IS Oil	Sales and distribution
PP, PP-PI	Production planning
CIN	India version for Excise, MODVAT, TDS, sales tax, octroi etc.
QM	Quality management

Business practices and benefits after SAP implementation

Changing Business Practices after Implementation of SAP R3

Generally with the implementation of ERP, organizations have to undergo some re-structuring and re-engineering of current business practices for streamlining of activities. However, many times this process of re-structuring results in numerous changes in the business organizations, which are resisted by the human factor of the organization. In such cases these changing business practices need to be managed carefully. Some data formats need to be changed etc. At ITL business practices and goals have changed extensively after ERP implementation such as focus of company has changed from data capturing to data analysis and business intelligence.

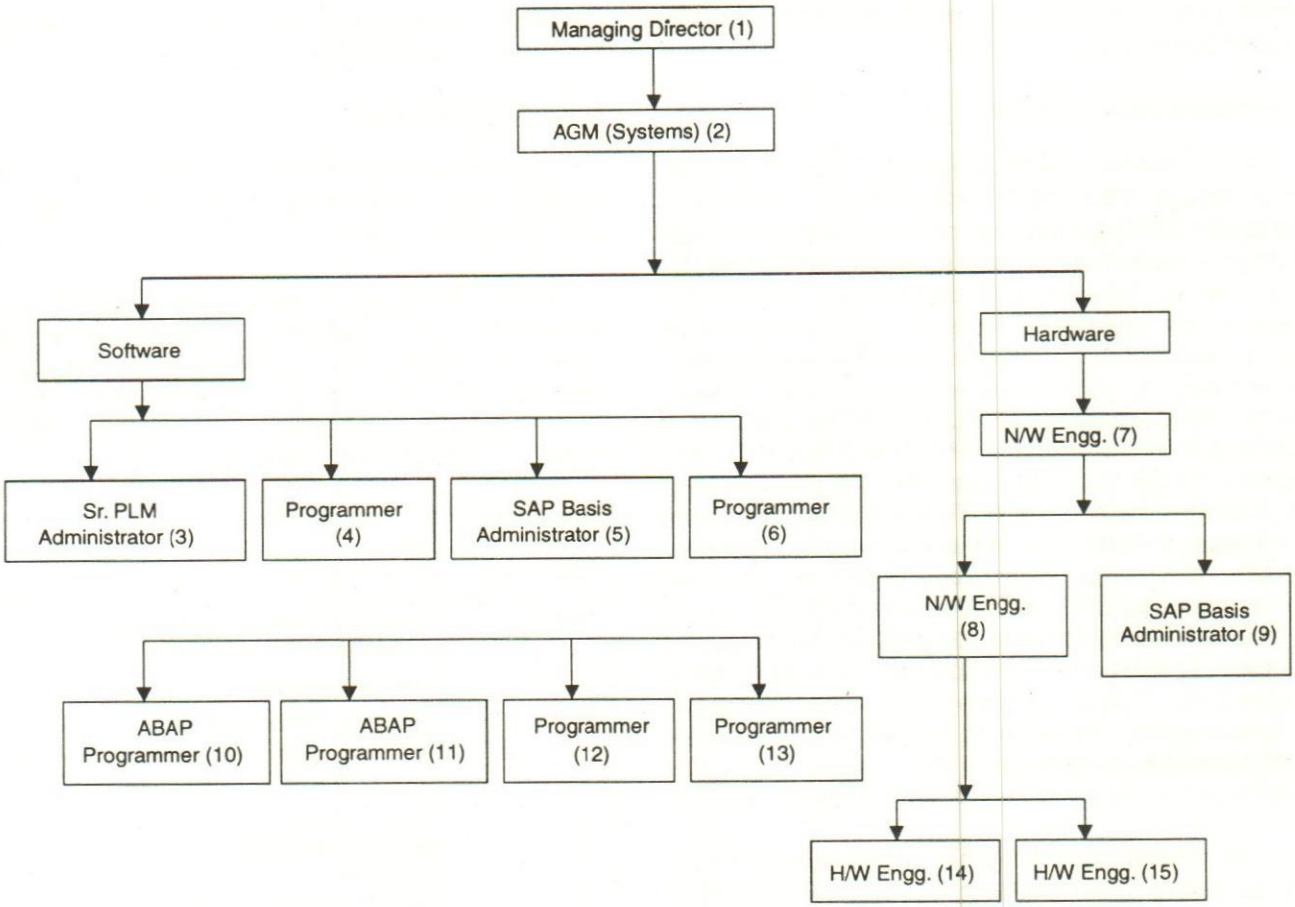


Fig. 2. ITL-EDP Department's Structure

(* as per the information collected in Oct,2006)

Following were the major changes encountered with the ERP implementation:

- ***Data Migration***: There was a need to define clearly all specifications that were required to populate the data into the new system. Templates were developed to undertake the migration of legacy systems and integrate the new data elements to the SAP R/3 system. All the closing balances of the previous systems were brought forward as opening balances for SAP R/3 system.
- ***Changes in Job profiles***: This is a usual perception that automation may fire some of the manpower of the organizations since things are going to be handled with automated machines but at ITL no such practice was adopted rather changes were made only in the job profiles. Employees were clustered according to their skill sets and ranks obtained in SAP training programmes. Fig. 2 shows EDP department Structure with various job profiles.
- ***Workflow Changes***: Workflow of the organization changed entirely. SAP R/3 was now handling the whole system, right from the entry into the gate till the dispatch of products. Complete automation was achieved but with proper authorization management. Whatsoever is of the particular employee's concern and for which he had the authorization rights, that employee could see and operate only that part of SAP R/3 System. This managed the workflow in the organization in a very well organized and optimized way. Figure 3 shows the complete workflow of ITL in the form of a network layout diagram. The network layout diagram shows that the main server room is connected with all the departments of ITL. The entire departments are connected with highly stable communication media i.e. fiber

optics. All the departments are having their personal computers as client computers and are being controlled by the server room, which further contains several dedicated servers. All the activities from *New Admin Block* to server room are automated with the implementation of SAP R/3 System.

- ***User Management***: User management is an important activity whenever new system is implemented in any organization because users may not be ready to adapt to the new system and to leave the traditional methods of doing work. In other words there may be resistance from the user side.

ITL higher officials handled user resistance effectively through the following means

- Increasing salaries of SAP R/3 Users.
- Providing training certifications.
- Different types of rewards and incentives given on the basis of performance appraisal.
- No reduction of staff.
- Top management participation such as MD taking personal interests in conducting workshops to encourage the employees.

Certain anti-resistance policies were also made to show the doors to ill-behaved users of the SAP system.

Benefits from Implementation of SAP R3

SAP R/3's applications are modular. They can be used either alone or combined with other solutions. The integration capability of these applications increases the benefits derived for any company. The implementation of SAP software, such as SAP R/3 is almost always a massive operation that brings a lot of changes in the organization. The whole process can take a few years. Mostly every person in the organization is involved, whether they are part of the SAP Technical Support Organization (TSO) or the actual end-users of the SAP software.

All the changes that the implementation of SAP generates are being made to reach high level goals, such as improved communication and increased return on information (because people will work with the same information).

ITL has derived following benefits by implementing SAP R/3:

- High-end security has been achieved and every employee authentication and authorization rights have been clearly defined. As a consequence of this there is no fiddling of data by unauthorized users of the system. The system has provided expanded information access with appropriate user rights.
- The entire database is centralized and the system has consolidated and standardized diverse legacy database platforms. Standardized and normalized data and data formats have been adopted.
- Problems related to networking and resource sharing has been removed.
- Proper reporting procedures and standard operating practices are being practiced.
- There is cross-functional process orientation with high visibility.
- More focus is now on business intelligence (BI) instead of emphasizing on data capturing and storing activities.
- Treatment of inventories and finance area was major problem of legacy system but with the implementation of SAP R/3, this problem was solved with adoption of JIT (Just in Time) system of inventories. SAP R/3 thus promotes and supports adoption of latest management tools and techniques.
- Improved customer service levels, lesser material shortages and reduced late deliveries have been achieved.
- It has provided flexibility to the running system, which can shift from one method of practice to another if required between different years.
- Mapping of legacy data to Sap R/3 database was not a hectic activity. The closing balances of legacy system were brought as opening balance to SAP R/3.
- Even after implementation of SAP R/3, the ITL legal departments were allowed to be view the old system by, so as to solve the legal issues.
- The financial partners of the company can automatically generate their own reports from the system. In fact they can understand these termi-

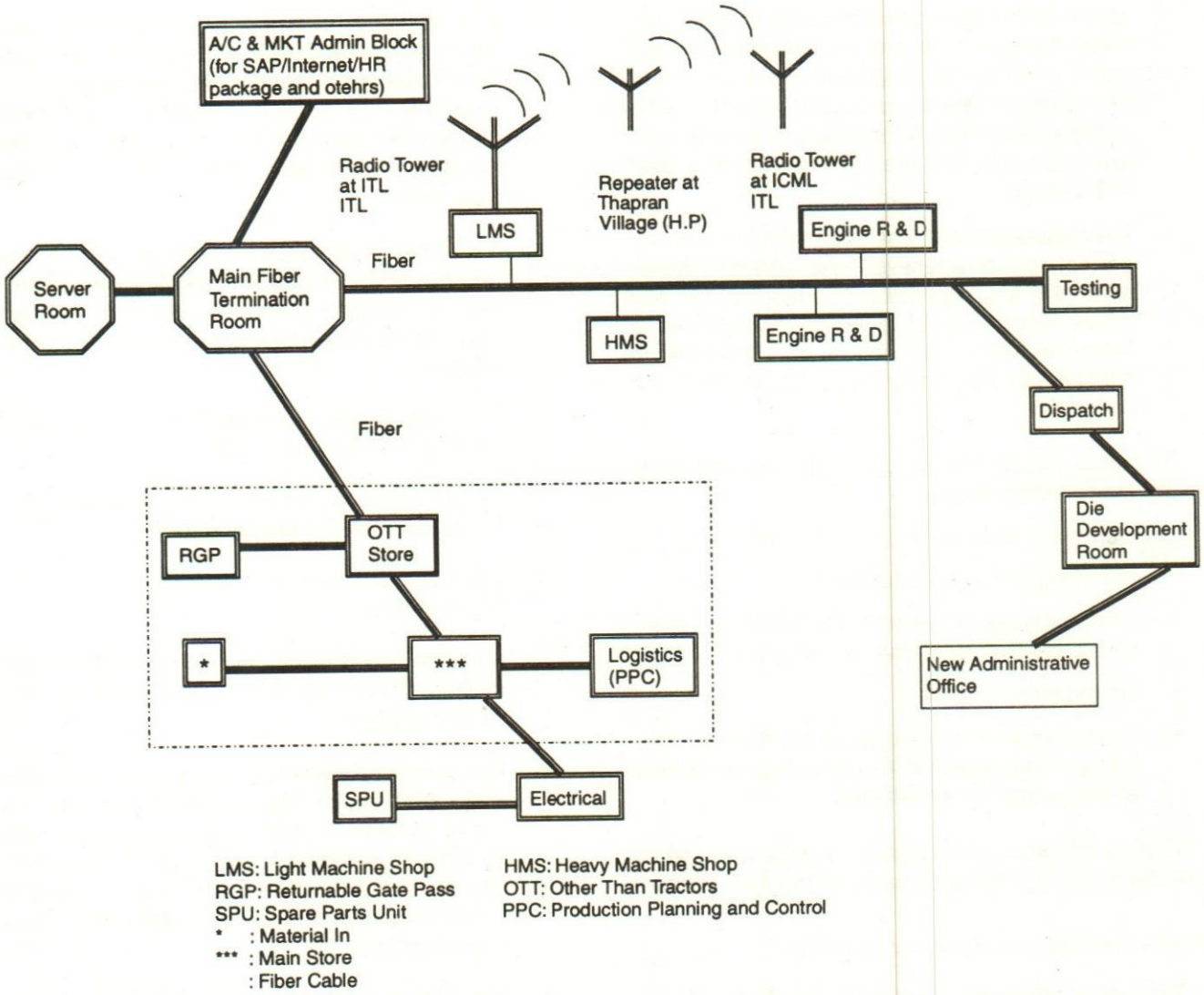


Fig. 3. Network Layout diagram of ITL Work Flow

nologies and reports because of unified framework and the global presence of SAP R/3, even if they are in different countries.

Technology architecture in terms of equipment and other technology support at ITL

Technology Architecture in terms of equipment

ITL is one of the pioneering business concerns equipped with the latest technology gazettes and tools. It has implemented not only the leading software solutions but also adopted the most modern hardware equipment for the software support. Annexure-6 shows the entire technology architecture established at ITL. ITL has 11 dedicated servers installed in a server room, which are controlling more than 250 workstations, 600 personal computers of ITL and 200 of ICML plant. These servers are also providing services of more than 500 printers of various categories, more than 15 plotters and high-resolution scanners to the users of both ITL and ICML plants of Sonalika group. ITL is moving towards success heights with tremendous pace by using the speed of communication. Fiber optic CAT 5 type communication media is used to connect all the terminals of organization and is managed at a special location i.e. in the main fiber termination room shown in the workflow diagram in Fig. 3. This sever room is connected to the various workstations and personal computers of different departments of ITL and ICML as shown in Fig. 3.

Server room consists of 11 server of high-end technology divided into 3 groups. In the first group there are: *Development Server, Quality Check Server and SAP*

Production Server. The second group of servers consists of (for providing web services and handling HR information): *HR Package Server, Web Server and Web Portal Server* and the third group consists of 5 servers (for the purpose of research and development of Engines and Tractors): *IDEA Server, NX Server, CATIA Server, TEAM CENTER Server of ITL and TEAM CENTER Server of ICML.* These servers are based on parallel computing architecture. All the servers are having 8 processors and 16 GB memory except the SAP production server, which consists of 10 processors (Xenon) and 64 GB memory. Moreover the organization runs Win 2000 Server operating system.

Special data room is employed for maintaining the data warehouse of the organization. This room consists of the RAID/Mirroring storage devices of the capacity of 1500 GB. It also contains backup devices such as LTO (Linear Tape Open), which are connected to the storage devices in order to take regular backup of the vital data. This data room is connected to the SAP Production Server.

The Development Server is being used by the ABAP programmers for adding new functionalities to the existing ones and then these are passed to the quality-checking server. If the newly added functionality is ok, then it is being passed to the SAP production server for the further use.

The second group of server maintains HR Information and runs in-house developed HR package (developed by using Oracle, Net Technologies by the EDP team of ITL). This package is compatible with the SAP Production Server and it does automatic postings to the SAP Production Server. Web server and Web portal servers are maintained for providing web services to the 800 Web account holders of ITL and 400 of ICML and Employee Information System facilities.

The third group of servers is dedicated for research and development activities of ITL and ICML. The company has implemented CAD software such as IDEA, NX, Team Center by UGS and CATIA CAD software from IBM. Entire technology architecture is shown in Fig. 4.

Other Technological Support at ITL

No doubt that after implementing SAPR/3, ITL has reaped variety of benefits in terms of revenue, performance, management and production, but it has got support of some other software packages along with SAP support. Some of the activities of those manufacturing organizations, which believe in massive research and development for enhancement of their processes, may not be supported by any ERP package alone. These manufacturing giants have to employ some other software solutions to support such activities. ITL has also implemented such packages. Some of them are in house developed. ITL has implemented IDEA, NX, CATIA and TEAMCENTER software for its Tractor and Engine R & D purposes. These software solutions are from renowned software providers such as UGS and IBM. All these software are CAD software for research and development of the various new parts of Tractors and Engines. IDEA, NX and TEAMCENTER from UGS and CATIA from IBM is used to support R & D purposes. ITL EDP team has also in-house developed HR package for handling HR activities. Though SAP R/3 is also leader in implementing HR module but because of some internal reasons company has decided to implement its own in-house developed HR package named ITL-HRMS. The package has complete compatibility with SAP R/3. Automatic postings of HR information are done in centralized database. The description of these is mentioned in technology architecture of ITL in Fig. 4.

Future ahead with SAP R/3

The case study discussed above reveals how Sonalika took the bold decision of implementing the world's leader in ERP solution i.e. SAPS R/3. Visualizing IT as a tool for achieving this objective, Sonalika endeavored to implement the SAP R/3 system at ITL. This step proved to be very fruitful for Sonalika, as the Return on Investment showed huge increase within three years of implementation of the new system. Within such short span of time, Sonalika was able to achieve what it was expecting in terms of revenue generation and management of activities in an automated environment. The company is now operating in a completely automated business system and hence leading the manufacturing companies of Punjab, and giving tough competition to other tractors manufacturing units in the whole of India. In fact with the successful implementation of this SAP R/3 ERP System, Sonalika has become courageous to control its ICML plant of Himachal Pradesh to produce multi-utility vehicles. ITL's future can be visualized as indeed a bright one with the use of SAP R/3 system at both the plants ITL at Hoshiarpur and ICML at District Amb of Himachal Pardesh state. It will help both the plants to operate in a smooth and integrated manner generating surplus revenue and increased return on investment. SAP R/3, because of its global presence has come out to be flexible and unified system, which has proved a boon for ITL,

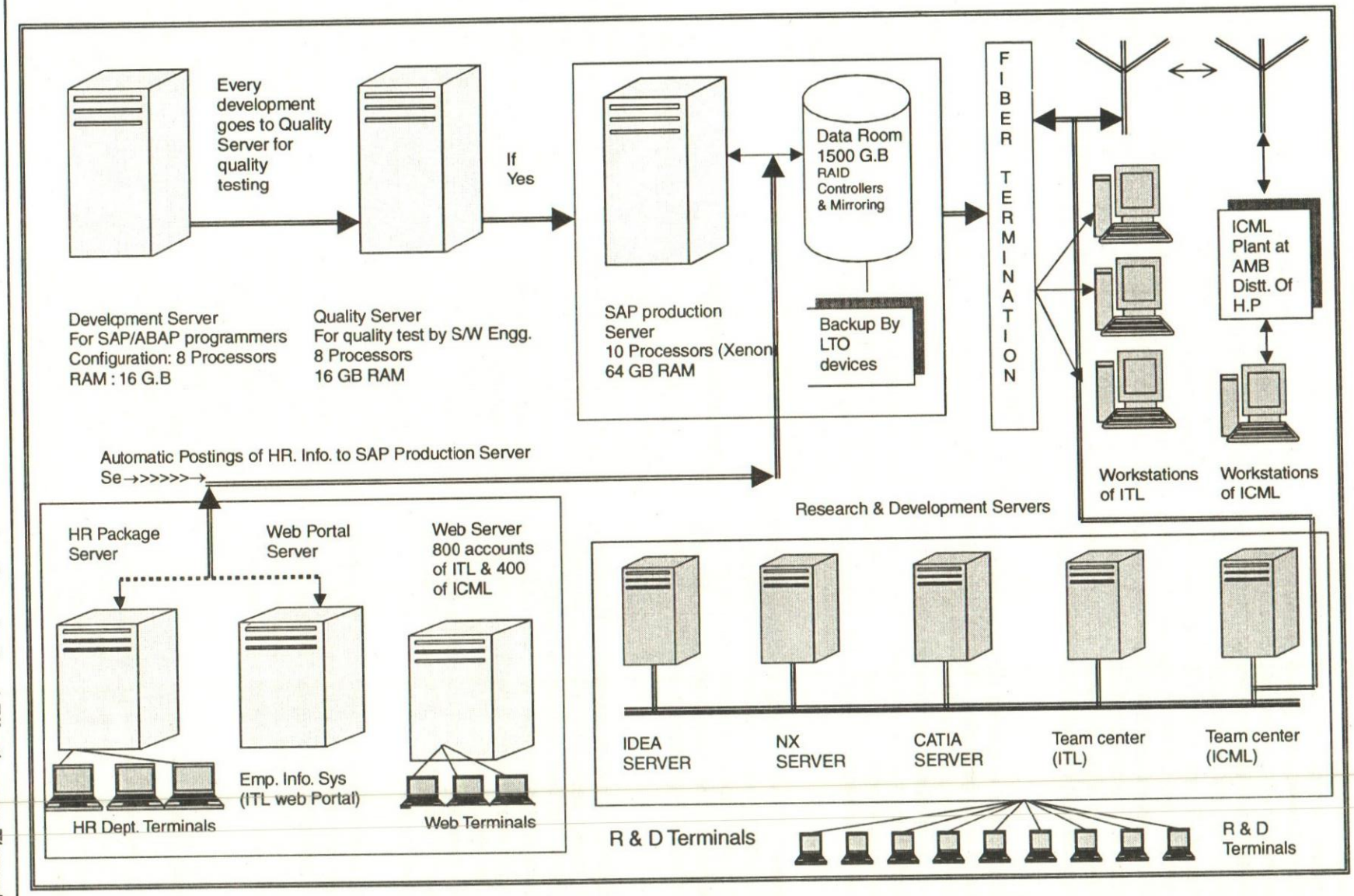


Fig. 4. Technology Architecture of ITL

and its foreign financial partners. The case highlighted above provides encouragement to the all those industrial units who are still using the outdated legacy systems to move towards an integrated ERP systems and ultimately deriving huge financial and operational benefits out of the new system.

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Many highly intelligent people are poor thinkers. Many people of average intelligence are skilled thinkers. The power of the car is separate from the way the car is driven.

– Edward de Bono

Feature

New Policy Regime and Productivity Growth of Manufacturing Sector in India

Inderjeet Singh, Ravi Kiran & Manpreet Kaur

Productivity has emerged as a key indicator of successful restructuring and upgrading by firms and industries in the face of intensified global competition and liberalized trade. The present study observes changes in industries after the 1991 reforms and analyses trends in value added, labour, capital as well as trends in labour and capital productivity for 17 industrial groups for the period 1980-81 to 2002-03 and also for two sub-periods, period I,1980-81 to 1990-91 and period II, 1991-92 to 2002-03. This study tries to examine the trends in partial productivities in the two periods to see whether there has been an improvement in productivity in the post-1981 period, the period associated with liberalization and globalization.

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An economy can grow if it creates the right conditions for development. Development means higher income and employment, which can be translated into higher standard of living. The industrial sector with its forward and backward linkages and its high employment potential holds the key to the economic development of the country. It is mainly through the growth of the industrial sector that real wealth is created.

The last decade following liberalization has seen revolutionary changes in the state of manufacturing in India. This has been through continual infusion of energy and commitment, in the form of ideas and initiatives. India has seen a large part of production and other value added jobs being transferred to its shores from all around the world. This has not only been because of the various advantages of India in terms of its human resource as well as being an attractive market destination, but the growth has been assisted by what may be termed as a revolution in the fundamental ways of thinking about manufacturing management. The competitive environment, which emerged after the liberalization of the economy, saw the development.

The nineties, i.e. the period associated with globalisation, liberalisation and privatization, has seen Indian companies developing core competencies in terms of technologies and managing the dynamism and opportunities that have come by over the years. These reforms were aimed at making Indian industry more efficient, technologically up-to-date, and with the expectation that efficiency improvement, technological upgradation, and enhancement of competitiveness would enable the Indian industry to achieve rapid growth.

In the face of intensified global competition and liberalized trade, productivity has emerged as a key indicator of successful restructuring and upgrading by firms and industries. Productivity growth has traditionally

been regarded as one of the main sources of income growth, along with capital accumulation and the increase in human capital development. These factors and the historically positive link between productivity, employment and earnings have made productivity improvement an important policy lever for economic development. Advocates of liberalization argue that opening up local markets to foreign competition and foreign direct investment will improve the productivity of domestic industry, resulting in more efficient allocation of resources and greater overall output. The effects of liberalization on productivity may be influenced by the initial level of financial development; the investor climate in the state, as well as labour regulations.

The reforms are set to provide an impetus to increase the competition, which in turn affects the productivity. The economic reforms are generally associated with increase in foreign direct investment, which leads to increase in productivity.

Productivity is the relationship between real output and input to produce a certain level of output. It measures the efficiency with which inputs are transformed into outputs in the production process. An increase in productivity occurs generally when more output is produced either with the same amount of input, or with less input, or with little increment in input. Higher productivity growth is associated with growth in capital intensity, labour productivity and in total factor productivity. TFP measures the efficiency of the utilization of both capital (K) and human resources or labour (L) in the production process. A higher total factor productivity growth (TFPG) indicates efficient utilization and deployment of resources such as raw materials and technical inputs needed for the productions of goods and services. Higher productivity brings about lower unit cost, higher product quality, better wages for workers, and better returns on investment. Porter (1990) and DRI McGraw Hill (1993) stressed that productivity is the prime determinant of a country's level of competitiveness, higher standard of living and sustained growth in the long run.

Productivity Growth during Pre-Eighties

Banerji (1975) analyzed partial productivity indices of labour and capital and total productivity index during the period 1946-64 (Table 1). The trend in the study shows that the performance of manufacturing sector was sluggish over the period 1946-64. While labour productivity showed significant up trend, no evidence was found to indicate the presence of technical progress in the sector. Mehta (1980) in a comprehensive study has calculated partial and total factor productivity indices for 27 large-scale industries. This study for Indian manufacturing shows that overall efficiency of the industrial sector declined during the period under study. Labour productivity had an increasing trend, while capital productivity had a declining decreasing trend along with rising capital output ratio and capital labour ratio increased at a fairly fast. Total productivity index registered a decline.

Table 1: Growth Accounting Estimates of Growth rate of TFP in Indian Manufacturing Sector during pre-eighties

Author	Period	Growth rate of TFP per cent per annum
Banerji, A.	1948-64	–1.6
Brahmanada (1982)	1950-80	–0.2
Mehta, M. (1980)	1953-65	–1.6
Goldar (1986)	1951-79	1.27

Goldar (1986) study covering the period 1951-79 has been divided into two sub-periods 1951-65 and 1959-79. Goldar computed both partial and total factor productivity indices for manufacturing sector as a whole. Goldar's study uses Kendrick index, Solow index and Translog index of total factor productivity. During the period 1951-65, the labour productivity and capital intensity showed an upward trend. The capital productivity recorded a decline of 1.14 per cent per annum. The average annual rate of growth was 1.27 per cent per annum during 1951-79. In the second sub-period Goldar has observed similarity in the results of partial productivity and capital intensity as in the first period. Goldar's estimates of TFPG for a composite sector including the large-scale registered manufacturing sector, tends to be relatively higher than the other estimates. The average annual rate of growth in case of Translog index was of the order of 1.31 per cent per annum. This was also higher as compared with Solow and Kendrick indices, which was of the order of 1.29 and 1.06 per cent per annum. Goldar's estimate for small-scale registered manufacturing is very similar to that for the large scale, i. e., 1.2 per cent per annum. Accordingly, Goldar has concluded that technological progress has contributed to output growth, though marginally, and growth in total factor productivity is sluggish.

Brahmanada's (1982) work incorporates both neo-classical and classical methodologies and has the whole span from 1950-51 to 1980-81 in its preview. The study shows evidence of a rising trend in productivity during 1950-51 to 1970-71. But thereafter a falling trend is reported in productivity. Between 1950-51 and 1970-71 the

simple index of composite factor productivity went up during the first decade at 0.77 per cent; during the second decade it went up at an annual rate of 0.87 per cent; but during the third decade it started declining. There is evidence, both on the basis of drift in capital productivity and composite factor productivity, that from 1970-71 onwards diminishing returns on the net seem to have set in organized manufacturing. Though labour productivity rose, capital productivity seemed to be falling at an alarmingly fast rate. This is also reflected in falling tendency in the rate of profit. In other words labour productivity did not increase at a high rate to overcome falling capital productivity.

Productivity Growth during Eighties and Nineties: The Post-Reform Period

Several recent studies (Table 2) have attempted to empirically estimate the differences in outcomes of post and pre-liberalization policies on the Indian manufacturing industries. Studies by Ahluwalia, I.J. (1985, 1991) for the period 1959 to 1985 examines total factor productivity. The studies show that during the two decades of the sixties and the seventies, total factor productivity in the manufacturing sector declined. However, there is also a finding that in the first half of eighties productivity growth improved. The dominant source of the acceleration in total factor productivity has been the growth of value added. The measure of TFPG used in the study is derived from a Translog production function under the assumption of competitive equilibrium.

Balakrishnan and Pushpangandan (1994) study TFPG for Indian manufacturing from 1970-71 to 1988-89. The statistical analysis confirms a turnaround if TFP estimates are derived from the value added single-deflation series. The point however is that if TFP index is derived by double-deflation there is an absence of an increase in the growth rate of TFP.

Rao (1996) used the "double-deflation" method for measuring TFP. The study suggests a rapidly declining TFP growth for the manufacturing industries after 1983. The Dholakia and Dholakia (1994) study on TFPG for Indian manufacturing from 1970-71 to 1988-89 reports that the annual growth of real value added in the Indian registered manufacturing sector, when measured through the single deflation method, shows remarkable acceleration during the 1980s as compared to 1970s (from 3 per cent to 8 per cent). On the other hand, when the same is measured through the double deflation method, the acceleration in growth rate is found to be:

Table 2: Growth accounting estimates of growth rate of tfp in indian manufacturing sector

Author	Period	Growth rate of TFP per cent per annum
Unel (2003)	1979-80	1.8
	1990-91	3.2
	1991-92	2.5
	1997-98	4.7
Gangopadhyaya and Wadhwa (1998)	1974-80	1.17
	1981-85	5.44
	1986-90	5.01
	1991-93	3.88
Trivedi and et al. (2000)	1973-80	1.04
	1980-90	3.60
	1990-97	1.97
Goldar (2000)	1981-90	4.52
	1991-98	1.86
Ahluwalia (1991)	1965-79	-0.3
	1980-85	3.4
Kiran, R. (1998)	1973-74 to 1992-93	.054
	1973-74 to 1981-82	–1.14
	1982-83 to 1992-93	0.61
Dholakia and Dholakia (1994)		
a) (Single deflation)	1970	3.0
b) (Double deflation)	1980	8.0
When weights for the 19 Input groups based on WPI (1970-71) are used	1970	3.5
	1980	11.2
Weights used by Balakrishnan and Pushpangandan	1970	7.5
	1980	8.1
Weights used by Dholakia and Dholakia	1970	5.9
	1980	9.8
Rao, J.M. (1996) (TFP) (Single deflation)	1973-74 to 1992-93	1.3
(Double deflation)		2.2
Balakrishnan, P., and Pushpangandan, K. (1994) (TFP)	1973-74 to 1988-89	.0002
(Single deflation)		
(Double deflation)		–.05

(i) much higher in the 1980s as compared to the 1970s (3.5 per cent to 11.2 per cent) when the weights for the 19 input groups based on WPI (1970-71) are used;

(ii) negligible during the 1980s as compared to the 1970s(7.5 per cent to 8.1 per cent) when weights for the whole manufacturing sector as considered by Balakrishnan and Pushpangandan (1994) are used; and

(iii) lower in magnitude but significant during the 1980s with 9.8 per cent growth as compared to 5.9 per cent during the 1970s weights used by Dholakia and Dholakia.

A study by Kiran, R. (1998) is an attempt to examine the changes in the growth of productivity in Indian manufacturing. The time period of the study is 1973-74 to 1992-93. The study reports an increase in productivity during 1983-84 to 1992-93, the period associated with slight liberalisation. A study by Sivadasan, J. (2003) examines the effect of removing licensing requirements, liberalizing foreign direct investment and reducing tariff rates on plant-level and aggregate productivity. The study covers the period from 1986-87 to 1994-94. For estimating the production function, a modified form of a recently proposed structural technique was used (Levin–Solm and Retrin, 2003). The study finds that delicensing and other micro-reforms had a significant positive impact on productivity. The study also depicted an increase in mean intra plant productivity level and also in the aggregate productivity growth following FDI liberalisation.

Some other studies have analysed the impact of India's economic reforms initiated in 1991 on the productive efficiency of India's manufacturing sector (Rajan and Sen 2002; Forbes 2001; Joshi and Little 1998; Srinivasan 1996). These studies have provided valuable insight into the impact of liberalisation, especially liberalisation of controls over trade. Although the reforms were initiated by Rajiv Gandhi, these reforms were piecemeal. They were appearing to have promoted growth and productive efficiency of the manufacturing sector (Ahluwalia 1991, 1995; Srivastava 1996; ICICI 1994). Empirical studies suggest that the trade reforms promoted total factor productivity (TFP) during the decade of eighties (Goldar 1986; Chand and Sen 2002). According to these studies, the manufacturing sector did respond to liberalisation and the high growth rate of the Indian economy during the nineties was due to continued structural reforms, including trade liberalisation, leading to efficiency gains (WTO, 2002). This view is supported by Krishna and Mitra (1998), who found that labour productivity and TFP was substantially higher in the nineties compared to the period up to 1990-91. Das, D. K. (2001), reports that a positive impact of the lowering of non-tariff barriers (NTBs) on the manufacturing as well as intermediate goods sector promoted the industrial productivity. Although Goldar and Kumari (2003) report a deceleration of TFP growth in Indian manufacturing in the 1990s, their analysis indicates that the lowering of effective protection of industries promoted productivity growth during the period 1991-98. The results also suggest that gestation lags in investment projects and slower agricultural growth in 1990s had an adverse effect on productivity growth.

Studies of Das, D. K. (2001, 2003), Kumari, A. (2001) and Srivastava, V. (2001) point out that TFP growth in the manufacturing sector worsened during the nineties compared to the eighties. Srivastava (2001) reports that the TFP growth rate in Indian manufacturing was 3.6 per cent per annum in the period from 1990-91 to 1997-98. Balakrishnan et al. (2000) also reports a significant decline in the growth rate of TFP since 1991-92 in five manufacturing industries and they fail to find a link between trade reforms and productivity in the nineties. The study by Kusum Das (1998) analysed 76 three digit industries covering the period 1980-81 to 1993-94. This study also found that productivity response to the trade policy reform is mixed. This study correlated the productivity growth with different measures of trade liberalisation. However, the results of this exercise show that in majority of the cases the trade liberalisation variable has a statistically insignificant positive relationship with productivity growth. A study on productivity trends in Indian manufacturing undertaken by Unel (2003) has concluded that total factor productivity (TFP) growth in aggregate manufacturing and many sub-sectors accelerated after the 1991 reforms.

The study by Balakrishnan et al. (2000) used firm level panel data of industries that faced greater reduction in trade protection for the period 1988-89 to 1997-98. This study found that productivity growth decelerated in the post-reform period. Srivastava (2001) reports that the total factor productivity growth rate in Indian manufacturing had declined during the period 1990-91 to 1997-98.

Study by Hulten and Srinivasan (1999) shows that there is little evidence of any positive impact from the initial economic reforms on TFP growth of the Indian manufacturing industries. The study, however, found that there were other positive impacts on investment, labour productivity and capital per worker from the economic reforms. Some of the studies have concentrated on examining the impact of economic reforms on the scale effects in the manufacturing industries in India. Fikkert and Hasan (1998) analyzed the returns to scale for a panel of selected Indian manufacturing industries for the pre-liberalization period from 1976 to 1985 using a restricted cost function. Although they found a large number of firms operating with increasing returns to scale, the results suggested that most of them were operating close to constant returns to scale. The study suggests that there are not significant gains in scale efficiency from the tentative steps in economic liberalization in the 1980s.

In a similar panel study using a production function from 1986 to 1993, Krishna and Mitra (1998) show that there are increasing returns to scale in electronics, transport equipment and non-electrical industries; and that there was an increase in exploitation of the scale economies after the economic liberalization. Das's (2003) estimates suggest that TFP growth in post-1991 reform period to be negative. Goldar (1986, 2000), Rao (1996), Gangopadhyaya and Wadhwa (1998) and Trivedi et.al. (2000) found acceleration in growth rate of TFP in Indian manufacturing during the decade of the 1980s. A study by Rath, B. and Madheswaran, S. (2004) examines total factor productivity growth during 1979-80 to 1997-98. Their analysis focuses on the trend of technical progress and technical efficiency change. The empirical result suggests that total factor productivity growth in a large number of industries have improved during 1979-80 to 1997-98.

Analysis of value added, labour, capital and partial productivity in Indian Manufacturing (1980-81 to 2002-03)

In the present study an analysis has been done for 17 industrial groups for the period 1980-81 to 2002-03 and also for two sub-periods, period I - 1980-81 to 1990-91 and period II - 1991-92 to 2002-03. The study also analyses the trends in the growth rate of capital and labour productivity for both the periods as well as for the entire period to examine whether there has been an improvement in partial productivity in the post-liberalization phase. The study also analyses the growth rates of value added, labour and capital for Indian manufacturing sector. The 1991 New Economic Policy is a major step towards liberalization. Deregulation of industry and exposing it selectively to competition from outside were believed to ultimately raise productivity and efficiency to international levels. It is with this view that the present study tries to examine the trends in productivity in the two periods to see whether there has been an improvement in productivity in the post-1981 period, the period associated with liberalization and globalization.

The present study uses the data from Annual Survey of Industries (ASI) for computing the labour and Capital Productivity for 17 two digit industries for the period 1980-81 to 2002-03 as well as for period I, 1980-81 to 1990-91 and Period II, 1991-92 to 2002-03, the post-liberalization phase. The capital series for productivity analysis have been generated by using the Perpetual Inventory Accumulation Method (Balkrishnan, P.et.al., 1994). In this study, the focus is on the empirical measurement of partial productivity. Partial factor productivity measures the ratio of output to one of the inputs setting aside interdependence of use of other output. Labour productivity (V/L) is measured as a ratio of value added to the total number of persons employed. Capital Productivity (V/K) is measured as a ratio of value added to gross fixed capital. The gross measure of value added is obtained by adding depreciation to net value added. The data on gross value added is deflated using industry specific wholesale prices (at 1993-94 prices).

For labour input, the total number of persons employed is used and for capital, gross fixed capital at replacement cost is used. Perpetual inventory method is used. The capital stock at any year is calculated as:

$$K_t = K_0 + \sum_{t=1}^{T} I_t$$

Where I_t, is investment in year t and K_0 is capital stock for benchmark year, i.e. 1980-81, Investment figures were obtained using the formula:

$$I_t = (B_t - B_{t-1} + D_t)/R_t$$

Where B is book value of fixed capital, D is depreciation. For R wholesale prices index of machinery (base 1993-94 =100) is used.

Analysis

Out of 17 industrial groups analysed, the value added is reported to be higher for nine groups in the pre-liberalization phase (Table 3). In eleven sectors, the rate of growth of labour has fallen in the second period of analysis. The rate of growth of capital is mostly positive for almost all sectors in both the periods and infact higher in 15 out of 17 in the post-liberalization phase. Value added is higher for the Wearing Apparel; Dressing and Dyeing of Fur sector#18, followed by manufacture of Furniture#36 (I), Manufacturing N.E.C#36 (II), Tanning and Dressing of Leather Manufacture of Luggage, Handbags Saddlery, Harness and Footwear#19, for the entire period of the analysis. The rate of growth of value added is low in manufacturing of Machinery and Equipment N.E.C#29, Manufacture of Office, Accounting and Computing Machinery#30, Manufacture of Electrical Machinery and Apparatus N.E.C., #31, Manufacture of Radio, Television and Communication Equipment and Apparatus#32, Manufacture of Coke, Refined Petroleum Products and Nuclear Fuel#23 and Manufacture of Rubber and Plastic Products #25. Manufacture of Wearing Apparel; Dress-

Table 3: Growth Rates of Value Added, Labour and Capital in Indian manufacturing (1980-81 to 2002-03)

Industry Code	Value added			Labour			Capital		
	Entire Period	Period I	Period II	Entire Period	Period I	Period II	Entire Period	Period I	Period II
15	11.11	12.76	8.76	0.77	–2.06	0.74	7.25	4.97	7.23
16	9.93	15.99	4.49	1.99	1.35	0.68	8.72	5.98	9.57
17	5.74	7.54	5.86	–1.46	–1.96	–2.48	6.79	3.37	6.81
18	16.01	10.01	9.61	9.25	5.54	9.46	13.75	7.14	13.40
19	12.58	11.03	3.24	5.77	9.81	2.26	9.94	4.43	8.27
20	11.66	6.13	14.86	–0.07	–1.54	1.23	5.99	3.52	7.07
21,22	7.80	6.08	4.69	0.42	–0.44	–0.58	6.59	3.75	6.94
24	12.22	8.21	8.35	3.08	3.15	2.58	10.63	10.86	8.59
23,25	5.32	–5.65	8.55	1.03	–5.92	2.16	4.74	–0.50	7.39
26	8.20	9.25	2.80	2.11	4.80	1.07	9.66	9.65	8.94
27	7.59	8.40	5.53	0.95	3.54	–1.43	6.33	3.91	4.73
28	10.67	8.28	5.62	3.50	4.98	2.17	7.48	3.81	6.86
29–32	4.06	0.30	1.26	1.83	4.74	–1.09	6.32	4.74	5.75
33	11.57	1.59	10.78	6.36	6.65	5.32	9.88	5.25	10.37
34,35	7.90	5.86	5.94	1.01	2.93	–1.72	5.71	2.60	6.97
36(I)	13.89	3.51	14.98	5.41	1.76	6.99	10.30	3.89	13.86
36(II)	13.65	1.39	12.83	7.38	4.85	7.71	11.33	4.63	14.46

Computed

ing and Dyeing of Fur#18 reports a higher growth in value added in pre-liberalisation period while in case of manufacture of Furniture 36 (I), Manufacturing N.E.C#36 (II), and Tanning and Dressing of Leather Manufacture of Luggage, Handbags Saddlery, Harness and Footwear#19 the rate of growth of value added is higher in the second period of analysis. In most of the studies the rate of growth of capital is higher for the post-1991 period while rate of growth of labour and value added is higher in the first period of analysis.

Analysis of the partial productivities (Table 4) depicts a mixed trend while the rate of growth of capital productivity is generally higher for ten sectors in period I, which is the pre-liberalization period and the labour productivity is higher for ten sectors in the second period of analysis. Out of 17 sectors, six sectors namely Manufacture of Wood and Products of Wood and Cork, except furniture; Manufacture of Articles Of Straw and Plating Materials, #20 Manufacture of Chemicals and Chemical Products#24, Manufacture of Coke, Refined Petroleum Products and Nuclear Fuel#23 and Manufacture of Rubber and Plastic Products#25, Manufacture of Medical, Precision and Optical Instruments, Watches and Clocks#33, Manufacture of Furniture#36(I), Manufacturing N.E.C #36(II) report higher capital productivity in the post-liberalization phase. Labour productivity is increasing in ten sectors in the post-liberalisation phase. The sectors, namely manufacture of wood and of products of wood and cork, except furniture; Manufacture of Articles of Straw and Plating Materials#20 depicts a higher labour and capital productivity in the entire period.

Similarly, the food products group has a labour productivity of 10.27 and capital productivity of 3.61 for the entire period. The two sectors manufacture of Coke, Petroleum Products Manufacture of Rubber and Plastic Products#23, 25, Manufacture of Machinery and Equipment 29-32, depicts lower growth rates in both labour and capital productivity for the entire period under study. The performance in terms of productivity is low as well as the rate of growth of value added is less.

Nothing specific can be said at this stage as a view of partial productivities and value added and inputs depicts one side of the picture. An analysis of total factor productivity can give us better insight into the performance of the manufacturing sector as a whole. But the trends do depict a higher growth of capital productivity in the first period of analysis, i.e. the pre-liberalisation phase in

nine out of 17 of the sectors, while labour productivity is reported to be higher in seven sectors in the pre-1991 period.

Table 4: Growth Rates of Labour Productivity and Capital Productivity in Indian manufacturing (1980-81 to 2002-03)

Industry Code	Labour Productivity			Capital Productivity		
	Entire Period	Period I	Period II	Entire Period	Period I	Period II
15	10.27	15.13	7.96	3.61	7.43	1.42
16	7.78	14.45	3.78	1.12	9.45	–4.64
17	7.31	9.69	8.55	–0.98	4.03	–0.89
18	6.18	4.90	0.13	1.99	3.34	–3.35
19	6.44	1.12	0.95	2.41	6.32	–4.64
20	11.74	7.80	13.47	5.36	2.53	7.27
21,22	7.34	6.54	5.30	1.13	2.25	–2.11
24	8.91	4.91	5.62	1.49	–2.39	–0.23
23,25	4.24	0.29	6.25	0.55	–5.17	1.08
26	5.96	4.25	1.71	–1.33	–0.37	–5.64
27	6.58	4.70	7.06	1.19	4.32	0.76
28	6.93	3.14	3.38	2.97	4.31	–1.17
29–32	2.18	–4.25	2.38	–2.13	–4.24	–4.24
33	4.90	–4.75	5.19	1.54	–3.48	0.37
34,35	6.83	2.85	7.79	2.08	3.18	–0.96
36(I)	7.80	1.72	7.46	3.02	–0.37	0.98
36(II)	5.83	–3.30	4.75	2.08	–3.10	–1.42

Computed

Conclusion

Although India moved over to the slight liberalization phase, India initiated various reforms in the economy since the 1990s. The reforms were undertaken in order to increase the productivity and efficiency and ready to face the global challenges.

Studies by Sivadasan, J. (2003) Kiran, R. (1998) Goldar (1986, 2000); Chand and Sen (2002), 2002 Krishna and Mitra (1998) Das, D. K. (2001), Unel (2003), Rao (1996) Gangopadhyaya and Wadhwa (1998) and Trivedi et.al. (2000) Rath, B. and Madheswaran, S. (2004) show that there is increase in productivity in the period of eighties, the period associated with slight liberalisation phase. Trivedi et al. (2000), using value added (single deflated as well as the double deflated) approach, found that the growth rate of TFP was positive in the 1990s, but that it was lower than in the 91980s.

Balakrishnan and Pushpangadan (1994) picked the weights for 19 input groups from the input-output table and the weighted price indices for these input groups are combined to reach at a price index for materials in Indian manufacturing. Rao's study (1996) did not support any turnaround in the 1980's and hence his results came out to be in agreement with Balakrishnan & Pushpangadan. Dholkia and Dholkia (1994) argued that the weights picked from input-output table are incorrect as they pertain to the unregistered manufacturing also. They computed the correct weights for the registered manufacturing sector and using the same method i.e. double deflated value added approach, they reported acceleration in the 1980s. Therefore estimates provided by Dholkia and Dholkia are in sharp contradiction to those of Balakrishnan and Pushpangadan. From the nineties onwards no conclusive evidence can be drawn as Goldar's study (2000) claims that the decade of the 1980s has been a period of rapid TFP growth in the Indian manufacturing. However, according to the study the pace could not be maintained in the subsequent years. Trivedi et al. (2000), using value added (single deflated as well as the double deflated) approach, found that the growth rate of TFP was positive in the 1990s, but it was lower than in the 1980s.

But overall from the earlier studies the results about the impact of the 1991 reforms on the productivity growth of manufacturing sector are mixed. No conclusive evidence can be drawn from these studies. The reason may be the differences in the methodologies used in different studies and the issues related with the measurement of inputs especially the capital.

Analysis of the partial productivity depict a higher growth of capital productivity in the first period of analysis, i.e. the pre-liberalisation phase in ten out of 17 the sectors, while labour productivity is reported to be higher in nine sectors in the post-1991 period, the period associated with liberalisation. Value added is highest for Manufacture of Wearing Apparel; Dressing and Dyeing of Fur#18,followed by, manufacture of Furniture36 (I), Manufacturing N.E.C#36 (II), Tanning and Dressing of Leather Manufacture of Luggage, Handbags Saddlery, Harness and Footwear#19 for the entire period of the analysis.

There was a decline in absolute number of persons engaged in organized manufacturing from 8,319,563 in 1991-92 to 7,935,948 in 2002-03, which is a cause of concern. A bias towards capital intensive technology could be a reason for decline in employment. Another reason could be poor performance on the productivity front by labour intensive manufacturing sub-sector like leather and leather products in the second period of the analysis.

Table 5

Industry Code	Description
15	Food Products
16	Beverages and Tobacco Products
17	Manufacture of Textiles
18	Manufacture of Wearing Apparel; Dressing and Dyeing of Fur
19	Tanning and Dressing of Leather Manufacture of Luggage, Handbags Saddlery, Harness and Footwear
20	Manufacture of Wood and of Products of Wood and Cork, Except Furniture; Manufacture of Articles Of Straw and Plating Materials
21,22	Manufacture of Paper and Paper Products and Publishing, Printing and Reproduction of Recorded Media of India
24	Manufacture of Chemicals and Chemical Products
23,25	Manufacture of Coke, Refined Petroleum Products and Nuclear Fuel and Manufacture of Rubber and Plastic Products
26	Manufacture of other Non-Metallic Mineral Products
27	Manufacture of Basic Metals
28	Manufacture of Fabricated Metal Products, Except Machinery and Equipments
29,30,31,32	Manufacture of Machinery and Equipment N.E.C, Manufacture of Office, Accounting and Computing Machinery, Manufacture of Electrical Machinery and Apparatus N.E.C., Manufacture of Radio, Television and Communication Equipment and Apparatus
33	Manufacture of Medical, Precision and Optical Instruments, Watches and Clocks
34,35	Manufacture of Motor Vehicles, Trailer and Semi-Trailers, Manufacture of Other Transport Equipment
36I	Manufacture of Furniture
36II	Manufacturing N.E.C

Nothing specific can be said at this stage as a view of partial productivity and value added and inputs depicts one side of the picture. An analysis of total factor productivity can give us better insight into the performance of the manufacturing sector as a whole. But the trends do depict a higher growth of capital productivity in the first period of analysis, i.e. the pre-liberalisation phase in nine out of 17 of the sectors, while labour productivity is reported to be higher in seven sectors in the pre-1991 period.

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As users, we typically want our technology to be a black box; we don't want to be bothered with adjusting it, monitoring it, repairing it, or knowing about its inner workings. A sure sign of the success of a technology is that we scarcely think of it as technology at all.

– Steven Shapin

Feature

India's Progress in Infrastructure Development

T. Koti Reddy

Infrastructure is an essential input for economic development and the link between infrastructure and development is a continuous process. Industrial progress depends on the development of the generation of electricity, transport and communication. In India there is a need to introduce an appropriate policy framework, which gives the private sector adequate confidence and incentive to invest on a massive scale. To attain an annual GDP growth rate of 9 per cent, it is necessary to accelerate the rate of investment in infrastructure. In this paper an attempt is made to analyze the progress of some of the most important constituents of economic infrastructure - power, transport and communication - which are the essential ingredients to promote economic development in India.

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The heavy investments on infrastructural facilities are easily justified since they have provided the necessary inputs for rapid agricultural development and industrial expansion. The concentration of infrastructure in urban areas and the relative neglect of rural areas and the consequent exodus of the rural poor to urban areas, leads to problems such as urban congestion, growth of slums, acute housing shortage, transport bottlenecks and so on. For the development of infrastructural facilities during the eleventh five-year plan, an investment of $ 492 billion would be required. These investments are to be achieved through a combination of public investment, public – private partnerships (PPP) and exclusive private investment, wherever feasible. Investment requirement in some key infrastructure by 2012 is estimated at Rs 220,000 crore for modernization and upgradation of highways, Rs 40,000 crore for civil aviation, Rs 50,000 crore for ports and Rs 300,000 crore (of which 40 per cent is expected to come from the private sector through PPP) for the railways. This kind of investment is required if India is to attain a sustainable growth rate of 9 per cent with emphasis on a broad-based and inclusive approach that would improve the quality of life and reduce disparities across regions and communities.

During 2006-07, the investment in infrastructure was 5 per cent of the total GDP. But if the economy was to continue to grow at 9 per cent, then the share of investment in infrastructure would also have to go up to 9 per cent by 2011-12. To achieve this figure a total investment of $ 492 billion was required over the next five years. From a global viewpoint this might not be a large figure but in the Indian context it meant that the extra money had to be raised. The Planning Commission envisages that 30 per cent of this amount or nearly $ 145 billion will come from the private sector. According to the Planning Commission the private sector would invest about 74 per cent in ports and airports, 67 per cent in telecom, 36 per cent in roads, 26 per cent in power generation and

Table 1: Trends in growth of Physical output in infrastructure sectors (in percentage)

(Apr-Dec)

Item	2002-03	2003-04	2004-05	2005-06	2005-06	2006-07
I Energy						
1) Coal Production	4.6	5.1	6.4	6.4	6.2	4.5
2) Electricity Generated (utilities only)	3.2	5.1	5.2	5.1	4.8	7.5
3) Petroleum						
a) Crude Oil Production	3.4	0.7	1.8	-5.3	-6.0	6.0
b) Refinery throughput	4.9	8.2	4.3	2.1	0.5	12.6
II Steel	7.3	9.8	8.4	11.2	10.7	9.7
III Cement	8.8	6.1	6.6	12.3	10.9	9.9
Average growth rate of I to III	5.0	6.1	5.8	6.1	5.5	8.3
IV Transport and communications						
Railway revenue earning goods traffic	5.3	7.5	8.1	10.7	10.7	9.7
Cargo handled at major ports	9.0	10.0	11.3	10.3	12.6	8.3
Telecom - Cell Connections	119.2	115.3	10.4	89.4	55.4	107.31
Civil Aviation						
a) Cargo handled						
i) Exports	13.3	1.0	12.4	7.3	13.1	-1.3
ii) Imports	18.6	13.4	24.2	15.8	12.7	19.6
b) Passengers handled at						
i) International Terminals	4.8	6.5	14.0	12.8	12.7	11.8
ii) Domestic Terminals	9.6	13.1	23.6	27.1	21.9	37.0

Source: (1) Item No I to III, Ministry of Commerce & Industry

(2) Item No. IV, Ministry of Statistics and Programme Implementation

17 per cent in Railways. Of the private sector's share of $ 145 billion about 30 per cent or $ 44 billion could come from equity and the remaining $ 101 billion through debt. In the public sector share too $ 140 billion of the $ 240 billion would have to be raised through debt.

Targets during the Eleventh Five-Year Plan:

- Additional power generation capacity of about 70,000 MW and ensuring that electricity is provided to all electrified hamlets.
- Providing six lanes in the 6,500 km of the Golden Quadrilateral and selected national highways.
- Constructing another 6,736 km on the North-South and East-West Corridors.
- Constructing another 12,109 km of National High-ways, widening of 20,000 km of National High-ways to two lanes, developing 1,000 km of expressways, constructing 8,737 km of roads, including 3,846 km of National Highways in the North East.
- Construction of 165,244 km of new rural roads, and renewing and upgrading an existing 192,464 km, covering 78,304 rural habitations.
- Laying down 10,300 km of new railway lines and gauge conversion of 10,000 km. Modernization and redevelopment of 21 railway stations. Introduction of private entities in container trains for rapid addition of rolling stock and capacity.
- Capacity addition of 485 million tonnes in major ports, 345 million tonnes in minor ports.
- Modernization and redevelopment of four metro and 35 non-metro airports, constructing seven Greenfield airports and three airports in the North East.

It is evident from table 1 that the growth in coal production has increased from 4.6 per cent in 2002-03 to 6.4 per cent in 2005-06. During the first nine months of 2006-07 coal production grew by 4.5 per cent as against 6.2 per cent achieved in the corresponding periods of the previous year. The growth in crude oil

production has come down from 3.4 per cent in 2002-03 to (-5.3%) in 2005-06. Growth in electricity generation on utilities in 2002-03 was 3.2 per cent, but it increased to 4.8 per cent in 2005-06. Electricity generation grew by 7.5 per cent in April to December 2006-07 as against 4.8 per cent achieved in the corresponding period of the previous year. The growth in steel and cement in general is indeed quite impressive. Railway revenue earnings, goods traffic, cargo handled at major ports, passengers handled at international terminals and domestic terminals registered an acceleration in growth rates, but there was a decline in the growth rates of civil aviation (cargo handled exports and imports) and telecom cellphone connections.

During the first nine months of 2006-07 crude petroleum, refinery products and electricity generation registered an acceleration in growth rates, but there was a decline in the growth rates of coal, cement and finished steel. The objective of this paper is to review the trends in most important constituents of infrastructure – power, transport and communication.

Power

Electricity, which is one form of energy, is an essential ingredient of economic development and is required for commercial and non-commercial uses. Commercial uses include the use of electricity in industries, agriculture and transport. Non-commercial uses include electricity required for domestic lighting, cooking, mechanical gadgets like refrigerators, air conditioners etc. With the growth of population and with the increase in the use of modern gadgets in daily life, it is quite natural that the demand for electricity for domestic use should grow at a faster rate.

Access to electricity also improves living standards and raises the levels of social and economic development. Immense social benefits accrue from electrical connections at home for children. A regular good quality power supply has also been shown to boost agricultural productivity, post-harvest processing of agricultural commodities, cold storage facilities and up to the minute access to price and market information, allowing farmers to expand their markets. The availability of power also gives a boost to the non-farm sector, as village economies are transformed by the availability of power through mechanization and productivity increase. Studies also point out that tariff for power, the quality of supply and the extent of access are closely related.

It is observed from table 2 that there is a direct correlation between the degree of economic growth, the size of real per capita income and per capita consumption of electricity. The greater the degree of economic growth the higher is the real per capita income of a country, and the higher is the per capita electricity consumption. Electricity consumption in India has been steadily increasing, although in per capita terms it is still much lower than that of developed countries.

Table 2: Electricity consumption per capita (In Kilowatt – Hrs)

S. No	Country	Year 1980	Year 2003	GDP Per capita PPP 2004 (US $)
1	Norway	22400	25295	38454
2	Iceland	13838	29412	33051
3	Australia	6599	11446	30331
4	Japan	4944	8212	29261
5	United States of America	10336	14057	39676
6	France	4633	8319	29300
7	China	307	1440	5896
8	India	173	594	3139
9	Pakistan	176	493	2225
10	Nepal	17	91	1490
11	Bangladesh	30	45	1870

Source: Human Development Report 2006, page no. 353

Table 3: Tenth plan targets and achievements in power sector (by type) (in MW)

Item	Target		Additional Capacity		Status
	Original	Mid–Term appraisal	Commissioned	Under execution	Overall anticipation
Thermal	25417	23261	10129	3535	13664
Hydro	14393	11125	7196	990	8186
Nuclear	1300	2570	1180	220	1400
Total	41100	36956	18505	4745	23250

Source: Economic Survey, 2006-07, page no. 182

It is evident from table 3 that the tenth plan capacity additional target of 41,110 MW was scaled down to 36,956 MW at the time of mid-term appraisal. The likely achievement is expected to be around 23,250 MW, which is 57 per cent of the original target and 63 per cent of the target in the mid-term appraisal.

It can be seen from table 4 that thermal power that is generated by coal and oil has always been the major source of electric power in India. In absolute terms installed capacity of thermal power had increased from

48,086 MW in 1991-92 to 77,974 MW in 2003-04, but in relative terms the share of thermal power decreased from 69.92 to 69.19%. Hydro and wind power is a renewable natural resource. In 1991-92 the installed capacity of hydro and wind power was 19194 MW but by 2003-04 it had increased to 31,995 MW. In relative terms, it had increased from 27.79 per cent to 28.39 per cent. Nuclear power accounts for 2.5 per cent of the total installed capacity of the electricity.

Table 4: Installed electricity Generation Capacity (in MW)

Year	Thermal	Hydro+ Wind	Nuclear	Total
1991-92	48,086 (69.62)	19,194 (27.79)	1,785 (2.58)	69,065 (100)
1995-96	60,083 (72.13)	20,985 (25.19)	2,225 (2.67)	83,293 (100)
1999-00	70,493 (71.79)	25,012 (25.47)	2,680 (2.7)	98,185 (100)
2003-04	77,974 (69.19)	31,995 (28.39)	2,720 (2.41)	112,682 (100)
Compound Growth percentage over (1991-04)	4.11	4.35	3.67	4.16

Source: Economic survey, 2004-05

Note: Figures in brackets are percentage of total installed capacity

The compound growth of installed electricity generation capacity during the period 1991-2004 was 4.16 per cent. The compound growth in thermal power generation for the period 1991-2004 was 4.11 per cent. Similarly the average annual growth of hydro and wind power was 4.35 per cent and the rate of growth of nuclear power generation averaged 3.67 per cent per annum during 1991-2004 (table 4).

To meet the projected power requirement by 2012 an additional capacity 100,000 MW is required during the 10th and 11th five year plans. A capacity of nearly 41,110 MW (thermal: 25416.24 MW) is targeted to be achieved in the tenth plan and the eleventh plan was to have a stronger focus on hydro power. The central sector would contribute 22,832 MW (thermal 12,790 MW), the state sector 11,157 MW (thermal 6675.64 MW) and private sector 7,121 MW (thermal 5950.6 MW) in the X plan. However, as per the latest review, the likely capacity addition during the 10th plan is 30,700 MW.

The installed power generation capacity in the country has increased from 1400 MW in 1947 to 124,287.17 MW as on 31st March, 2006, comprising 82,410.54 MW thermal, 32,325 MW hydro, 6,190.86 MW renewable energy sources and 3360 MW nuclear. A capacity addition programme of 19682 MW has been fixed for 2006-07 considering the fact that a large chunk of proportion of the installed capacity will come from the public sector. The outlay for the power sector has been raised from Rs 45,591 crore during the IXth plan to Rs 143,399 crore in the Xth plan. This would include a gross budgetary support of Rs 25,000 crore and the remaining Rs 118,399 crore would be internal and external budgetary resources. Power generation during 2005-06 was Rs 617.510, comprising 497.214 BU's thermal and 103.057 BU's hydro. The target of power generation for 2006-07 has been fixed at 663 BU. The plant load factor has shown a steady improvement over the years and has improved from 52.8 per cent in 1990-91 to 73.6 per cent in 2005-06.

The government has launched the accelerated power development reforms programme which aims at the upgradation of the sub-transmission and distribution system in the country and improvement in commercial viability of state electricity boards, by reducing the aggregate technical and commercial losses to around 15 per cent as against the existing order of 50 per cent. The central government provides additional central assistance to the states for strengthening, upgradation and distribution work.

In order to stimulate the growth of small-scale industries and promote a more balanced and diversified economy, rapid rural electrification was found necessary and was pursued vigorously at both central and state levels. The progress of percentage of villages electrified among all villages is given in table 5. Between 1990 and 1999, the percentage of villages electrified on an average had increased from 87.04 per cent to 92.30 per cent. By 1999, 92.30 per cent of the total number of villages had been electrified. The proportion of villages electrified among all villages in 1999 was 100 per cent in Haryana, Kerala and Punjab; 99.92 per cent in Andhra Pradesh, 99.62 per cent in Tamil Nadu, 99.51 per cent in Gujarat, 92.30 per cent in West Bengal, and 73.30 per cent in Orissa.

In the early stages, the emphasis was on village electrification. However, the serious famines of the mid-sixties focused attention on the need to stabilize agriculture through exploitation of ground water resources. For this purpose, the energisation of pumpsets was considered important and hence the emphasis shifted from village electrification to energisation of pump sets. The setting up of the rural electrification corporation has helped to accelerate the speed of electrification in the rural areas in an organized manner. The progress of number of pump sets energized per 100 people is given in table 6.

Table 5: Rural Power availability Index (percentage of villages electrified among all villages)

State	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Andhra Pradesh	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	99.92	99.92
Bihar	68.42	69.21	69.67	70.35	70.66	70.74	70.81	70.85	70.86	70.87
Gujarat	99.25	99.25	99.25	99.25	99.25	99.25	99.25	99.44	99.49	99.51
Haryana	99.79	99.79	99.79	99.79	99.79	99.79	99.79	100.00	100.00	100.00
Himachal Pradesh	98.61	98.61	98.61	98.61	98.61	98.61	98.61	97.87	97.87	98.95
Karnataka	97.85	97.85	97.85	97.85	97.85	97.85	97.85	97.71	98.51	98.56
Kerala	88.08	88.08	88.08	88.08	88.08	88.08	88.08	100.00	100.00	100.00
Madhya Pradesh	83.92	88.09	90.68	91.53	92.58	94.00	94.71	69.86	95.01	95.43
Maharastra	96.77	96.77	96.77	96.77	96.77	96.77	96.77	100.00	100.00	100.00
Orissa	64.03	66.98	69.13	69.55	70.03	70.51	72.08	94.37	71.56	73.30
Punjab	99.31	99.31	99.31	99.31	99.31	99.31	99.31	100.00	100.00	100.00
Rajastan	69.09	71.31	73.30	75.11	76.99	78.84	80.82	88.56	90.40	92.21
Tamil Nadu	99.57	99.58	99.62	99.62	99.62	99.62	99.62	99.62	99.62	99.62
Uttar Pradesh	71.24	73.19	73.85	74.69	75.27	75.65	76.81	77.20	77.95	78.58
West Bengal	69.62	72.76	73.91	75.06	75.99	76.80	77.04	77.21	77.34	77.56
Average	87.04	88.05	88.67	89.04	89.39	89.72	90.10	91.51	91.90	92.30

Source: Government of India, Reports of the rural electrification corporation

Note: Higher Index numbers indicate greater availability of power.

Cited in the India Rural Infrastructure Report, 2007, 'National Council for Applied Economic Research,' Sage Publications, p. 110

Table 6: Rural power access Index (Number of pump sels energized per 100 people)

S.No	State	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
1.	Andhra pradesh	2.25	2.45	2.54	2.77	2.96	3.14	3.20	3.52	3.51	3.60
2.	Bihar	0.34	0.34	0.34	0.34	0.34	0.34	0.33	0.33	0.33	0.32
3.	Gujarat	1.59	1.71	1.73	1.81	1.86	1.91	1.95	2.01	2.08	—
4.	Haryana	2.74	2.89	2.93	3.00	2.99	2.98	2.96	2.93	2.90	2.91
5.	Himachal Pradesh	0.07	0.07	0.08	0.08	0.08	0.08	0.08	0.09	0.09	0.09
6.	Karnataka	0.21	2.39	2.54	2.68	2.80	2.95	3.05	3.12	3.19	3.34
7.	Kerala	0.95	1.04	1.12	1.21	1.26	1.32	1.38	1.42	1.48	1.58
8.	Madhaya Pradesh	1.57	1.76	1.81	1.88	1.92	1.98	2.03	2.09	2.15	2.20
9.	Maharashtra	3.05	3.34	3.39	3.49	3.59	3.76	3.94	4.03	4.12	4.12
10.	Orissa	0.17	0.19	0.20	0.21	2.09	0.23	0.24	0.24	0.24	0.25
11.	Punjab	3.80	4.21	4.16	4.24	4.40	4.46	4.58	4.63	4.64	4.67
12.	Rajasthan	1.03	1.15	1.17	1.22	1.27	1.32	1.36	0.89	1.45	1.49
13.	Tamil Nadu	3.44	3.59	3.62	3.72	3.81	3.90	3.99	4.06	4.14	4.21
14.	Uttar Pradesh	0.57	0.59	0.59	0.59	0.61	0.61	0.62	0.62	0.62	0.62
15.	West Bengal	0.16	0.18	0.18	0.18	0.19	0.19	0.19	0.19	0.19	0.19
	Average	1.46	1.73	1.76	1.83	2.01	1.94	1.99	2.01	2.08	2.12

Source: Government of India reports of the Rural Electrification Corporation

Sited, in India Rural Infrastructure Reports, 2007, 'NCAER', Sage Publications, P. No. 109

Note: Higher Index numbers indicate greater access to power

Between 1990 and 1999, on an average, the number of pump sets energized per 100 people had increased from 1.73 to 2.12. The proportion of the number of pump sets energised per 100 people in 1999 was 4.67 in Punjab, 4.12 in Maharashtra, 3.60 in Andhra Pradesh, 3.34 in Karnataka and 0.09 in Himachal Pradesh. It is

observed that the number of pump sets energized per 100 people was high in Punjab and low in Himachal Pradesh.

Transport

Transport is an integral part of the production of nearly all goods and services and improvements in transport will contribute to a more efficient combination of factor inputs. The transport system can contribute to poverty reduction by enabling the productive activities that create pro-poor economic growth and by providing the poor, especially those living in rural areas, with access to economic opportunities and social services and a means of participating fully in society. The main objective of development planning in India is higher growth in GDP.

Indian planners gave high priority to the development of transport. In their opinion 'an efficient and well developed system of transport and communication is vital to the success of a plan of economic development which lays stress on rapid industrialization' (Second five year plan (1956-61) p.459, cited in Ruddar Datt & K P M Sundaram, 1997, Indian Economy).

Transport development since 1950-51 has registered impressive progress, but its overall performance is poor and there is wide disparity among states. For example in Karnataka only 0.4% of villages were unconnected in 1997, while in Madhya Pradesh (inclusive of Chattisgarh), the comparable figure is as high as 71.6 per cent. The percentage of unconnected villages in Bihar is around 52 per cent. Many villages still rely on earth tracks, which are unsuitable for motorized traffic, because of the poor riding quality and which become practically impassible during the rainy season because of missing bridges and culverts. Much of the network is underdeveloped, poor quality, structurally weak and poorly maintained. The lack of roads means that 20 to 30 per cent of the agricultural, horticultural and forest produce gets wasted because it cannot be transported to marketing and processing centres (India Rural Infrastructure Report 2007, NCAER, Sage Publications, p. no. 50).

During 2007-08 (BE) the transport sector was provided with the third largest pool of resources of Rs 71,589.02 crore to be spent on the development of Railways, ports, shipping, civil aviation, roads and bridges and inland water transport. Rs 18,861 crore has been proposed for the Ministry of Shipping, Road Transport and Highways, Rs 33,153 crore for the Power Ministry and Rs 28,674 crore for the Human Resource and Development Ministry (Budget document 2007-08).

In India it is estimated that the demand elasticity of transport services with respect to GDP ranges from 1.2 to 1.4. Assuming that for the next five years India's economy grows at the same pace as for the last decade (i.e. 6 to 7%), the demand for transport could be projected to grow at 8 to 9%.

Road Transport

India has one of the largest road networks in the world, aggregating to 3.34 million kilometres. The country's road network consists of expressways, National Highways, State highways, major district roads, other district roads and village roads. The road network comprises 66,590 kms of national highways, 128,000 kms of state highways, 470,000 kms of major district roads and about 2,650,000 kms of other district and rural roads. The National Highways comprise only about 2 per cent of the total length of roads and carry about 40 per cent of the total traffic across in the country. Out of the total length of National Highways, 32 per cent is single lane/ intermediate lane, 56 per cent consists of 2-lane standard and the remaining 12 per cent is 4-lane standard or more (Economic Survey 2006-07, p. 191).

By November 30, 2006, 6,776 kms of National Highways pertaining to the National Highway Development Programme had been completed, the bulk of which (5,475 kms) lies on the golden Quadrilateral. The ongoing National Highway Development Programme (NHDP) will provide a significant boost for the road transport industry, enabling truckers to cover longer distances in single trips. Four-lane divided highways will allow greater use of multi-axle vehicles, with operating costs substantially less than those of medium-sized rigid trucks.

Rail Transport

Indian Railways in one of the largest railway systems in the world. The Railways has played an integrating role in the social and economic development of the country. The Railways also has the advantage of being less energy intensive and more environment friendly. The concept of establishing a rail network in India was first coined by the British, considering the huge size of the country, and also considering political, strategic and economic expediencies. Thus the first railways in the subcontinent came into being on 16th April, 1853. It ran over a stretch 21 miles from Bombay to Thane. In the next year, a line was opened in Calcutta. A special feature of the development of the Railways in India was that in many regions, it went side by side with India's industrial progress.

The cotton mill industry in Bombay, the jute textile industry in Calcutta, the tea plantation in Assam and Bengal, the oil industry in Assam - all these owe their development to the extension of the Railways. Today the total length of the Railways is 107,000 kilometres. It carries 11 million passengers in a day and transports 40% of the country's freight.

Table 7 gives a summary of the working of the Indian Railways since Independence. Total traffic earnings include receipts from total traffic earnings, goods earnings, coach earnings and also other miscellaneous receipts. From Rs 260 crore in 1950-51, total traffic earning touched Rs 22,660 crore in 1995-96 and is expected to touch Rs 71,318 crore in 2007-08. During the same period, total working expenses have also been mounting from Rs 210 crore to Rs 18,530 crore in 1995-96 and is expected to touch Rs 56,687 crore in 2007-08. Out of the net revenue the Railways pays a dividend to the government, which is known as dividend to General Revenues. In 1950-51 the dividend to General Revenue was Rs 30 crore in 1995-96, which rose to Rs 1,260 crore. In 2007-08 it is expected to be Rs 3,909 crore. From the mid-1980s the Railways have been earning sufficient income to not only pay the dividend but also get a surplus. It may be noted that the net railway revenue is placed at Rs 14,870 crore for 2006-07. Out of this the dividend payment to general revenues amounted to Rs 4,243 crore. The balance amount came to Rs 10,627 crore. During 2007-08 after dividend payment to general revenues, the surplus to Indian Railways is expected to touch Rs 10,722 crore.

Table 7: Finances of Indian Railways (Rs in crores)

Year	Total earnings expenses	Total working	Net earnings Revenue	Dividend to General	Surplus(+) Deficit (-)
1950-51	260	210	50	30	+20
1960-61	460	370	90	60	+30
1970-71	1,000	860	140	160	-20
1980-81	2,620	2,500	120	320	-200
1995-96	22,660	18,530	4,130	1,260	+2,870
1997-98	28,140	25,140	3,000	1,630	+1,370
2006-07	63,120	48,250	14,870	4,243	+10,627
2007-08	71,318	56,687	14,631	3,909	+10,722

Source: 1. 1950-51 to 1997-98, from various Railway Budgets

2. Data for 2006-07, 2007-2008: Explanatory memorandum on the Railway Budget

The Union Minister for Railways has proposed an outlay of Rs 31,000 crore for the Annual Plan of 2007-08. The outlay exceeds the plan size for the current year by 32 per cent and would be the largest annual plan for the Railways so far. The thrust of the annual plan would be maintaining the high growth rate through early completion of throughput enhancement works, traffic facilities and works related to network expansion and development of high traffic density routes. The annual plan of Rs 31,000 crore includes support of Rs 7,611 crore from General Revenues. Internal resource is projected at Rs 17,323 crore and extra budgetary resources would include Rs 5,740 crore. The Railway Minister has sought an additional fund of Rs 2,725 crore from the Ministry Of Finance for the National Projects of Jammu and Kashmir and North Eastern Region. These include Udhampur–Srinagar-Baramulla, Jiribam–Imphal Road (Tupul) and Kumarghat–Nagartala New line and Lumding–Silchar–Jiribam Gauge conversion projects.

Table 8: Cargo Traffic at Major Ports (Million Tonnes)

S.No	Port	Cargo Traffic 2004-05	Cargo Traffic 2005-06	Cargo Handling Target for 2006-07
1.	Visakhapatnam	50.10	55.80	61.59
2.	Kolkata	46.20	53.02	51.80
3.	Chennai	43.80	47.25	52.20
4.	Kandla	41.55	45.91	50.80
5.	Mumbai	35.19	44.19	49.00
6.	JNPT	32.81	37.75	43.20
7.	New Mangalore	33.89	34.45	37.20
8.	Paradip	30.10	33.11	40.80
9.	Mormugao	30.66	31.69	35.30
10.	Tuticorn	15.81	17.14	18.20
11.	Cochin	14.10	13.94	15.67
12.	Ennore	9.48	9.16	9.80
	Total	383.69	423.41	465.56

Source: Ministry of External Affairs GOI, 2006 India in Business, FICCI.

Port

There was an impressive growth of 13.6 per cent per annum in container traffic during the five years ending in 2005-06. India's largest container port, Jawaharlal Nehru Port (JNPT) handled 2.67 million TEUs (20 foot equivalent units) in 2005-06. The annual aggregate cargo handling capacity of major ports increased from 383.69 million tonnes in 2004-05 to 423.41 million tonnes in 2005-06 and is expected to touch 465.56 million tonnes in 2006-07 (Table 8).

Telecommunications

The predominant role of information and communi-

cation technology (ICT) as a sine qua non for achieving rapid social and economic development has been recognized the world over. While the wireline/wireless penetration in most developed economics is reaching saturation, in the developed and developing economies there is vast opportunity to accelerate socio-economic development by meeting their telecommunication needs. Over the last decade telecom has been one of the robust growth drivers, which has contributed immensely to the country's impressive economic performance (Dept. of Telecommunications 2005-06, Annual Report). The announcement of the new telecom policy 1999 was a watershed event for telecommunications in India. Tele-density has also increased from 8.95 per cent in March 2005 to 16.8 per cent in December 2006 (Economic Survey 2006-07, p. 188).

Under the Bharat Nirman Yojana, a total of 66,822 villages are to be provided with VPTs by November 2007. Against this target, a total of 17,182 villages have already been covered. More than 2 lakh public call offices and 14.18 million phones have been provided in the rural area. Out of the 607,491 villages in the country 539,572 villages have been provided with village public telephones (VPTs) as on 31st December, 2005 (Dept. of Telecommunications 2005-06 Annual Report).

Table 9: Growth of telephones over the years (in millions)

	March 2003	March 2004	March 2005	March 2006	December 2006
Fixed lines	41.33	40.92	41.42	40.23	40.32
CDMA	0.61	9.46	15.92	32.67	44.17
GSM	12.69	26.15	41.03	69.19	105.43
Wireless (CDMA and GSM)	13.30	35.61	56.95	101.86	149.60
Gross Total	54.63	76.53	98.37	142.09	189.92
Annual Growth in percentage	–	40	29	44	45

Source: Economic Survey 2006-07, p. 188

It can be observed from the table 9 that the total number of telephones has increased from 54.63 million on March 31st, 2003 to 142.09 million on March 31st, 2006 and 189.921 million on December 31st, 2006. With this growth the number of telephones is expected to reach 250 million by the end of 2007.

The actual inflow of foreign direct investments (FDIs) up to July 2006 was Rs 11,801.46 crore. There are a total of 23.54 lakh public call offices (PCOs) functioning in the country, of which two lakh are in the rural areas. Apart from this 5.6 lakh village public telephones (VPTs) also provide access to telecom facilities in the rural areas. By the end of 2012, a total of 650 million telephone connections are to be achieved.

There is also a vision of providing 200 million rural telephone connections, which translates into a rural teledensity of 25 per cent. It is also envisaged that internet and broadband subscribers will increase to 40 million and 20 million respectively by 2010.

Postal system

The Indian Post Office, founded in 1837 and which issued the first Indian postage stamp in 1852, is the largest postal system in the world. As on 31st March 2006, India had over 155,333 post offices and since then has always been upgrading facilities and services. To control costs, more than 90 per cent of these post offices are in the rural sector. On an average a post office serves an area of 21.16 square kms and a population of 6,623. The Indian postal system offers airmail services daily to all parts of the world.

Table 10: Postal Network - International Comparisons

Country	Permanent post office	Population served	Average Area Served (Sq. Kms)	Employee
China	63,555	20,521	151	0.49
India	1,55,333	6,623	21.16	0.53
Indonesia	20,073	10,954	94.88	0.11
Malaysia	1,211	20,169	272.30	0.59
Sri Lanka	4,680	4,074	14.02	1.18
U.K	15,868	3,734	15.31	3.24
U.S.A	37,579	7,825	256.24	2.81

Source: Economic survey 2006-07, p. 190

The Department of Posts has given a new thrust to its programme of modernization and computerization in order to heighten customer satisfaction. Presently 8,163 post offices, which include all head post offices and major sub-post offices, are computerized for both counter and back office work.

It is evident from table 4.2 that with 155,333 post offices, the postal network in India is the largest in the world. The long-term objective of the Department of Postal services of the Government of India is to locate a post office within 3 kms of every village and to provide the

facility of a letter box in every village with a population of over 500. China has 63,555 post offices and on an average one post office serves an area of 151 sq. kms and a population of 20,521. It is quite clear that the Indian postal network is amongst the largest networks in the world in terms of area covered and population served.

Conclusion

Investment in infrastructure is essential for achieving economic development, as the Indian economy has been experiencing supply shortages for its infrastructure services. The survey of conventional energy resources shows clearly that this cannot be a solution to India's energy crisis, due to the hike in oil prices. It is this which has led to a search for renewable sources of energy, including programmes relating to bio-energy, solar energy, wind power and micro-hydel, and energy from industrial wastes should be developed. Indian Renewable Energy Development Agency (IREDA) and other financial institutions should provide institutional finance to the commercially viable projects extensively. The problem of rural energy supplies could be solved through locally available renewable sources like cow dung and agro-waste. Hydro-power is to be developed with a sense of urgency particularly for meeting peak-demand.

Transport network in India is extensive, but its overall performance is poor. Infrastructure capacity is inadequate and service operations are outmoded. A number of areas, particularly interior areas and hilly tracts, remain to be linked up with roads. Government should give importance to coordinated and balanced development of roads in the country. Upgrading technology in Railways needs greater attention so as to improve reliability, reduce maintenance cost and increase customer satisfaction. It is also necessary to emphasize the increase in efficiency and mismanagement of the Railways. Some of the actions required to solve the transport bottlenecks include reforming the current policy and institutional arrangements, minimizing adverse social and environmental impacts and expanding infrastructure capacity.

Increased private sector participation, imposing user charges are needed to secure funding for the further development of highways. Attention should be paid to transport safety, including community-level initiatives, as much as to engineering solutions.

The telecom sector is growing at close to 70 per cent per annum, but development in the sector was overshadowed by the issue of the offer of 'limited mobility' services by basic service operators. The growth in the telecom sector on the one hand has resulted in increased rural tele-density, but on the other hand the gap between rural and urban tele-density has widened during this period. The strategic and lucrative area of basic telephone services has now been thrown open to the private sector, including foreign investors. Price regulation, ensuring technical compatibility among different service providers, fixation of access charges, protection of consumer interest and resolution of disputes between service providers, are the vital inputs for global competition and for India's success in the international markets.

In order to attain an annual GDP growth rate of 9 per cent, it is imperative to accelerate the rate of investment in infrastructure. As part of the reform process, the government recognized that the infrastructure sector is a key area for attracting international private investment. The government has to take steps to attract foreign investment in infrastructure. Apart from this, private sector participation is expected to help upgrade the technology, improve the quality of infrastructure services and lower the costs and prices of services.

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Men who do things without being told draw the most wages.

– Edwin H. Stuart

Feature

Impact of Investment in Information Technology on Public Sector Banks in India

R K Mittal & Sanjay Dhingra

Indian banks are investing heavily in technologies such as telebanking, mobile banking, net banking, automated teller machine (ATMs), credit cards, debit cards, smart cards, call centres, CRM, data warehousing etc. In this paper, after defining input and output parameters, CCR output-oriented model (output maximization) and BCC output-oriented model (output maximization) of Data Envelopment Analysis (DEA) are applied to evaluate the impact of information technology investments on India's public sector banks (PSBs). This study indicates that information technology investment had a negligible or even a negative effect on the productivity and profitability of PSBs.

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Information Technology (IT) innovations in the last few years have changed the landscape of banks in India. Today IT seems to be the prime mover in all banking transactions. Electronic and information technology together are bringing a swift change in the way banks operate, especially offering better delivery channels and customer friendly services. Anywhere banking, tele-banking, mobile banking, net banking, automated teller machine (ATMs), credit cards, debit cards, smart cards, call centres, CRM and data warehousing have totally transformed the banking industry. Today almost all the major banks in India like ICICI Bank, UTI Bank, Citibank, Standard Chartered Bank, ABN Amro, SBI and PNB are offering online services to their customers. ATMs have emerged as the most favoured channel for offering banking services to customers. The progress of IT usage in banks in India on different parameters is summarized in Table 1.

The progress on the IT deployment in banks in India on various parameters viz. computerized branches, ATMs, computer literate employees, IT specialists and IT investment is shown in Table 1. From this table it is clear that the performance of new private sector banks is unmatchable. The public sector banks (PSBs) are the worst defaulters in terms of these parameters, although their performance is picking up.

In a survey conducted by McKinsey Consultancy (2002) it was observed that there exists a large productivity gap between Indian banks and the US banks. This gap is found to be 90% in public sector banks and 68% in private sector banks including foreign banks. This study suggests that banks should invest more in information technology. However, for any further investment it becomes imperative to assess the impact of existing investment in terms of gains in the bank's profitability and

Table 1: Information Technology and its Usage in Banks in India

Items	Public Sector Banks					Old Private Sector Banks				
Year	1996	1997	1998	1999	2000	1996	1997	1998	1999	2000
Fully computerized branches as % of total branches	3.14	5.26	7.84	10.31	13.79	8.38	12.01	16.60	23.78	30.74
ATMs as % of total branches	0.11	0.24	0.38	0.49	0.80	0.00	0.11	0.15	0.29	0.39
Computer literate employees as % of total staff	7.92	10.64	14.02	20.01	21.51	11.62	16.14	21.37	28.63	34.03
IT specialists as % of total staff	0.19	0.24	0.33	0.39	0.47	0.52	0.55	0.81	1.20	1.50
IT expenditure as % of operating profits	3.97	4.17	5.10	5.53	6.60	4.23	4.01	2.52	3.91	5.13
IT investments as % of operating profits	4.72	5.34	6.32	8.02	N.A.	5.91	4.01	3.92	6.99	N.A.
ALPM* branches as % of total branches	6.44	8.78	9.70	10.50	12.21	8.77	10.03	10.57	10.35	12.48
Items	New Private Sector Banks					Foreign Sector Banks				
Year	1996	1997	1998	1999	2000	1996	1997	1998	1999	2000
Fully computerized branches as % of total branches	100	100	100	100.00	100.00	100	100.00	100	100	100
ATMs as % of total branches	89.19	87.7	89.1	87.67	89.19	87.7	89.19	87.7	89.2	88
Computer literate employees as % of total staff	100.00	100	100	100.00	100.00	100	100.00	100	100	100
IT specialists as % of total staff	4.95	4.5	5.0	4.52	4.95	4.52	4.95	4.5	4.9	4.5
IT expenditure as % of operating profits	6.75	5.9	6.8	5.89	6.75	5.89	6.75	5.9	6.8	5.9
IT investments as % of operating profits	41.84	21.4	41.8	21.35	41.84	21.35	41.84	21.4	41.8	21.4
ALPM* branches as % of total branches	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.

*ALPM: Advance Ledger Posting Machine

Source: RBI Bulletin, December 2002

productivity. Here the study of PSBs becomes all the more relevant as their ongoing and future investments are massive in technology. Although many studies have been conducted to investigate this effect, the results are not conclusive in supporting a systematic effect due to shortcomings in these studies. These shortcomings include measurement errors, lags between investment and benefits, and redistribution of profits and mismanagement of IT resources. The present study attempts to find the impact of information technology investments on the productivity and profitability of PSBs using Data Envelopment Analysis (DEA).

Review of Literature

Over the years several studies have been conducted both at the industry and firm level to examine the impact of IT on productivity and profitability. Some of them have drawn statistical correlation between IT spending and performance measures such as profitability or stocks value for their analysis (Dos Santos et al; 1993). They found an insignificant correlation between IT spending and profitability measures, implying thereby that IT spending is unproductive. Brynjolfsson and Hitt (1996), however, cautioned that these findings do not account for the economic theory of equilibrium which implies that increased IT spending does not imply increased profitability. More recent firm level studies, however, point to a more positive picture of IT contribution towards productivity. These findings raise several questions about mismeasurement of output by not accounting for improved

variety and quality and about whether IT benefits are seen at firm level or at the industrial level. Such issues have been discussed in detail by Brynjolfsson (1993) and to a lesser extend by Brynjolfsson and Hitt (1996).

One illustration of the industry level studies is that of Morrison and Bernlt (1990), which found that in the manufacturing industry 'estimated marginal benefits of investment in IT are less than the marginal cost, implying the problem of over investment. More specifically they found that for each dollar spent on IT, the marginal increase in output is only 80 cents. Similarly Loveman (1994) found insignificant contribution of IT expenditure to the output of manufacturing firms. Lichtenberg (1995), on the other hand, concludes that there are significant benefits from investment in IT to the firms. Using Cobb-Douglas production function, he found increasing returns on investment in computes. He further found that one information system (IS) employee is equivalent to six non-IS employees in terms of marginal productivity.

Brynjolfsson and Hitt (1996) in their study using Cobb-Douglas production function, have found that computerization aids the firm's level output significantly. They conclude that computer related capital investment contributes 81 per cent to the marginal increase in output, whereas non-IT capital contributes only 6% to the marginal output. They have also shown that IS labour is more than twice as productive as non-IS labour.

Most such studies relating to the contribution of IT towards the firm's productivity have been restricted to the manufacturing industry, possibly owing both to a lack of data at the firm level in the service industry and perhaps, more significantly, due to the difficulty of unambiguously identifying the "output" of a service industry. The latter problem is particularly persistent in the banking industry, which is the focus of this study.

The study by Parsons, Gotieb, and Denny (1993) is one of the studies that deals with the impact of IT on banking productivity per se. They conclude from their estimation of data from five Canadian banks using translog production function that while there is a 17 to 23 per cent increase in productivity with the use of computers, the returns are very modest compared to the levels of IT investments. The other study to examine the effect of IT investment on both productivity and profitability in the US retail banking sector was conducted by Prasad and Harker (1997). They conclude that additional investment in the IT capital may have no real benefits and may be more of a strategic necessity to stay within the competition. However, the results indicate that there are substantially high returns to increase investment in IT labour. The other study conducted by Lunardi, Becker and Macada (2003), found competition, products and services, and customers, as the main strategic variables affecting IT. They found no difference of opinion between IT executives and other functional executives, regarding their perception of the impact of IT on strategic variables. Another important study undertaken by offsite monitoring and surveillance division of department of Banking Supervision (2002) used financial indicators to derive indirect linkages by assuming computerization as one of the factor in the improvement in efficiency. They concluded that higher performance levels have been achieved without a corresponding increase in the number of employees. Also, it has been possible for public sector banks and old private banks to improve their productivity and efficiency over a period of five years.

Choudhari and Tripathy (2004) applied DEA to measure the relative performance of public sector banks and found that the Corporation Bank is the efficient in all indicators i.e. profitability, financial management, growth, productivity, and liquidity, while the Oriental Bank of Commerce is the next most efficient bank. Kamakura and Ratchford (1996) evaluated multiple retail stores for their efficiency using DEA and translog cost function. Many other studies used DEA in a banking setting. A few took computer terminals as input measurement (Oral and Yolalan, 1990; Vassiloglon and Giokas, 1990) while others (Soterion and Zenios, 1999; Zenios et al., 1999) considered access time as input measurement. This study makes use of the DEA technique to analyze the impact of information technology investments on productivity and profitability of PSBs in India.

Data Envelopment Analysis and its Rationale for the Study

Charnes, Cooper and Rhodes (1978) first proposed DEA as an evaluation tool to measure and compare DMU productivity. After that this tool was extensively used in banking and other areas to measure the DMU relative productivity. Examples include the maintenance activities of US Air Force bases in different geographic locations, or police forces in England and Wales as well as performances of branch banks in Cyprus and Canada and the efficiency of universities in performing their education and research functions in US, England and France. These kinds of application extend to evaluating the performance of cities, regions and countries with many different kinds of inputs and outputs that include "social" and "safety-net" expenditure as inputs and various "quality-of-life" dimensions as outputs (Cooper et al., 2000). Data Envelopment Analysis is an approach of comparing the efficiency of organizational units such as bank

branches, schools, hospitals and other similar instances where there is a relatively homogenous set of units. The analysis will measure output(s) achieved from the input(s) provided and will compare the group of DMUs by their strength in turning input into output. At the end of analysis the DEA will be able to say which units are (relatively) efficient and which are (relatively) inefficient.

The Data Envelopment Analysis is a method for mathematically comparing the productivity of different decision-making units based on multiple inputs and outputs. The ratio of weighted inputs and outputs produces a single measure of productivity called relative efficiency. DMUs that have a ratio of one are referred to as efficient, given the required inputs and produced outputs. The units that have a ratio less than one are less efficient relative to the more efficient unit(s). Because the weights for input and output variables of DMU are computed to maximize the ratio and which are then compared to similar ratios of best performing DMUs, the measured productivity is also referred to as relative efficiency.

Approaches of performance measurements

There are various parametric and non-parametric approaches to measure performance. Performance ratios are widely used in all sectors of business. The best known ratios are for financial and production managers. The financial ratios regarding liquidity, capital adequacy, earnings and liability are widely used measures of organizational performance. However, they have one disadvantage. Each single ratio must be compared with some benchmark ratio one at a time. While the calculation of a set of financial ratios is relatively easy, the aggregation of those ratios can be quite complicated involving experienced judgment. Financial ratios do provide information on the overall financial performance of an organization, but provide little information about the amount by which performance could be improved or the area where the effort should be focused in order to improve performance. On the other hand the DEA method not only finds the efficient DMUs but also tells how to make other inefficient DMUs efficient by varying in the input and output parameters by a suggested amount.

The regression models are quantitatively robust, they lack the ability to include multiple inputs and outputs because regression models usually restrict the analysis to one dependent variable. Regression models also provide only an estimate of model success, while offering no feedback about improvement possibilities. Additionally, regression models impose a particular functional form on the data, producing a single function that represents a set of hypothetical "average" performers. DEA, on the other hand, produces an efficient frontier consisting of the set of most efficient performers, allowing a direct comparison to the best performers as opposed to average. The difference between regression and DEA is illustrated in Fig. 1 (Donthu et al., 2005):

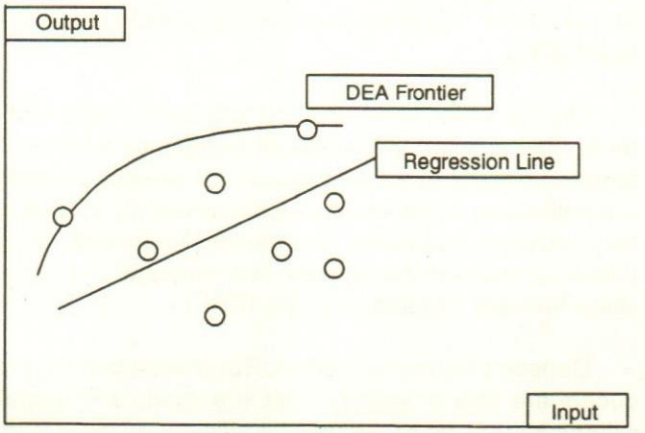

Fig. 1. Regression versus DEA

While the regression produces an "average" line across all DMUs, DEA produces an efficient frontier that encompasses the best performers. While DMUs above the regression line appear to be performing better than average, they are not performing as well as the best performers or most productive DMUs on the efficient frontier.

DEA Model Selection

One of the basic choices in selecting a DEA model is whether to use an input-orientation or an output-orientation. The difference is subtle but important and can typically be best understood by considering whether a DMU emphasizes reducing input while achieving the same level of output or puts more emphasis on producing more output given the same level of input.

DEA offers three possible orientations in efficiency analysis (Charnes et al. 1994):

(a) Input–oriented models are models where DMUs are deemed to produce a given amount of output with the smallest possible amount of input.

(b) Output-oriented models are models where DMUs are deemed to produce the highest possible amount of output with the given amount of input.

(c) Base-oriented models are models where DMUs are deemed to produce the optimal mix of input and output.

Return to Scale

Return to scale refers to increasing or decreasing efficiency based on size. For example, a manufacturer can achieve certain economies of scale by producing a thousand integrated circuits at a time rather than one at a time. It might be only 100 times as hard as producing one at a time. This is an example of increasing returns to scale (IRS).

On the other hand, the manufacturer might find it more than a trillion times difficult to produce a trillion integrated circuits at a time because of storage problems and limitations on the worldwide Silicon supply. This range of production illustrates Decreasing Returns to Scale (DRS). Combining the extreme two ranges would necessitate Variable Returns to Scale (VRS).

Constant Return to Scale (CRS) means that the producers are able to linearly scale the inputs and outputs without increasing or decreasing efficiency. This is a significant assumption. The assumption of CRS may be valid over limited ranges but its use must be justified. But, CRS efficiency scores will never be higher than that of VRS efficiency scores.

In a CRS model, the input-oriented efficiency score is exactly equal to the inverse of the output-oriented efficiency score. This is not necessarily true for inefficient DMUs in the case of other return to scale assumptions. The CRS version is more restrictive than the VRS and yields usually a fewer number of efficient units and also lower efficient score among all DMUs.

In DEA literature the CRS model is typically referred to as the CCR model after the originators of the seminal publication, by Charnes, Cooper and Rhodes (1978).

The CCR Model of DEA

DEA is a linear programming based technique for measuring relative performance of DMUs. CCR Model, which was initially proposed by a Charnes, Cooper and Rhodes, can be represented as a fractional linear programming problem:

$$E_o = \frac{u_1 y_{1o} + u_2 y_{2o} + \cdots\cdots + u_s y_{so}}{v_1 x_{1o} + v_2 x_{2o} + \cdots\cdots\cdots + v_m x_{mo}}$$

subject to

$$Eo = \frac{u_1 y_{1j} + u_2 y_{2j} + \cdots\cdots + u_s y_{sj}}{v_1 x_{1j} + v_2 x_{2j} + \cdots\cdots\cdots + v_m x_{mj}} \leq 1 \ (j = 1, \ldots, n)$$

$v_1, v_2, \ldots\ldots, v_m \ e \geq 0$

$u_1, u_2, \ldots\ldots, u_s \ e \geq 0$

where E_o = the efficiency of the o^{th} DMU,

Y_{so} = s^{th} output of o^{th} DMU,

U_s = weight of s^{th} output

X_{mo} = m^{th} input of the o^{th} DMU

V_m = weight of m^{th} input

Here the DMU_j to be evaluated on any trial be designed as DMU_o where o ranges over 1,2,...,n.

The constraints meant that the ratio of "virtual output" vs "virtual input" should not exceed one for every DMU. The above fractional programme can be replaced by the following linear programme:

Maximize $Eo = u_1 y_{1o} + v_2 y_{2o} + \ldots + u_s y_{so}$

Subject to $v_1 x_{1o} + v_2 x_{2o} + \ldots + v_m x_{mo} = 1$

$U_1 y_{1j} + u_s y_{sj} \leq v_1 x_{1j} + v_2 x_{2j} + \ldots + v_m x_{mj} \ (j = 1, \ldots, n)$

$V_1, v_2, \ldots v_m \geq 0$

$u_1, u_2, \ldots u_m \geq 0$

The DEA model is a fractional linear programme but may be converted into linear form in a straight forward manner so that the methods of linear programming can be applied. The fractional programme can be converted to a linear programme by normalizing either the numerator or the denominator of the fractional programme objective function. The weighted sum of the inputs is constrained to be unity in the linear programme. As the objective function is the weighted sum of outputs that has to be maximized, this formulation is referred to as the output maximization DEA programme.

The key feature of above model is weights are treated as unknown. They can be obtained by solving the fractional programming problem to obtain values for the input weights (v_i) (i =1,...,m) and the output weights (u_r) (r =1,....,s) as variables. The value obtained of these weights will maximize the efficiency of the o^{th} target units.

The BCC Model of DEA

The output-oriented BCC model can be written as

$$\begin{aligned} &\text{Max} && \eta B \\ &\text{Subject to} && X\lambda \le x_o \\ & && \eta B y_o - Y\lambda \le 0 \\ & && e\lambda = 1 \\ & && \lambda \ge 0 \end{aligned}$$

This is the envelopment form of the output-oriented BCC model.

Research Methodology

A sample of 14 public sector banks have been selected for the study depending upon the availability of data. The selection of indicators for study have been decided with the view of identifying the impact of computerization. The inputs parameters to the DEA models included in analysis of productivity are: *staff expenses* to *operating expenses, expenditure incurred on computerization and development of communication network and percentage of offsite ATMs to total branches.* Corresponding output are *business per employee, total income per branch* and *operating profit per branch.* Similarly input parameters to the DEA models included in analysis of profitability are *staff expenses to operating expenses, expenditure incurred on computerization and development of communication network and percentage of offsite ATMs to total branches* and corresponding outputs used are *net profit to deposits, operating profit to average working funds, return on assets* and *profit margins.*

The CCR output-oriented model (output maximization) and BCC output-oriented model (output maximization) are then applied to evaluate the productivity and profitability of banks. While the CCR and BCC model results are evaluated under conditions of constant and non-constant returns to scale assumptions, respectively. The data for analysis have been used from PROWESS 2.5, a corporate database developed by Center for Monitoring of Indian Economy (CMIE), banks' websites and from RBI report of trend and progress of banking in India on November 24, 2005. The data is based on banks' performance in the year 2004-05. DEA-Solver software has been used to solve linear programming model. Correlation between the IT expenditure by banks and DEA efficiency scores of productivity and profitability is then calculated to look into relationship between these variables.

Results and Discussion

The DEA results on profitability and productivity para-meters are summarized in Table 2 and Table 3 respectively. The DMU(s) score the rating 1 considered to be efficient and others considered to be relatively inefficient.

Table 2: DEA efficiency score of banks for profitability indicators 2004-2005

No.	DMU	CCR		BCC	
		Scores	Rank	Scores	Rank
1	Allahabad Bank	1	1	1	1
2	Andhra Bank	0.810296	9	1	1
3	Bank of Baroda	1	1	1	1
4	Bank of India	0.430358	14	0.520885	14
5	Bank of Maha-rashtra	0.840315	7	0.960504	9
6	Canara Bank	0.686102	11	0.869209	11
7	Corporation Bank	1	1	1	1
8	Indian Overseas Bank	0.814853	8	0.962893	8
9	Oriental Bank of Commerce	1	1	1	1
10	Punjab National Bank	0.479939	12	0.857706	12
11	State Bank of India	0.456063	13	0.733218	13
12	Syndicate Bank	0.728514	10	0.892072	10
13	Uco Bank	1	1	1	1
14	Vijaya Bank	1	1	1	1

Table 3: DEA efficiency score of banks for productivity indicators 2004-2005

No.	DMU	CCR		BCC	
		Scores	Rank	Scores	Rank
1	Allahabad Bank	1	1	1	1
2	Andhra Bank	0.493468	14	0.722222	14
3	Bank of Baroda	1	1	1	1
4	Bank of India	0.693738	11	0.852629	12
5	Bank of Maha-rashtra	0.870207	7	0.960753	9
6	Canara Bank	0.853036	8	1	1
7	Corporation Bank	0.769499	10	0.940228	10
8	Indian Overseas Bank	1	1	1	1
9	Oriental Bank of Commerce	1	1	1	1
10	Punjab National Bank	0.499164	13	0.811884	13
11	State Bank of India	0.523978	12	1	1
12	Syndicate Bank	0.809044	9	0.89676	11
13	Uco Bank	1	1	1	1
14	Vijaya Bank	1	1	1	1

On profitability indicators the CCR model result shows that DMUs at Serial Nos. 1,3,7,9,13,14 are efficient while BCC model found DMUs at Serial Nos. 1,2,,3,7,9,13,14 to be efficient. Similarly on productivity indicators the CCR model results identified DMUs at serial nos. 1,3,8,9,13,14 to be efficient while BCC model found DMUs at serial nos. 1,3,6,8,9,11,13,14 to be efficient. Correlation between the IT expenditure by banks and DEA efficiency scores of productivity and profitability is then calculated to look into relationship between these variables. Results of correlation are depicted in Table 4.

Table 4: Correlation between IT expenditure incurred by the banks and their efficiency scores

	CCR	BCC
Productivity	-0.55689	-0.09986
Profitability	-0.79171	-0.88421

Clearly correlation between the IT expenditure incurred by the banks and their efficiency scores for profitability indicators is negative and "statistically significant" at significance level of .05 with degree of freedom at 12, using two-tailed test for both CCR and BCC model. While correlation between IT expenditure incurred by the banks and their efficiency scores for the productivity indicators is again negative, "statistically significant" for CCR model outcome at significance level of .05 with degree of freedom at 12 and using two-tailed test and "statistically not significant" for BCC model outcome.

Conclusion

The result of the study indicates that increased information technology investments has a negligible or even a negative effect on Indian public sector banks' productivity and profitability. Our research in a way reconfirms the "productivity paradox" theory. As a possible explanation of these results, we can say that PSBs have a massive physical infrastructure and to make these banks IT enabled, business process reengineering and better coordination between different activities and systems is required. These banks must concentrate on this thinking to achieve positive results.

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Feature

The Economics of Mobile Wireless Spectrum: A Review

Hemant K Sabat

This paper integrates theories on the economics of distribution, regulation, acquisition and ownership of mobile wireless spectrum. In the mobile wireless industry, the key industry and business drivers are the investments made by network operators. Of these cost drivers, the most influential on the industry's dynamics are the capital investments, which include spectrum acquisition investments. This paper draws inferences across the group of original papers containing theories on spectrum distribution and regulation, carriers' selection of different types of spectrum markets to acquire spectrum, and carriers' spectrum acquisition strategies.

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One of the factors facilitating current technological leaps in the mobile wireless industry is the availability of spectrum with wireless carriers that enables them to offer wireless services (Sabat, 2002a; Sabat, 2003a). In light of this influence on the sustainability of a carrier's business and on the industry at large, an understanding is required of how the mobile wireless spectrum is distributed, how the spectrum market is regulated, why different carriers opt to acquire spectrum from different types of spectrum markets, and why different carriers adopt different strategies to acquire spectrum (hereafter referred to as 'spectrum acquisition strategies') within these types of spectrum markets.

Whereas spectrum availability has been one of the key factors driving the industry's growth, spectrum management in the young mobile wireless industry is still in its infancy. Further, the industry's newsbytes and literature describe spectrum rulings and developments as they occur. Given the explosive growth of the industry, the evolution of radio spectrum investment economics has outpaced research in this field and these newsbytes and theory provide limited guidance.

To fill this lacuna, a study to understand the economics of mobile wireless spectrum was conducted. Synthesizing the findings of the study, this paper integrates the theories on the economics of mobile wireless spectrum and describes:-

- The philosophical issue of who should own, distribute and regulate spectrum, while providing a critique of the two prevailing approaches to distributing and regulating spectrum use;
- How national and international regulatory bodies along with national governments distribute and regulate spectrum in the industry;
- Operators' key spectrum investment drivers, types of spectrum markets, spectrum acquisi-

tion strategies, and what conditions lead an operator to adopt one or a combination of these strategies.

Theories on the Economics of Spectrum

An Overview of the Theory Development, Methodology and Empirical Validation

The theory on spectrum economics was developed based on research, analysis and synthesis of factors that decide spectrum investments made by carriers. This study analyzed the following factors:-

- The key business drivers, both cost and revenue, of the mobile wireless industry;
- The magnitude of influence of the cost drivers and the reasons behind it;
- The need to own spectrum;
- The ultimate ownership of spectrum;
- The drivers behind evolution of spectrum regulation and distribution mechanisms;
- The conditions that make a spectrum distribution and regulatory instrument effective;
- The impact of an operator's spectrum investments on its return on investment (ROI);
- The factors, both organizational and environmental, that an operator considers while developing the spectrum acquisition strategy;
- The conditions that make a spectrum acquisition strategy effective;
- The evolution of a carrier's strategy as a response to the competitive market;
- The business implications of adoption of one or a combination of spectrum acquisition strategies; and
- The bases to organize these strategies into a convenient-to-use classification.

Synthesizing the findings, we constructed:-

- A theory on spectrum distribution and regulation;
- The taxonomy of spectrum acquisition strategies;
- The theory to account for why different carriers opt to acquire spectrum in different spectrum markets; and
- The theory to account for why different carriers adopt different spectrum acquisition strategies in these markets.

This overarching study on the economics of spectrum investments by wireless service providers included research and analysis of the following:-

- Wireless spectrum auctions and other spectrum distributions held over the last decade in various parts of the world;
- Wireless spectrum regulatory regimes in over 50 countries across the world; and
- Spectrum acquisition strategies pursued, over the last decade, by more than 300 wireless network operators operating across the world in over 50 countries.

This study used two sources of data, primary and secondary. The primary source of data was collected during the author's industry experience, as a business practitioner, in establishing and growing next-generation wireless businesses during the last telecom boom followed by the downturn. Data from these implementations was used to further build this thesis. These implementations, the data generated from these, the analysis of this data, findings and inferences of this overarching study are described in a series of 22 articles. This series of articles advises on successful paradigms, implementation issues, and best practices in establishing and growing a next-generation mobile wireless business. Secondary sources of data were used to further refine the thesis. Secondary sources included investment analyst reports and research, industry conferences and newsletters.

The Theories on Spectrum Acquisition, Ownership, Distribution and Regulation

The thesis developed from the study on the economics of mobile wireless spectrum is that:-

- A mixed approach to spectrum ownership that combines both the common and property approaches is the most effective way to utilise spectrum.
- A country chooses a spectrum distribution and regulation method depending on the extent of the development of free market economics in the country and in the spectrum industry, as well as the infrastructure available in the country to distribute and regulate spectrum.
- Depending on a carrier's amount and type of

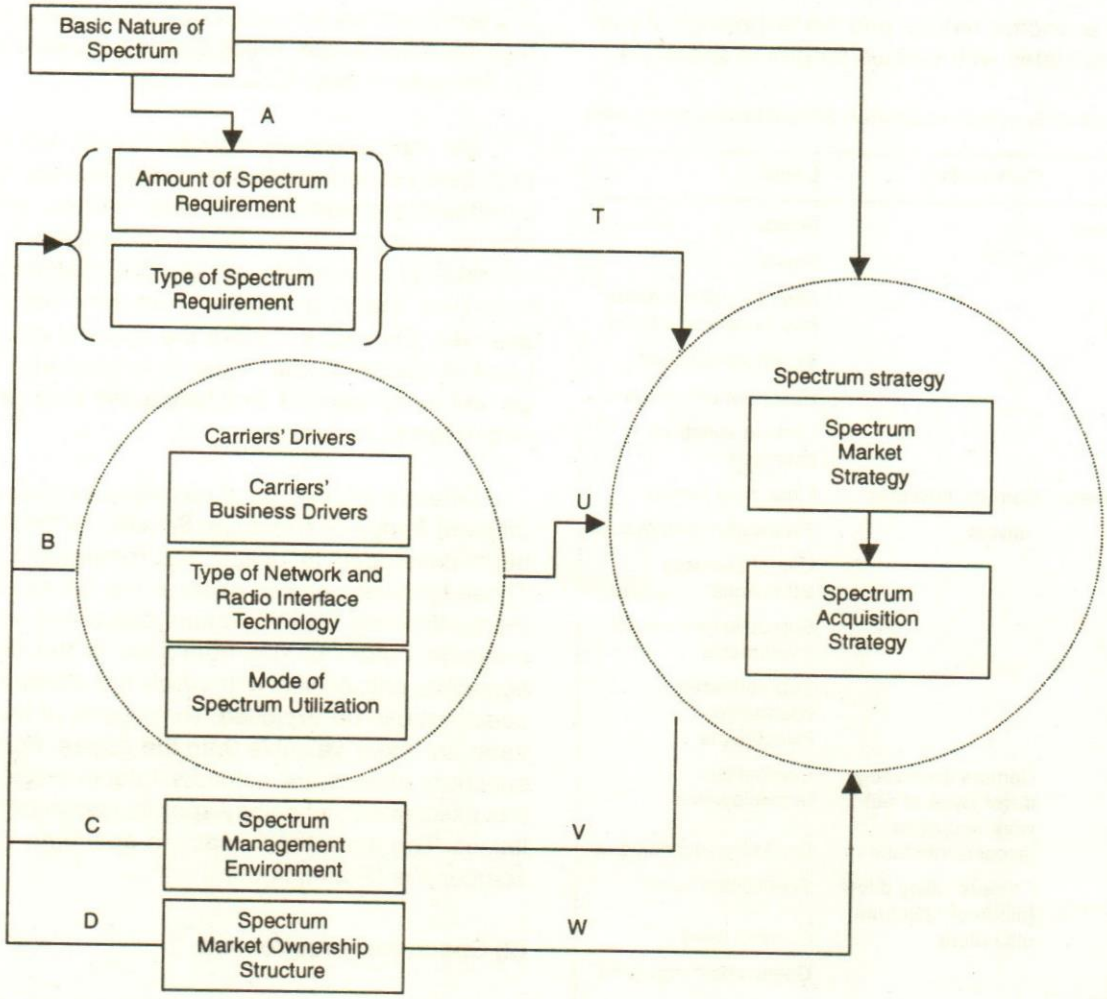

Fig. 1. Drivers of carriers' spectrum acquisition strategies

spectrum requirements, its business and market drivers, and spectrum regulatory environment, it adopts one or more strategies to acquire spectrum licenses from spectrum markets.

Factors driving the economics of spectrum

Of the key economic indicators, critical to the industry's success are carriers' top line business drivers such as pricing pressures, network operators' capital and operational cost drivers, the competitive landscape, and service providers' offerings (i.e., applications and services). Of the cost drivers, the most influential on the industry's dynamics is the capital investment (Sabat, 2002b), which includes spectrum investments made by carriers.

Though the investment to acquire spectrum is a one-time investment, its magnitude as a proportion of a carrier's total capital expenditure could be as high as 50 per cent (Sabat, 2002b; Sabat, 2002c). Coupled with the basic nature of spectrum, a number of factors place a shocking premium on the true value of spectrum and hence, influence carriers' spectrum acquisition strategies. These influencing factors (or constructs) include amount and type of spectrum requirements, spectrum management regime, carriers' drivers, and spectrum ownership structure in a market.

These constructs were identified in earlier papers (Sabat, 2006a; Sabat, 2007). These constructs assume different levels (Table 1). The inter-relationships between the factors and the levels of these constructs are described here. An overview is visually depicted in Fig. 1.

(1) Basic Nature of Spectrum

The basic nature of radio spectrum relates to its two

aspects: its economic nature, and the technological complexities associated with various ranges of spectrum.

Table 1: Drivers of Spectrum Acquisition Strategies and their Levels

Constructs		Levels
Basic nature of spectrum		Scarce
		Plenty
Spectrum requirement		Spectrum-rich (carrier has excess spectrum)
		Spectrum-deficient
		Spectrum-constrained
		Lacking spectrum coverage
Carriers' drivers	Carriers' business drivers	Financially strong
		Financially constrained
		Unmet business aspirations
		Sub-optimized capital investments
		Sub-optimized operational investments
	Carriers' technology driver (type of network and radio (access) interface	Compatible technologies
		Dissimilar technologies
	Carriers' utility driver (mode of spectrum utilization)	Specialized need
		Generic need
Spectrum management regime		Government-regulated
		Free market-driven
Spectrum ownership structure		Aggregated state Segregated state Independent owners

Economic nature of spectrum: Going by fundamental economics of any good, there is no emphasis on the good's acquisition strategy if it is available in plenty. Therefore, spectrum acquisition strategies are required only when available spectrum is scarce (link 'S' in Figure 1).

From an understanding of the fundamental nature of airwaves, one knows that the total spectrum bandwidth available for wireless use is fixed. The wireless service providers operating in a given region share this fixed spectrum resource. Operators' access to spectrum in the market is limited and a carrier can offer wireless services only if it owns the license to use a particular spectrum band in the region. Therefore, wireless spectrum is a *scarce commodity* and like any other economic resource, airwaves are a *public* resource and must be utilised for the greater good. Further, broadcast licenses in a spectrum are a scarce commodity that is limited has high economic value, which could and should be paid for on the open market (Coase, 1959).

The implications are not hard to perceive. First, spectrum being economically scarce and thereby carrying an exorbitant premium on its value, carriers endeavor to acquire spectrum from every possible avenue that offers spectrum at a price they can afford, and as much of spectrum (see link 'A' in Figure 1) as they can from these avenues. Second, the more the spectral efficiency of a band of spectrum, the higher is its premium, the stronger will be its demand, and hence, the stronger the drive of carriers to acquire it.

Different technological complexities associated with different bands of spectrum: Specific technologies have been developed to utilize electromagnetic spectrum. These technologies can utilize some bands of spectrum more efficiently than the others due to the very electromagnetic nature of spectrum. Due to the difference in economic efficiencies with which the different bands of spectrum can be exploited, some parts of the spectrum band are more valuable than the others. Further, these spectrum chunks are not substitutable since each band has associated technology-specific restrictions and regulations. The more the valuable a spectrum band is, the scarcer it is (Sabat, 2003b).

(2) Spectrum Requirement

Carriers endeavor to own spectrum in quantities that serves their capacity requirements in a region, and in areas that meet their footprint aspirations (link 'T' in Figure 1). Carriers may desire to own large, moderate or small amount of spectrum. The larger the amount of spectrum required, the more aggressive strategy a carrier adopts to acquire spectrum. An aggressive acquisition strategy would require a carrier that is seeking spectrum to simultaneously pursue multiple avenues. A carrier that desires smaller amounts of spectrum would await opportunities to secure spectrum at the best bargain.

The amount of spectrum carriers own is influenced by four factors (Figure 1), viz., the basic nature of spectrum (link 'A', as described earlier), spectrum distribution and regulatory regime, carriers' drivers, and spectrum market drivers (Sabat, 2006a; Sabat, 2007).

(3) The Spectrum Management Regime: Distribution and Regulation

This relates to the foremost continuing and prevail-

ing debate in the field of spectrum distribution and regulation. That is, whether spectrum is a common asset or a property. The answer to this will decide the philosophical issue of who should own, distribute and regulate spectrum: government-backed regulator or free spectrum market. This influences a carrier's adoption of a suitable spectrum acquisition strategy (see link 'V' in Figure 1).

Coase's (1959) seminal thesis on spectrum's economic value set off a rigorous discussion on spectrum ownership, distribution, regulation and investments or acquisition strategies. Some propose to replace the present regime of exclusive usage rights with comprehensive private property rights (Spiller & Cardilli, 1999; Hazlett, 2001; Kwerel & Williams, 2002). Noam (1998), Benkler (2003), Werbach (2004) and Reed (2002) argue against spectrum privatization and for the establishment of a comprehensive open access regime. Faulhaber and Farber (2003) and Bauer (2004) hold intermediate positions. Spectrum distribution and regulation mechanisms have been described in several papers (Gruber, 2001; Gruber, 2002; Yan, 2004). By giving a critique of the two views, Sabat (2003b) recommends a suitable mix of the two approaches to spectrum management. However, the current practice is that international and national regulatory bodies and national governments regulate its use and distribute among operators and service providers. This is because by their very nature, airwaves are a *public* resource and are to be utilized for the greater good.

If spectrum is considered a common good, national governments and their regulatory bodies increasingly influence the management of spectrum in a region. In such a *regulated spectrum regime*, a carrier awaits opportunities that allows it acquire spectrum. As regulators are required to do a greater due diligence than free market principals, the opportunities are less frequent. Delay in spectrum availability makes spectrum a scarce resource. Further, the longer the wait before a carrier acquires spectrum, the more the demand is pent up, and the more aggressive the carrier is in search of spectrum markets. Furthermore, regulators may dictate which strategies are permissible to acquire for what amount of spectrum for specific opportunities (see link 'C' in Figure 1). The more limiting the conditions are while acquiring spectrum, the more aggressive the need is to acquire spectrum, and the more aggressive a carrier is when spectrum is available for distribution or trading in various markets.

In a *free spectrum market*, carriers (who are the primary players with interests in acquiring spectrum) are primarily driven by their business needs. Therefore, opportunities to acquire spectrum are more frequent in a free market than a strictly regulated regime. Carriers are found to more actively engage in spectrum acquisition through various means. Further, as carriers' spectrum needs are met time to time, the demand is not pent up and the desire to acquire spectrum is met time to time. Therefore, carriers are more inclined to pursue milder strategies than they would in a strictly regulated regime.

By providing an integrative view of the spectrum rulings of wireless regulatory agencies in the U.S. (Sabat, 2005), Canada, India and many countries in Asia and Europe, and by analyzing recently-held spectrum auctions in various parts of the world, Sabat (2003b) describes how national and international regulatory bodies along with national governments distribute spectrum and regulate its use. The theories are:-

(i) How spectrum is distributed

Carriers acquire spectrum from three types of markets:

- Primary spectrum market,
- Secondary spectrum trading markets, or
- Designated regions governed by special spectrum regulations, i.e., where spectrum ownership is constrained.

(a) Primary Spectrum Market: In primary spectrum markets, national government and its regulatory bodies distribute spectrum to buyers. To maintain uniformity in spectrum allocations across various countries, international standard-setting bodies suggest national governments various spectrum bands for specific use. As the guardian of spectrum, national governments then award operators the licenses to use the spectrum in allocated regions of the country. National governments monitor spectrum distribution and utilization through their regulatory bodies that create policies.

Regulatory agencies use many methods to distribute spectrum to prospective buyers. Lottery, beauty contest and auction are the most popular methods. Each of these instruments has specific characteristics that favor different countries based on their economic, political and social system. Sabat (2003b) describes the advantages and limitations of these methods. Sabat (2005) describes how the spectrum distribution mechanisms in the U.S. and India evolved over a period of time.

(b) Secondary Spectrum Market: Secondary spectrum markets are the markets in which spectrum owners trade the ownership with buyers including carriers. The

spectrum owners could include carriers with excessive spectrum, carriers willing to trade off spectrum to generate liquidity, carriers obligated to sell spectrum by the regulator of the region, financial entities owning spectrum to resell, independent entities owning interests in the wireless industry, and would-be-carriers attempting an entry into the wireless service provider industry.

As national governments do not directly involve in these markets, their role as a watchdog assumes greater relevance. To avoid monopoly and malpractices and ensure appropriately priced services for end consumers, national governments frame appropriate safeguards and regulations that foster free market environment.

(c) Designated Regions Governed by Special Regulatory Constraints: The above spectrum strategies are a natural outcome of the industry's spectrum economics. However, national governments may enforce regulations to develop cellular services in certain regions of a country, or to maintain fair market conditions. These regions are called 'designated regions' (Sabat, 2006a).

(ii) How spectrum is regulated

With huge amounts of dollars at stake in spectrum acquisitions and its enormous implications, it is imperative that national governments and their regulatory bodies continuously regulate the spectrum industry fairly and openly after distributing the spectrum. They strive to do these through multiple ways. Spectrum caps (Sabat, 2006a), trading or transfer limitations (Sabat, 2004a), regulatory review (Sabat, 2005), and ownership stake caps (Sabat, 2003b) in domestic holdings are the primary restrictions placed on spectrum globally.

Various factors influence the adoption of a particular instrument and the conditions under which a particular instrument is effective varies as well. The regulatory instruments employed by spectrum regulators, the factors that influence the adoption of a particular instrument, the conditions under which a particular instrument is effective, and their advantages and disadvantages are described in an earlier paper (Sabat, 2003b). Though these are the primary means through with national governments have attempted to prevent spectrum from accumulating in the hands of one or two dominant operators, there are other instruments that regulatory bodies employ to drive spectrum market efficiencies.

Further, in difficult market conditions, operators could merge, or acquire either another operator or certain of its operations. In such regions, regulators could facilitate consolidation moves to drive operational efficiencies and scale and scope economies in the industry. To maintain competitive marketplace, and hence, value-justified wireless service charges, regulators could also stipulate requirements to authorize a merger (Sabat, 2003b).

National governments and regulatory bodies could spur innovation in the communications industry by encouraging regulations that promote the use of unlicensed spectrum, either directly or indirectly. However, critics are concerned that increased use of unlicensed spectrum could cause interference problems with licenses users' transmissions.

Whereas national governments and their representative bodies may be proactive in driving spectrum market efficiencies, the industry may encounter technical, financial and political complexities. With assistance from industry think-tanks, regulatory bodies may call for a new approach to the way communications spectrum is viewed, as well as used. There are developments that are giving rise to an 'open spectrum' movement, the various aspects of which are described in other papers (Sabat, 2003b).

Upcoming wireless technologies are changing how electromagnetic spectrum is viewed, as well as used. These new radio technologies can use transmit voice and data communications using parts of the spectrum that are unlicensed or underused (Sabat, 2003b; Sabat, 2004a).

A few regulatory bodies are considering time factor for spectrum access. Under such scenarios, licensees could rent certain spectrum bands during time periods when they are not in use. This would grant license holders the maximum flexibility to use—or allow others to use—the spectrum, within technical constraints, to provide any services demanded by the public. With this flexibility, service providers can be expected to move spectrum quickly to its highest and best use. However, it is difficult to underestimate the magnitude of the challenge in implementing such regulations even while avoiding excessive intrusions by regulatory bodies. Any spectrum policy will also have to deal with the fact that while a few of the governments have not had a clear spectrum regulation policy, that has not inhibited it from making determinations upon which were based both corporate and consumer spending decisions (Sabat, 2003b). To help better understand the theory on spectrum distribution and regulation, Sabat (2005) describes how the U.S. government and its regulatory body, the Federal Communications Commission, distribute and regulate spectrum.

(4) Carriers' Drivers

These are internal drivers that relate to carriers' operations and can be grouped as follows:-

(a) Carriers' business drivers

(b) Carriers' technology drivers: type of network and radio interface technology

(c) Carriers' spectrum utility driver: mode of spectrum utilization.

(i) Carriers' Business Drivers

The drivers related to starting, operating and growing a carrier's wireless business influence its spectrum acquisition strategies (see link 'U' in Figure 1). These factors include operators' *goals and aspirations* regarding geographical coverage of its service in uncovered markets, its target consumer segment, its target markets, its alignment of operations, its compatibility with other players in the region, its cost of customer acquisition, its subscriber volume and their usage patterns in the region, the current capacity of its existing network if it has an installed base through *capital investments* made earlier in the region, its *network operating costs*, its *financial* strength and liquidity requirements, and availability of cash with it to purchase spectrum licenses. The criticality of a business driver to a carrier's business sustainability and growth decides the adoption of a particular strategy to acquire spectrum. If the sustainability of a business is in question, carriers pursue aggressive spectrum acquisition strategies. On the other hand, if the critical spectrum needs of a carrier are met, e.g., sustainability, it opts for a milder strategy to acquire spectrum, e.g., to grow its business. The influencing business drivers are described in an earlier paper (Sabat, 2006a).

(ii) Carriers' Technology Driver: Type of Network and Radio Interface (Access) Technology

The choice of network and radio interface technology affects spectrum allocation due to different channelization, frequency re-use of various technologies and roaming, as well as a host of other issues (Sabat, 2003c). Further, each technology is based on specific protocols and standards that utilize spectrum in a specific way so that they can facilitate communication between and within networks and systems. Each technology has communication characteristics that are fundamentally different. Therefore, different technologies can optimally enable different types of applications and services (Sabat, 2002c).

In addition, a carrier has several networks that it might have built, acquired or migrated since inception. This patchwork of networks is usually *heterogeneous* (or dissimilar) due to its varied sources. In such a medley, security, interoperability and reliability of interfaces between any two technologies are critical. It is much easier to resolve these issues among *compatible technologies* than dissimilar ones. In addition, each technology follows a specific migration path for upgrade (Sabat, 2005). Therefore, a carrier's technology decisions have an impact on its spectrum market strategies (see link 'U' in Figure 1).

(iii) Carriers' Spectrum Utility Driver: Mode of spectrum utilization

The mode of utilization of spectrum relates how spectrum can be optimally utilized by a carrier. This decides the amount and type of spectrum required to offer a service (see link 'B' in Figure 1). The type of spectrum required relates to the type of applications and services that could be optimally offered in a spectrum range.

An understanding of the technological nature of spectrum asserts that different frequencies of spectrum are suitable for different applications. Whereas carriers may strongly endeavor to own specific type of spectrum and they may adopt a combination of strategies to strengthen their bid and successfully acquire this spectrum, national governments may set it aside for the security of the homeland. In such cases, carriers opt for alternative spectrum ranges. Further, bandwidth-heavy applications demand either larger chunks of spectrum or more spectrally efficient technologies to transmit the same content. A carrier may choose to offer an application or service based on its business strategies. The applications or services a carrier offers may be specialized or commoditized (or generic).

The mode of utilization decides the type of spectrum to be employed and, hence, a carrier's inclination to pursue one or more market strategies to acquire certain types of spectrum blocks. This prompts the carrier to await opportunities when the specific spectrum is distributed or traded, independent of the source. When such spectrum is available in any market, it will pursue aggressively in that market. On the other hand, if a carrier offers an assortment of services as part of its balanced services portfolio, it will be less dependent on any specific type of spectrum. As the spectrum required to offer commoditized services is more readily available and traded, the carrier will have more types of markets to acquire spectrum.

Spectrum market	Spectrum acquisition strategy		
Primary spectrum market	Auction Lottery Beauty contest	Single primary owner Joint primary owners	
Secondary spectrum market	Resale Asset exchange	Roaming	Independent Affiliates Greenfield 3G operators
		Network sharing Pool and share Network asset swapping MVNO	
Markets under special regulatory constraints	Equity holding Leasing or commodity trading Mergers, acquisitions and divestitures Surrogate		

Fig. 2. Taxonomy of Spectrum Acquisition Strategies

(5) Spectrum Ownership Structure in a Market

This factor relates to the spectrum licensing structure in a market or region or a nation. From a technological perspective, there must be appropriate amount of spectrum available with carriers in each of their operating markets to meet their capacity requirements in these markets so that the carriers can offer a desired quality of service (QoS) to its subscribers. Given that the total amount of spectrum availability in a market is fixed, the maximum amount of spectrum that a carrier can own in a market is determined by the number of spectrum owners in that market, and the structure of spectrum ownership (see link 'D' in Figure 1).

The ownership of spectrum in a market is a continuum, the two ends of which is an *aggregated* or *segregated state*. Carriers endeavor to obtain adequate spectrum, preferably in a contiguous band, when it is distributed in the primary spectrum market by national governments (see link 'W' in Figure 1). If a few carriers are successful in this initiative, the spectrum ownership gets *aggregated* among these carriers in the region. If the ownership of spectrum is highly segregated as well as not contiguous with each carrier in a region as a result of spectrum acquisition from the primary market, the possibilities of spectrum trading between carriers vastly increases.

Whereas many carriers own adequate spectrum to offer wireless services and use it to offer wireless services, many others aggregate spectrum to leverage trading opportunities and resell it as opportunities come by, and a few others relinquish the ownership due to their changed business plans. Even the carriers that own adequate spectrum now may need more spectrum to meet capacity requirements that may arise in the future from the deployment of new technologies and to meet their coverage aspirations. These possibilities give rise to spectrum trading in the industry, and thus secondary spectrum markets originate in regions. The more the extent of free market condition persists, the more dynamically these markets evolve, and the more dynamic the spectrum market ownership structure becomes. Furthermore, financially-constrained carriers may also form strategic alliances to own spectrum, build networks, and provision wireless services.

The above factors strongly influence the carrier's decision on opting for a particular market to acquire spectrum. Further, the price at which a carrier buys spectrum is determined by a combination of above-mentioned drivers. What conditions lead a carrier to opt for a particular market and a particular strategy to acquire spectrum within that market is described below.

The Theory on Spectrum Markets and Spectrum Acquisition Strategies

Carriers employ three categories of strategies to acquire spectrum: those in the primary spectrum market, those in the secondary spectrum trading markets, and those in the designated regions governed by special regulatory constraints (Fig. 2).

Strategies to Acquire Spectrum in Primary Spectrum Market

In primary spectrum markets, national government and its regulatory bodies distribute spectrum. As national governments are the guardian of spectrum ('government-regulated'), they have a repository of large blocks of contiguous spectrum ('aggregated state') for distribution. Carriers that need large chunks of spectrum ('spectrum-deficient', spectrum-constrained') and own little or nothing of the type of spectrum they require to offer a service would want to enter the fray, other 'carriers' drivers' remaining the same. Carriers apply for spectrum in regions that are in line with their business goals ('unmet business aspirations') and mode of spectrum utilization ('specialized need', 'generic need') that will be enabled by the spectrum that is made available by the government. Carriers apply for spectrum regardless of their network technology ('dissimilar technologies' or 'compatible technologies'). Depending on their 'financial strength', carriers endeavor to own spectrum either independently ('financially strong') as the primary owner or in association with financial institutions ('financially constrained') that are interested in funding spectrum acquisition (as the joint owner).

Strategies to Acquire Spectrum in Secondary Spectrum Market

Not all are carriers can acquire spectrum from primary markets for several reasons that includes scarcity ('scarce') of spectrum (Gruber, 2001; Gruber, 2002; Noam, 1998; Sabat, 2006a). Secondary spectrum markets are the markets in which spectrum owners trade the ownership with buyers that include carriers. The spectrum owners will include carriers with excessive spectrum ('spectrum-rich'), carriers willing to trade off spectrum to generate liquidity ('financially strong'), carriers obligated to sell spectrum by the regulator of the region ('government-regulated'), financial entities owning spectrum to resell, independent entities owning interests in the wireless industry, and would-be-carriers ('unmet business aspirations') attempting an entry into the wireless service provider industry.

The spectrum buyers will include carriers that intend to join the fray ('unmet business aspirations'), but are did not win license in the bidding process, that do not have the necessary capital ('financially constrained') to buy spectrum, or are not in a position to form partnerships to own spectrum ('segregated state'), that may not need spectrum in certain ranges or markets ('specialized need'), that have technologies aligned with the spectrum ('compatible technologies') and that may need spectrum where their spectrum ownership is not contiguous ('segregated'). Other scenarios have been described in an earlier paper (Sabat, 2006a).

In an effort to reduce spectrum investments ('sub-optimized capital investments') and yet meet their spectrum requirements ('unmet business aspirations', 'spectrum-deficient', 'spectrum-constrained'), carriers have been exploring various strategies to acquire spectrum in secondary markets. These strategies include spectrum resale, asset exchange, equity ownership in a spectrum owner, spectrum lease, and wireless network operations consolidation.

(i) Spectrum Resale: A carrier may buy spectrum in markets where it already offers service to beef up spectrum coverage ('spectrum coverage-deficient'), provide additional spectral capacity in markets where the carrier is running into problems, and to better accommodate overall growth ('unmet business aspirations'). In a market where all the spectrum is sold-out ('aggregated'), if a 'spectrum-deficient' carrier has sufficient operational liquidity ('financially strong'), and if its offering requires continuous availability of spectrum for a significant duration ('specialized need'), it acquires spectrum in its target market from a spectrum reseller.

The spectrum reseller would be carriers that accumulate spectrum anticipating emergence of secondary markets, those that are working to relocate smaller licensee's to aggregate useful blocks ('aggregated state'), those that are 'financially constrained' may opt to raise liquidity through a spectrum resale, and those that must resale spectrum to meet the stipulated requirements by government or a bankruptcy court ('government-regulated'), acting on behalf of the investors, to emerge out of bankruptcy. Spectrum reselling is beneficial to reseller if the latter:

- Has excess spectrum in the market ('spectrum-rich') because its subscriber base and service usage do not need as much spectrum;
- Wants to get out of a market ('unmet business aspirations') because the market may not be profitable or strategic to its business; or
- Is cash-starved ('financially constrained') and opts to raise finance through the sale of licenses pertaining to less strategic markets ('unmet business aspirations').

While reselling, a company may resale spectrum licenses in all the markets in which it has rights to operate ('government-regulated'), or in certain markets to raise

liquidity ('financially constrained'), and to build network in its remaining markets ('unmet business aspirations'). In certain cases, the telecom regulator of the region could ask a carrier to resell its spectrum to meet federal regulations ('government-regulated'). Should any carrier return its existing airwave licenses to the telecom regulator of a region, the regulator could be the reseller.

(ii) Asset Exchange: The rising cost of network expansion investments ('sub-optimized capital investments'), customer acquisition ('sub-optimized recurring investments') leads service providers to consider new partnerships with carriers with spectrum ('segregated state') and that are would-be competitors, either with compatible or dissimilar networks ('compatible technologies', 'dissimilar technologies'). Asset exchanges are a relatively inexpensive way ('financially constrained') to increase a carrier's footprint. The net effect is a virtual aggregation of spectrum ('aggregated state').

Carriers want to even out the coverage in areas where they may be weak ('spectrum coverage-deficient') or own no spectrum ('spectrum deficient'). Even if they are 'spectrum rich', they may need a specific band of spectrum to offer a specialized service ('specialized need') that they may not have. In these cases, carriers could align their operations without buying spectrum ('unmet business aspirations') as well. Therefore, carriers are increasingly looking at opportunities as per government guidelines ('government-regulated') to form or extend re-sale and roaming agreements, to secure revenues through alternate sources until they begin their 3G operations, to form affiliates, to share network build-outs, to pool and share spectrum, to swap network assets including spectrum and infrastructure, or to form Mobile Virtual Network Operator (MVNO) alliances.

Roaming and Re-sale: Carriers opt for roaming and resale agreements for several reasons. They may want to:

- Save on their network expansion investments ('sub-optimized capital investments', 'financially constrained');
- Reduce roaming fees that the operators charge each other ('sub-optimized operational investments');
- Provide service in contiguous areas in one or more of which a carrier does not own spectrum and where all the available spectrum is being actively used by existing carriers ('spectrum coverage-deficient');
- Generate a threshold revenue ('sub-optimized operational investments'), and build an initial customer base ('unmet business aspirations'), when a carrier is a new entrant; and
- Serve international subscribers moving across several countries ('unmet business aspirations', 'segregated state', 'compatible technologies').

This relatively uneconomical strategy will be pursued by carriers that do not have other options. Partners in a roaming arrangement could be independent carriers, affiliates or greenfield 3G operators.

(a) Independent carriers: Without extensive nationwide networks, regional players are always eager to sign resale and roaming agreements. Rural operators are also regional players and face the same challenges. Therefore, they opt for roaming and resale agreements.

These roaming partners live their purpose once the roaming operator builds its own network ('compatible technologies'), which is an expensive investment ('financially strong') but in line with its 'unmet business aspirations'. Roaming and re-sale agreements may give birth to *international operators,* operators that serve international subscribers ('unmet business aspirations', 'compatible technologies') moving across several countries where an operator may own little or no spectrum ('spectrum-deficient', 'spectrum coverage-deficient', 'segregated state').

(b) Affiliates: To benefit from roaming arrangements and expand coverage without investing in uncovered markets ('unmet business aspirations', 'spectrum coverage-deficient'), major wireless carriers may seek to form services marketing and distribution affiliations for the affiliates strategy. Such affiliates typically deploy similar network and radio interface technologies ('compatible technologies'). The larger partner benefits from the expansion of these relationships as they provide preferred networks for their subscribers into these new markets, lowering their reliance on roaming agreements with competing carriers ('unmet business aspirations') and providing more favorable economics in return than other viable options without making significant investments ('financially constrained').

The affiliates, on their part, benefit by operating under an established brand name ('unmet business aspirations'), and by getting access to the major player's more extensive network ('compatible technologies') and offer services in uncovered markets ('spectrum coverage-deficient'). However, roaming agreements are expensive propositions ('sub-optimized operational investments') and

hence, preferred as a shorter term alternatives to expand coverage ('unmet business aspirations') and building operating cash flows ('financially constrained') to make infrastructure investments ('compatible technologies').

(c) Greenfield 3G operators: To generate a threshold revenue, and build an initial customer base, many new technology operators ('dissimilar technologies') form roaming agreements with the currently-operating service providers ('segregated state', 'spectrum coverage-deficient') with compatible network infrastructure and radio interface ('compatible technologies').

Network Sharing: After winning a license, to avoid network complications arising out of issues such as interoperability, security, reliability, management and ownership ('aggregated' or 'segregated'), primary owners of the spectrum prefer to build their own network if they have sufficient financing capability ('financially strong'). There are primary owners that cannot finance network build-out alone ('financially constrained') and would like to reduce their spectrum and network infrastructure investments ('sub-optimized capital investments') and operating costs ('sub-optimized operational investments'). These carriers may choose to share network costs with other operators by entering into agreements to share build-out of their next-generation networks in accordance with governmental guidelines ('government-regulated'). This is particularly useful for smaller operators and new entrants in the markets that already have well-established branded players. Why different operators adopt different network sharing strategies, the network sharing models in practice, the benefits and risks of these models, and their implementation issues are described in (Sabat, 2003d; Sabat, 2008b).

Pool and Share Spectrum: If a carrier does not need all the licenses it owns ('spectrum-rich'), but needs licenses in certain other markets where it has a weak or no coverage ('spectrum-deficient', 'spectrum coverage-deficient', 'unmet business aspirations') and where there is no virgin spectrum available ('scarce'), it will trade some spectrum to improve its position in its spectrum-deficient markets. It will trade in those spectrum that are suitable for the type of applications and services it wants to offer ('specialized need'). Such a carrier either *pools and shares* spectrum to operate in the uncovered markets ('spectrum coverage-deficient'), while retaining spectrum ownership ('aggregated state'), or *swaps* spectrum with another carrier to own contiguous spectrum ('aggregated state') that frees the operator from expensive roaming arrangements with other operators ('sub-optimized operational investments').

In pool and share agreements, partner companies pool their spectrum resources in specified markets and provide access to their existing spectrum. The followers of this strategy include carriers that are aspiring to offer national coverage, but have holes in their spectrum in key markets, such as New York and California in the U.S., and those that are facing financial difficulties and are aiming to save network installation and operation costs.

Such ventures address significant holes in the partners' current wireless footprints ('unmet business aspirations', 'spectrum coverage-deficient'). It is also important to note that such joint ventures do not necessarily gain possession of the spectrum, but rather entitle to use this spectrum, with each company retaining ownership ('segregated state'). This fine distinction additionally allows the partnering companies potentially to separate later without a bitter battle over the all-important spectrum. Such deals also provide a solution to the thorny issue of getting enough spectrum to make a network infrastructure build-out worthwhile, while also reducing the cost for this move ('sub-optimized capital investment'). Further, such moves will reduce the partnering companies' reliance on roaming fees ('sub-optimized operational investments') and also allow them to target a wider customer base actively helping them in their top line revenues ('unmet business aspirations'). Next, the network build-out time is reduced for the partnering companies thereby reducing their time-to-market their services ('unmet business aspirations').

Once the objectives of such joint ventures are attained ('unmet business aspirations'), the combined entities will sell their stakes to either another entity or one of the partners.

Network Asset Swap: In a network asset swapping agreement, operators exchange network infrastructure and spectrum in certain markets. In a spectrum swapping arrangement, transacting operators exchange their spectrum licenses in a given market with licenses in other markets. The followers of this strategy will include bidders who purchase licenses to trade later, or carriers that follow pre-arranged co-operative bidding patterns. Carriers that are liquidity-rich when spectrum is available for sale may purchase licenses and trade it later during rainy days to raise liquidity ('financially constrained'). Carriers opt for co-operative bidding patterns when they do have not own enough spectrum in certain ranges in certain markets ('spectrum deficient', 'segregated state'), but the block of spectrum that is made available for sale exceeds their needs ('spectrum-rich') and / or they do not have necessary liquidity to buy the chunk of spectrum ('financially deficient'). Carriers endeavor to

own spectrum that is compatible with their existing network and radio interface technologies ('compatible technologies'). Even the regulator could be one of the parties in the arrangement. Regulations ('government-regulated') may warrant a swap of all network assets as well.

MVNO Agreement: There are situations where a retailer may want to enter the wireless field ('unmet business aspirations'), but does not own the underlying spectrum ('spectrum-deficient', 'spectrum-constrained') or radio network ('sub-optimized capital investments'). Such players use the wireless communications network of a third-party carrier to offer own private label branded versions of licensed carriers' existing wireless services. Such players are designated as MVNOs. An MVNO leases access to the radio spectrum from host network operators, which have radio spectrum licenses ('spectrum-rich', 'aggregated state'), and offers cellular services with independent price plans ('unmet business aspirations'), which are distinct from those of the host network. MVNOs differ from service providers and resellers, which offer cellular services identical or closely linked to those of the host network. Thus, MVNOs companies act as sales and distribution channels for licensed wireless carriers, buying airtime wholesale and reselling it to consumers. The MVNO models in practice, their benefits and risks (Sabat, 2004b; Sabat, 2003d; Sabat, 2006b), and implementation issues are elaborated in another paper (Sabat, 2004b).

(iii) Equity Holding in a Spectrum Owner: There may be carriers that aspire to be international carriers but do not own assets in international markets ('unmet business aspirations', 'spectrum coverage-deficient', 'compatible technologies'). There may be late entrants that want to grow rapidly as well ('unmet business aspirations'). These companies may attempt to acquire stakes in spectrum holders in their targeted markets. Should an opportunity arise, and there be sufficient liquidity available ('financially strong'), equity holders acquire complete stakes ('unmet business aspirations', 'compatible technologies').

(iv) Spectrum Lease: If a spectrum-deficient carrier is 'financially constrained' as well or if its offering requires spectrum during certain time duration of the day or month ('specialized need'), or during certain events ('specialized need'), it may acquire spectrum in selected markets from a spectrum lessor, i.e., a wireless carrier that leases its airwaves to others. This secondary market among carriers allows the companies to alleviate call capacity problems in large markets ('unmet business aspirations') and provide more service to rural areas ('unmet business aspirations') that may expedite the mandate of the government of a region ('government-regulated'). These markets deliver to carriers improved access to the airwaves, increasing their flexibility and bringing down their costs ('sub-optimized operational investments'), which would ultimately result in lower prices for consumers ('unmet business aspirations'). The leasing of airwaves improves carriers' ability to utilize this limited natural resource ('scarce'), and further encourages spectrum use, providing the opportunity for wireless companies to fill holes in their coverage areas ('spectrum coverage-deficient') and decrease the amount of areas containing no signal or dead zones ('unmet business aspirations'). Additionally, greater flexibility to pursue market-driven decisions, matched with streamlined procedures for spectrum transfers enable service providers to acquire and use spectrum more efficiently ('free market-driven'). In the end, these decisions provide increased access to spectrum for consumers whose carriers had been 'spectrum-constrained', leading to fewer dropped calls and improved QoS ('unmet business aspirations').

There has been a broad challenge to the notion that the establishment of exclusive rights in spectrum use, as was the dominant practice since the early days of wireless, is the most efficient approach. Driven by these considerations, of late, several countries have opted for a more market-based approach ('free market-driven') to spectrum management that gives a lesser role to the government ('government-regulated'). The policy makers in the EU and in the U.S. have created open access bands in addition to the traditional licensed regimes. In the past, regulators have prohibited adoption of this strategy ('government-regulated') (Sabat, 2005).

Whereas this change initially will not have a big impact because there is little spectrum surplus, it will let carriers fill in temporary or isolated coverage gaps without building towers or acquiring companies. Whereas spectrum-leasing strategy would irk carriers that paid billions for their airwave licenses, the strategy offers several benefits to the industry's players as well:

- In the past, regulators wanted to ensure that licensees bore responsibility for any interference to competing services or other violations of their guidelines. The rule has effectively prohibited leasing in all but a few circumstances though. The leasing strategy would let license holders strike deals that shift responsibility to lessees.
- A wireless carrier with unused airwaves could lease slices to a rival during peak usage hours or for a few years, easing congestion for subscribers.

- Small carriers that cannot afford to participate in multibillion-dollar spectrum license auctions could lease from big companies. They could use leasing to beam phone service to new homes in outlying areas without the expense of installing wires.
- An alarm service could rent a mobile phone firm's spectrum at night, when few of its channels are in use.
- News services could lease airwaves for events, such as the Olympics.

This policy shift has recently gained traction largely because of a shortage of spectrum that has led to busy cell-phone signals and slowed the rollout of wireless Internet services (Sabat 2003b; Sabat, 2004a; Sabat, 2006a).

(v) Operations Consolidation (Mergers, Acquisitions and Divestitures): To fill gaps in the spectrum range carriers' own ('spectrum coverage-deficient') or to expand into newer markets and expand their customer base with accelerated time-to-market ('unmet business aspirations'), they may want to consolidate their operations and services. To do so, they could merge, acquire either another operator or certain of its operations, or divest certain assets. The followers of this strategy will include national carriers that are without spectrum in the top markets ('spectrum-deficient'), and also those that have limited airwave capacity in key national markets.

These consolidation activities are a natural outcome of rulings to lift spectrum cap ('aggregated state') because with fewer regulatory hindrances ('government-regulated', 'free market-driven'), national operators may begin to consolidate, both among themselves and by acquiring regional and rural operators. After consolidation, companies could also be encouraged to operate separate subsidiaries, or even spin-offs, for efficient management of culturally-different acquisitions, and to drive transactions in newly-acquired markets.

Acquisitions are driven by a number of other factors as well, such as economies of scale, reduced outbound roaming costs ('sub-optimized operational investments'), reduced build-out costs and risks ('sub-optimized capital investments'), improved competitive position ('unmet business aspirations'), capital access ('financially constrained'), stock liquidity (financial constrained'), and capacity gains ('unmet business aspirations'). There are other benefits from consolidation. The shares of larger companies tend to trade more and can attract more meaningful investor bases. Their stock can also become a more viable acquisition currency. Further, if companies stay within the limits of the spectrum cap, it is possible to use acquisitions to gain more spectrum and increase network capacity. However, carriers also face the barriers that restrict national and regional consolidation. These barriers include anti-trust issues, technological compatibility, financial health and debt capacity, and remaining spectrum cap limitations. In addition to these general barriers to consolidation, rural and regional independent operators face many additional challenges. These challenges include piecemeal divestitures, large buyer spectrum overlap, analog risk, combined wireless and wireline operations, and other spectrum sources.

(3) Strategies to Acquire Spectrum under Special Spectrum Regulatory Constraints

The above spectrum strategies are a natural outcome of the industry's spectrum economics. However, national governments may enforce regulations ('government-regulated') to develop cellular services in certain regions of a country, to maintain fair market conditions, or to promote socio-economic agenda of the government.

National governments may enforce regulations to develop cellular services in designated regions of a country, or to maintain fair market conditions. If spectrum regulations promulgated to create fair market conditions do not allow an operator to operate in any of its targeted markets ('government-regulated'), it may operate through a surrogate partner. The followers of this strategy will include larger carriers that would like to access spectrum licenses in the regions ('unmet business aspirations') that are closed to them ('lacking spectrum-coverage'), i.e., licenses that only certain other types of carriers can own and that they do not qualify, and those carriers that would like to leverage available bidding credits for designated areas ('unmet business aspirations'), such as the tribal areas. These carriers opt for a qualifying partner that has 'compatible technologies', to ensure that the two partners can aggregate 'scarce' spectrum ('aggregated state', 'scarce') as an entity.

Conclusions: Implications For the Stakeholders

The industry's spectrum investment drivers and acquisition strategies discussed in this paper would help researchers, managers, investors and regulators in the following ways. In the current inclement milieu, it is crucial to look at the impact of heavy investments on funding and liquidity positions, and develop ways to reduce uncertainty that will lead to the emergence of a stable value chain. Understanding the industry's spectrum ac-

quisition strategies described in this paper can help drive the growth of the industry, align future spectrum investments with high-ROI business opportunities and thereby earn higher returns. A concerted effort by all the stakeholders will help the industry grow profitably.

To lobby with national governments and international spectrum-regulatory agencies for appropriate spectrum policies, investment analyst community, carrier associations, spectrum industry investors, and other telecom representatives must understand various spectrum strategies and competitive maneuvers. To acquire spectrum and to maximize their market share and revenues, operators must examine the spectrum strategies that their competitors are pursuing, and how these evolve over time. Equipment manufacturers must understand spectrum allocations to offer products that function in specific spectrum bands with customer-driven functionalities. As wireless carriers have to use particular bands for specific purposes, content and application developers must understand the spectrum allocations by regulatory bodies, and the strategies that mobile operators are pursuing, and design the services they can provide, either independently or in conjunction with operators.

As the industry evolves rapidly, the value chain, market, regulatory environment and service offerings, will change. Whereas each carrier, region and country may differ, this paper presented a way to look at the industry's spectrum economics that can be aptly utilized when thinking about the industry's evolution, efficiency, competitiveness and profitability.

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Something in human nature causes us to start slacking off at our moment of greatest accomplishment. As you become successful, you will need a great deal of self-discipline not to lose your sense of balance, humility, and commitment.

– Ross Perot

Feature

Energy Harvesting for Reviving Agriculture

Ram P Aneja and G Bhalachandran

The current spate of suicides by poverty stricken farmers in several advanced agricultural states of India, is not a series of isolated incidents, but a symptom of a crisis looming large in rural India. In a scenario afflicted by dubious viability of crops which also need high cash inputs (and hence credit), in a world where oil prices are sky rocketing by the day, the resource–shrunk Indian farmer is desperately looking for alternative farming systems, if he has to survive as a farmer. This study proposes to examine Energy Farming or Energy Harvesting through sustainable agriculture as a viable alternative farming system that can provide higher returns to farmers.

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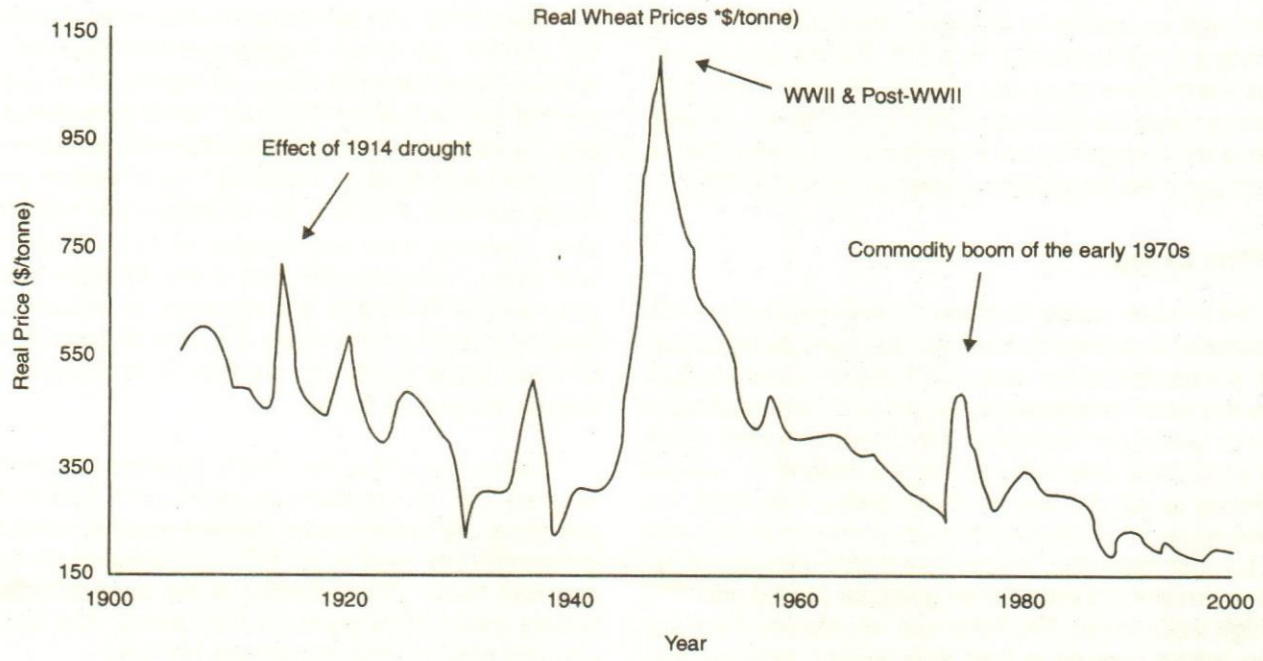
The failure of the Doha round of trade negotiations has once again focused the plight of agriculturists on the developing countries. The dumping of cheap agricultural commodities in the global market has become a major bone of contention between the rich and poor. It is quite obvious that the developed nations, with highly improved agriculture and vast expanse of land and water resources, are the 'price makers' in the global agriculture markets, while the rest of the world is merely a 'price taker'.

In spite of the fact that Indonesia and Malaysia are the most competitive producers of edible oils, they only get what can best be described as a 'residual' price. The large surpluses of edible oils that are dumped into the world market by large producers of soya oil from the US and rapeseed oil (called Canola) by the Canadians, determine the global prices of these oils. The only exceptions of developed countries falling victim to the dumping of cheap commodities in the global market are Australia and New Zealand. These two countries are amongst the most efficient producers of milk in the world and are mere 'price takers' in the global market.

The EU and the US determine the global prices of milk products as they dump a large amount of surpluses into the world market. The underlining issues are not of better economic efficiency but of 'dominance' of the world markets. Only about 2 per cent of the people in the developed world are dependent on agriculture, which in any case is highly subsidized in most of these countries (Shiva, 2002).

Consumers in the west pay a very high price for the commodities that are subsidized for export, as in these countries they are required to pay very high prices for the inefficiencies in the market. This can best be illustrated by the case of global milk prices. Consumers in Europe and North America pay over US $ 6000 per ton of milk powder that is produced in Australia and New Zealand, whereas in India it is just US $ 2000 per ton (Kadhirvel, 2004). Besides, edible oils are sold in the same markets at similarly higher prices as compared to



Source: Ker Roberts, Livestock Feed Grain Users' Group, Australian Government Grain Research Development Corporation.

Malaysia and Indonesia. The underlying fact is that current technology in agriculture and resources of land, water and sunshine on the planet can support a population that is several times the current population. To top it all, there is excess supply of agricultural labor in the world largely in the developing countries. Lack of productive employment in the rural areas of developing countries has emerged as a major economic challenge and opportunity.

The price of staple food grains, till the recent upswing in fossil fuel prices, were at a historic low as shown in Figure 1. These prices picked up only during the major World Wars or as a result of fossil fuel price shocks of 1973 and the volatility in its price during 2006. During August 2006, the crude oil prices touched the first all time high of US$ 78 per barrel. The volatility in crude oil prices is recorded even in September 2007 too. It happens to be US$ 81.79 per barrel on 29 September, 2007. This is an eye opener to agriculturists all over the world to think in terms of *'energy harvesting'*. This paves the way for an efficient utilization of surplus global resources of land and water to meet the energy requirements. In this process, sequestering of atmospheric carbon is the primary technique which should be augmented fully, since it is a replenishable one.

The Indian Agricultural Scenario

The Indian Agricultural scenario at present is quite depressing. The current spate of suicides by farmers in different parts of India points to the erosion of viability of small-scale agriculture particularly when the cash inputs into the farming operations have gone up with rising prices of inputs. The average Indian farmer is caught between rising expectations and lower incomes.

The Government of India had examined the current situations thoroughly by preparing a Situation Analysis Report based on a survey conducted by the National Sample Survey Organization in 2003. The results of this sample survey are presented in Table 1. These figures highlight the fact that for an average farmer in India, the average income from farming operations happens to be

Table 1: Average income and expenditure of the households of the farming community in India: 2003

Details of Income/	Annual Income (Rs.)	Annual Expenditure (Rs.)
Farming Income	11,628	
Other Non-Farming Income	13,752	
Total Income	25,380	
Cultivation Expenses		8,791
Other Expenses		24,449
Total Expenses		33,240
Borrowings	7,860	

Source: National Sample Survey Organization: 2003

Rs 11,628, as against an average expenditure of Rs 8,791 leaving a small surplus of Rs 2,837. But his total household expenditure is as high as Rs 33,240; which puts him in a negative balance of Rs 7,860. This would have been a much larger figure but for his non-farming income which provides an additional revenue of Rs 13,752.

A Silver Lining

No wonder, capital formation in Indian agriculture has become a misnomer. In most places, agricultural operation is a gamble in the monsoon season. States do fight over the water bestowed by nature and those that have excess water are switching over to water loving crops like sugarcane and rice just for the sake of it, without worrying about the fate of those states that need the same water for producing drought prone crops like millet. Lack of marketing infrastructure and institutional facilities prevent the sector from going for the full potential of high value crops like fruits and vegetables. Farmers have limited choices in their total farming systems that have so far served them well. The case study of AMUL will illustrate this amply.

The milk animals in farmers' houses are fed on the crop residues. AMUL provided a reliable market for milk. The farmers' response was positive. This strategy was extended by the NDDB and the farmers of this country have made India the largest producer of milk today. Similarly, soaring energy prices have opened up new vistas for agriculture all over the world. At the botanical level, a plant relies on the photosynthetic process of fixing carbon from the atmosphere. An average plant is 70% carbon (Twindell & Weir, 1986). The efficiency of these plants at the macro level can be measured in terms of carbon sequestering from the atmosphere and also the efficiency of solar energy effectively deployed by these plants. In terms of economics, the value of the end products is considered most crucial. If oil palm and sugarcane are considered as examples of some of the best converters of the sun's energy (and water), it is clear from the fact that these plants absorb solar energy to a large extent and store the same in them.

On an average, we have an equivalent of 1KWH of the sun's energy fall per hour on a square meter of the earth's surface (Finnerty, 1976). This is quite a lot of energy and the largest absorber of this energy is the plant kingdom. In agriculture, where water and sunshine are enormously used, there is an inbuilt capacity to store this energy absorbed in various forms. Farmers should know this and exploit it in the best possible way.

The most efficient use of solar energy takes place in rain forests that truly symbolize the free market economy. No wonder, one of the founders of Neo-classical Economics, Alfred Marshall, declared that the Mecca of economics lies in biology. The rain forest provides a free play for evolutionary forces, variation and selection. The Amazon basin fixes as much as I kg of carbon per sq. meter per year. That is a ton of carbon per hectare per year. However, most of the planet earth is not endowed with water resources like that of the Amazon basin. A good way of looking at the efficiency of various plants from an energy point of view is to look at the amount of biomass these plants can produce under varying agro-climatic ecological zones.

Switch grass that the North American Prairies are covered with, can produce as much as 15 tons of biomass (on a dry basis) under extreme weather conditions. No wonder this grass is the primary fodder for the bisons that rule these plains. Similar is the case with the elephant grass (Para grass) in East Africa, that can also produce over 15 tons of biomass per year.

India and most of the developing countries have plenty of sunshine and water. But agriculturists in these countries have to face the dumping of low priced agricultural products by the rich countries. The excess use of scientific fertilizers and pesticides in large-scale agricultural farming in developed countries now has hiked up the prices of fossil fuel. Fortunately, however, the world is not without any checks and balances. This has opened up the avenues for the resurgence of global agriculture. Instead of drilling deep into the mother earth and exhausting the gifted treasure, farmers can tap carbon from the atmosphere through photosynthesis.

Photosynthesis represents an exploitable renewable resource for the production of materials and energy. Woody and non-woody plants constitute a raw material resource for a myriad of organic products as well as bio fuels. In the light of diminishing store of natural energy reserves in the earth, the application of photosynthetic system as a potentially renewable energy resource legitimately merits serious consideration and development.

The annual utilization of solar radiation by the earth's plant life varies between 0.1 and 0.3 per cent. This production of fixed carbon is more than ten times the present world consumption of energy (Hall, 1976). Thus, there exists a significant potential for utilizing the photosynthesis process for the purpose of generating bio fuels.

Numerous factors play a direct role in determining the photosynthetic efficiencies of specific locales. Table 2 summaries the photosynthetic efficiencies in different

plants and geographical location for various places in the world.

Table 2: Photosynthetic Efficiencies in Plants at Different location

Geographical location and plants	Efficiency%
1) Terrestrial Systems:	
a) USA – Average	0.24
b) USA – Agriculture	0.25 - 0.75
c) Sugarcane, Hawaii, USA	1.6
2) Temperate zone plants:	
a) Rye Grass, UK	2.5
b) Sugar Beet, UK	4.3
c) Maize , UK	3.4
3) Sub-Tropical Plants	
a) Sudan Grass, USA	3.0
b) Sugarcane , Texas, USA	2.8
c) Pine, Australia	2.7
4) Tropical Plants	
a) Palm Oil, Malaysia	1.4
b) Napier grass, E L Salvador	4.2
c) Bulrush Millet, Australia	4.3
5) Earth's Average	**0.16**

Source: Finnerty, W. R., Comparison of Primary Products With respect To Energy Conversion, in H. G. Schlegel and J. Barnea (Ed.), Microbial Energy Conversion, Erich Goltze K G, Gottingen, 1976, p.84.

Solar isolation varies widely through various regions of the earth. The greatest amount of solar impingement is seen in the Sahara Desert, South-Western USA and the South African Desert. Other regions exhibit high rates of CO_2 fixation and photosynthetic efficiencies. Most parts of India come under this category.

Table 3: The Caloric Value of Various Sources of Carbon (Evaluated at current prices)

Fuel	Approx. Price/Kg	Calories/Kg	Calories per Rupee
Wood	2.00	3,500	1,750
Crop Residues	2.00	3,000	1,500
Dung Cakes	2.00	3,700	1,850
Coal	4.00	5,000	1,250
Charcoal	7.00	7,000	1,000
Kerosene	20.00	10,000	500
LPG	20.68	10,000	430
LPG-Commercial	44.84	10,000	222

Source: 1). TERI 2005, TERI Energy Data Directory and Year book, Tata Energy Research Institute, New Delhi.

2). Market survey by the authors

The discussion can be brought closer to reality by comparing the caloric values of various sources of carbon commonly used in our day to day life, for a basic unit of money value, say one rupee. Surprisingly, fire wood, crop residue and dung cakes top the list. That is why in the rural area these form the primary sources of energy. At the same time, they are cost effective too.

Table 3 succinctly depicts the caloric value of various sources of carbon under current consumer prices.

Bio-fuel Scenario in Developed Countries

Paradoxically, in some industrialized countries like Germany, food is cheaper than fuel compared by price per joule. In these countries, central heating units supplied by food grade wheat or maize are available. Bio fuel can be used both for centralized and decentralized production of electricity and heat. In 2006, bio-energy covers approximately 15% of the world's energy consumption (Valtenfall's Annual Report 2005). Most of bio-energy is consumed in developing countries and it is used for direct heating. However, for Sweden and Finland, the share of bio–energy happens to be 17% and 19% respectively, of their energy production which is ranked foremost among the industrialized countries.

The production of bio fuels is a good alternative to oil and natural gas and it can be considered as a healthy development. It is done through cheap organic matter (usually cellulose, agricultural and sewage waste). But, the net energy gain is high. The carbon in bio fuels is an extraction from the atmospheric carbon dioxide obtained through plants. As a result, burning it does not result in a net increase of carbon dioxide in the earth's atmosphere. In other words, an increased use of bio-fuel combats the excess carbon dioxide released into the atmosphere due to the enormous use of the fossil fuels.

Sweden has already switched over to bio-fuels with a share of 30% in the total energy consumption. Its national perspective energy plan for the year 2020 is to completely eliminate the use of fossil fuels. It is to be noted that this plan was drawn when crude oil prices were still hovering around US $ 30 per barrel as compared to the current prices of well over US $ 75 per barrel. Sweden relies on wood as the primary source of bio-energy supported by its well established agro forestry. It is because wood is grown in Sweden 'as a long term crop' by making the best use of their land, water and sunshine and limited manpower.

United States is reviving its agricultural markets by switching over to corn-based ethanol. Their ethanol industry has shown a 30% annual growth in recent years.

The state of Minnesota which has powered the automobile revolution has given the mission of making the US free of foreign fossil fuels.

The US economists believe that electric power produced by switch grass as the source of energy in solid fuel fired boilers can be competitively produced at US 4 cents a kwh.

Biomass-based Power

Switch grass is the dominant cover over the North American plain that is dominated by the bison. This hardy perennial grass is the main source of livestock nutrition in that area and it can yield up to 15 tons of biomass on a dry basis annually. Elephant grass that has been grown as nutritious fodder for cattle can yield as much as 5000 tons of dry matter annually. Even at Rs 2 a kg, it can not only provide competitive fuel but also be nutritious fodder. Indian cattle face the wrath of draughts and animals die under extreme fodder shortage. Cultivation and proper marketing of such biomass can also help in developing fodder banks for the cattle and under extreme circumstances fuel and fodder can become interchangeable.

Production of corn for the conversion into ethanol can very substantially increase our feed resources. It will not only provide additional crop residues to feed livestock directly but also the by-products that are left out in the process of ethanol production can be used as excellent cattle feed concentrates.

Waste land development

The enormous amount of waste land that we have in the rain fed areas can be used to harvest energy either in the form of producing oilseeds like jatropha or perennial grasses like switch grass that have energy and fodder value. The sugar mills in India produce their own steam and power (or both through cogeneration). Rice husk powered boilers are quite common in India. From the point of view of caloric value some of these grasses can be a cheap source of energy as shown in table 1. The carbon dioxide that is produced by the burning of these grasses is no other than the carbon dioxide they fixed in the process of photosynthesis.

Low Cost Energy Farming and Marketing

The suicides by farmers in some of the most advanced agriculture states in India are not mere pitiable isolated episodes, but a manifestation of the crisis looming large in the scene of Indian agriculture. The viability of crops which need a lot of cash inputs (and therefore credit) is under question. Alternative farming systems are needed to make Indian farming a viable proposition particularly for the small, resource-poor farmers.

The world economy and India in particular, is going through energy crisis. The current crude oil prices are not conducive for a sustainable global economy. The high spurt in energy prices can be taken as a boon to revive agriculture globally. The terms of trade between agriculture and industry have for a long time been unfavorable to the farming community. In fact, it can be argued that low prices for agricultural commodities have been the root cause of poverty in developing nations. This is because, by and large, the world is endowed with sufficient resources and technology to meet the food requirements of several times of the current global population. In a way, it is a problem of plenty. But, at the same time this endowment is unevenly distributed. This has to be seriously examined.

Energy farming term is used in a broad sense to mean the production of fuels or energy as a main or subsidiary product of agriculture. It can provide a low cost farming system to the distressed farmers, particularly in India which has plenty of sunshine that can be profitably harvested by these farmers with a little effort. In fact, agriculture is the largest harvester of solar energy today. The sequestering of carbon through photosynthesis is ten times greater than all the energy used globally. This has to be harnessed for the benefit of humanity at large.

The current prices of hydrocarbons are 8 to 10 times the prices of biomass in terms calorific values. Ethanol has been proved to be a viable option/substitute for petroleum products. Bio diesel is waiting in the wings to be a major player in the automotive fuel market. In other words, production of power from cellulose-tic crops is the feasible option under the given circumstances.

Agriculture and energy have always been inextricably linked in India from time immemorial. Even today 90 per cent of the energy used in rural India comes from wood, straw and agricultural waste including dung (Parikh, 2005). Apart from this, some 30 per cent of the farm power is contributed by animals. The current energy crisis is yet another opportunity to revive agriculture in India. Energy crops like maize (for the production of the ethanol) can be a better harvester of the sun's energy. It is high time the Indian farming sector looked into this option seriously with a view to maximizing the farmers' returns. The foregoing analysis underscores the view that

bio fuels have become profitable alternatives to fossil fuels at current prices. What is needed is a 'mission approach' to bring about policies and plans to exploit the full potential of these fuels as a part of not only the 'National Energy Security Plan' but also a way to revive Indian agriculture.

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The first responsibility of a leader is to define reality. The last is to say thank you. In between, the leader is a servant.

– Max Depree

Feature

Productivity of Coconut Cultivation in Kerala

M Lathika, V Mathew Kurian & C E Ajith Kumar

This paper examines the area, production and productivity of coconut cultivation in Kerala over the years, and also analyses the regional variations in the resource productivity and Total-Factor-Productivity (TFP) indices of coconut cultivation in Kerala.

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Coconut is a crop vital to Kerala in terms of its cultivation and its multifarious consumption by the people. It is a means of livelihood to millions and it is an important factor in the state economy. Of the total net sown area of Kerala, 41.31 per cent is taken up by coconut plantations. This makes Kerala the largest supplier of coconut in the country (GoK, 2001b). Coconut fetches about 15 per cent of the annual income and 35 per cent of the agricultural income (GoK, 1997). The cultivation of the crop is, however, beset with a number of problems (Thampan, 1980; Suseelan, 1986; Singhal, 1996).

Production loss of a crop could be attributed either to the decline in area or to diminishing productivity or to both. Area shift is influenced by the profitability of the crop in a previous period. Cultivators will always divert their limited land from a less profitable to a more profitable crop, though for perennial crops like coconut, such sudden shifts would be unnatural. When the possibility of output augmentation through area expansion without encroaching upon other crops is increasingly getting limited, productivity becomes the sole route to output growth. Average annual per-palm yield is at its lowest ebb in Kerala with 33 nuts as against that of the neighbouring states of Karnataka and Tamil Nadu, with 44 and 54 nuts respectively (Ohler, 1999). Productivity of a crop is influenced by a large number of factors such as climatic conditions, suitability of the crop to the land, agronomic practices followed like the use of manure and fertiliser, density of palm, age composition etc.

This paper examines the area, production and productivity of coconut cultivation in Kerala over the years, and also analyses the regional variations in the resource productivity and Total-Factor-Productivity (TFP) indices of coconut cultivation in Kerala.

Materials and Methods

The study is based on both primary and secondary

data. To analyse the trend in coconut cultivation, time series data on area, production and productivity of coconut for a period from 1960 to 2002 was used. Productivity aspects of coconut cultivation were assessed with the help of primary data.

Sampling design

Considering factors like the division of the state into five agro-climatic regions and the varied degree of suitability of different regions for coconut cultivation, a stratified multi-stage random sampling design has been adopted for the present study. Since the study is confined to the productivity of coconut cultivation, agro-climatic regions with varying levels of productivity, have been used as the strata in the sampling design. Accordingly, these agro-climatic regions in Kerala have been treated as the first stage of sampling unit. The high range region is hardly suitable for coconut cultivation, as palm trees cannot tolerate low temperature (less than 20 degree) and the density of coconut planting is very low in this region. Therefore this region is excluded from the purview of this study.

Of the four remaining regions, the 'southern region", the 'northern region", and the 'problem area region" have been randomly selected for the study. A district or that part of the district which lies within a particular agro-climatic region is randomly selected, which forms the second stage of sampling unit. Two panchayats from each district are selected randomly; and thus six panchayats from the three selected districts, belonging to three different agro-climatic regions, constitute the final area of the study. The period of study was 2000-01.

A list of coconut farmers in each panchayat has been prepared with the following inclusion criteria:

i) Size of land under coconut cultivation of the farmer is e ≥ 0.08 ha. (20 cents).

ii) Number of palms in the holding is e ≥ 10.

This has been made possible with the help of the records with the agricultural officer concerned, the local unit of Coconut Development Council and the information provided by some experienced coconut farmers. From each selected panchayat, 50 coconut farmers have been selected at random as the final units of sampling.

All the yield-contributing variables like land size, manure, fertilizer, plant protection charges, hired labour, family labour, fixed capital, spacing and education of the farmers have been taken for the study. It may be noted that the survey data on irrigation have elicited information only on the status of irrigation of the farms (whether irrigated or not) and not precisely on the level of irrigation. Furthermore, rainfall and moisture of the land could not be accounted for, hence the real influence of irrigation on the nut output could not be explicitly identified. Irrigation-related variables are, therefore, dispensed with in this study.

Coconut is widely regarded as a crop of prosperity (kalpavriksha), as it its nut and other parts serve various human needs like nutrition (kernel or endosperm, oil), beverage (tender nut/toddy), binding material (fibre/coir), thatching material (leaf), timber (ripened stem), firewood (all parts) etc. But only its nut is valued as an actual marketable commodity, though many farmers earn a substantial income by selling other palm parts too. Moreover, coconut is a crop which can accommodate other crops in their interspaces, which could also add to the income level of the farm. Keeping these facts in mind, the economy of the coconut is perceived in its totality in this study, taking the economy of other parts of the tree as well and the benefits yielded from the surrounding crops. The benefits of coconut cultivation is thus classified into three; one, 'nut benefit", two, 'palm benefit", which is the returns from all the marketable plant parts of the palm, and three, 'farm benefit", which includes the palm benefit and all the benefits yielded from the inter-crops of coconut in the garden.

Therefore, resource productivity of coconut cultivation is ascertained in terms of 'palm benefits" which includes annual returns from nuts as well as by-products of coconut palm measured in rupee terms and farm benefits, which is the sum total of palm benefits and the benefit in rupee terms accrued from the inter/mixed crops of the farm. The variables which contributed significantly to the variability in palm benefit and also the extent to which the output variable changes to a unit change in the input variable have been identified using a multiple linear regression. Region-wise resource productivity of palm benefit is measured using the conventional Cobb–Douglas production model, which is specified as follows:

$$Y = A.L^{a} K^{b} e^{u},$$

where Y is the palm benefit, Land K are labour and capital inputs and A, a and b are constants to be estimated and u is the stochastic disturbance term and e is the base of natural logarithm (Gujarathi 1995; Mehta 1980). A general case of the Cobb–Douglas production function using 'n' variables namely $X_1, X_2, \ldots, X_n$ of the following form is used for measuring productivity.

$$Y = A.\ X_1^{b1}\ X_2^{b2} \ldots\ X_n^{bn}\ e^{u}$$

Table 1: Percentage share of coconut area and production of the major coconut producing states of India

State	% area under coconut of NSA	Percentage share of the state in the year							
		Area				Production			
		1960	1980	2000	2002	1960	1980	2000	2002
A&N	65.00	1.0	1.8	1.4	1.3	0.7	1.4	0.7	0.7
AP	0.93	4.8	3.8	5.8	5.5	6.4	3.0	8.7	8.8
Assam	0.73	0.1	0.5	1.1	1.1	0.3	0.6	1.2	1.3
Goa	17.34	–	1.7	1.4	1.3	–	1.5	1.0	1.0
Karnataka	2.81	13.7	15.6	18.2	19.8	10.3	15.4	13.8	11.0
Kerala	39.39	69.7	61.8	50.9	49.7	70.6	53.6	42.6	44.8
Orissa	0.90	0.6	1.9	1.0	0.9	0.8	1.6	0.4	1.1
TN	4.88	7.6	10.7	17.2	17.8	9.1	20.8	26.6	25.7
WB	0.45	1.0	0.6	1.4	1.4	0.5	0.4	2.7	2.6
(Others)	0.01	1.56	1.5	0.8	0.4	1.3	1.7	0.5	0.7
India#	1.35	717.4	1083	1824	1914	4639	5942	12597	12678

Abbreviations: A&N – Andaman and Nicobar islands, AP – Andhra Pradesh, TN – Tamil Nadu, WB – West Bengal; NSA – net sown area

Note: '- ' data not available, as the state was formed only after the decade.

- actual area ('000 ha.) and production (million nuts)

Partial elasticity co-efficients $b_1, b_2, \ldots, b_n$ are estimated by using the Ordinary Least Square (OLS) method, that is, by linearising the above model (taking natural logarithms on both sides) which is specified as:

$$l_n Y = l_n A + b_l l_n X_1 + b_2 l_n X_2 + \ldots + b_n l_n X_n + u.$$

After analyzing the region-wise resource productivity of coconut cultivation, productivity index has been computed using Kendrick"s Total Factor Productivity Index (TFPI) (Mehta, 1980; Dhananjayan and Sasikala Devi, 1998). Total Factor Productivity Growth is defined by the following equation.

$$A_1 k = \frac{Y_1}{l_0 \; L + k_0 \; K + s_0 \; S + m_0 \; M}$$

where,

A_1^k = Total factor productivity index of Kendrick of the farm of i^{th} farmer,

Y_1 = Output of the farm (farm benefit) of the i^{th} farmer,

L = labour measured in labour days,

l_0 = wage rate of the i^{th} farmer,

K = fixed capital (i^{th} farmer),

k_0 = interest rate,

S = land size of the i^{th} farmer,

s_0 = rent of land,

M = manure and fertilizer and

m_0 = weight assigned to M (unity).

Results and Discussion

Before analyzing the area, production and productivity of coconut cultivation in Kerala over the years, the current status of the crop in the nation is assessed in order to get a first hand information regarding the relative stake of each major coconut producing states in India at the turn of last few decades.

From the table it discerns that the coconut production affairs of the country are largely determined by the four southern and coastal states of India, namely Kerala, Tamil Nadu, Karnataka and Andhra Pradesh. Kerala had more than 70 per cent share in both area and production during the early 1950s, with no other state in the near vicinity. However, its dominance and supremacy successively dwindled with the states of Tamil Nadu, Karnataka and Andhra Pradesh (in that order) registering a significant improvement in its tally. Table 1 reveals that all the states, barring Kerala, have been consolidating their stakes over the decades.

Table 2: Growth rates of area, output and yield of coconut in Kerala for the two sub-periods (I -1960-1975; II – 1976-2002)

Region	Area		Production		Productivity	
	Period I	Period II	Period I	Period II	Period I	Period II
Kerala	2.208	1.014	0.707	1.665	-1.501	0.651
Thiruvananthapuram	2.146	0.668	-0.268	1.587	-2.414	0.919
KPA district-group	1.070	-0.166	-1.954	-0.019	-3.024	0.147
Kollam	2.531	-1.101	-1.228	-0.513	-3.759	0.588
Alapuzha	-0.965	-0.686	-3.202	-1.128	-2.237	-0.442
KIE district-group	1.419	-0.341	-1.261	0.246	-2.679	0.588
Kottayam	-0.547	-1.954	-1.141	-1.381	-3.594	0.573
Idukki	-29.393	1.532	-62.550	2.796	-33.158	1.263
Ernakulam	1.278	0.687	-0.390	1.253	-1.669	0.566
Thrissur	2.569	2.610	2.002	2.972	-0.567	0.363
North district-group	2.109	2.771	-1.491	4.626	-3.600	1.856
Palakkad	-1.929	4.533	-7.010	6.402	-5.082	1.870
Malappuram	-4.322	2.434	-12.606	4.301	-8.285	1.868
Kozhikode	-1.454	1.235	-4.302	3.188	-2.849	1.953
Kannur	2.527	0.336	-1.783	3.231	-4.309	2.894

Note: The districts of Pathanamthitta, Wayanad and Kasaragod were not considered, as they were formed after 1976.

Since many studies on agricultural sector in Kerala point out the stagnation of agricultural crops in Kerala in the mid-seventies (Pushpangadhan, 1988; Kannan and Pushpangadhan, 1988, 1990), the entire study period from 1960–2002 has been divided into two sub-periods as phase I (pre–stagnation period: 1960 to 1975) and Phase II (post–stagnation period: 1976 to 2002). Period-wise growth rates were estimated by fitting kinked exponential model.

The state, as a whole, as well as the southern and central districts witnessed a declining growth rate in area in the second phase, but with the help of productivity, Kerala could attain commendable improvements in production in the second phase. Despite the positive and comparatively better growth in area in all the district groups of Kerala during the first phase, the production growth rates attained negative scores, which is a reflection of poor productivity performance. The state as well as all the districts invariably maintained negative growth rates in yield during the first phase. But the second phase witnessed a better growth in production for the state and all districts, which is evidently the result of better productivity. Output growth in Kerala, especially the one which is backed by growth in productivity in the second phase spells much delight in the state level coconut scenario, since this comes after a turbulent phase of growth of the crop in the state on account of the devastating mite infestation, sharp price falls and the century-long and yet unbridled deadly root wilt disease (GOK, 1997; GOI, 2001; Lathika and Ajith Kumar, 2005).

Table 3: Yield (number of nuts), per-palm and per-hectare, of coconut in Kerala

Region	Yield per-palm	Yield per-bearing palm	Yield per-hectare
Southern	35	42	10485
Problem area	32	40	8927
Northern	41	50	9025
Kerala	36	44	9479

Source: Field Survey

Before going into the productivity analysis the regional per-palm and per-hectare yield of coconut would enable us to understand the current productivity status of coconut cultivation in Kerala. Table 3 provides a comparative statement of yield under various scenarios. The southern region is found to be most productive land, while the palms in the northern region yield the highest number of nuts.

The palm benefits per unit area of a coconut farm are influenced by many variables. The variables thus identified from the literature survey are 'land size", 'hired labour (wages in Rs.)", 'fixed capital (Rs.)", 'manure + fertilizer (cost of in Rs.)", 'plant protection (cost of

Table 4: Region-wise resource productivity of coconut palm benefits in Kerala

Region[$]	constant	Elasticity coefficients of inputs[a]				Σb_i	R^2	Error d.f. (d)	$F_{2,d}$
		FC[b]	HL	M+F	Spacing				
1	0.8618	0.0238 (0.0418)	0.7911** (0.1469)	0.1869 (0.1026)	-0.3384 (0.2079)	0.6634	0.51	72	20.63**
2	-0.1305	0.1291 (0.0787)	0.8249** (0.1645)	0.2082 (0.1280)	0.0128 (0.1940)	1.1750	0.60	39	16.24**
3	2.1926	0.0189 (0.0781)	0.9632** (0.2023)	-0.0477 (0.1236)	-0.4311* (0.2113)	0.5033	0.36	59	9.36**

[a] - Figures in the parenthesis are the standard errors

[b] - abbreviations: FC – fixed capital, HL – hired labour, M+F – total of manure and fertilizer, Σ - sum of

** - $p < .01$; * - $p < .05$

[$] - Regions: 1 – Southern, 2 – Problem area, 3 - Northern

pesticides in Rs.), 'family labour (imputed value of, in Rs.), 'spacing (average area allotted per palm in the farm) and 'education (of the farmer in years). The resource productivity analysis of the palms is carried out primarily with the help of a Cobb-Douglas model. The assumptions and conditions of the model necessitated a reduced set of variables to be finally considered for fitting the model. Reduction in the number of the variables is achieved by fitting a multiple linear regression model of the palm benefits with all these eight variables. This exercise eliminated two variables, namely, 'plant protection" and 'family labour". The variable 'land size" also was dispensed with, as this variable is found to show multi-collinearity (Maddala 1998, Singh et.al 1991) with many independent variables considered. The variable 'education" was also omitted, as this is largely 'human capability variable", rather than a 'farm input variable". Thus, four variables namely, 'hired labour", 'fixed capital", 'manure + fertiliser" and 'spacing" have been finally selected for resource productivity analysis. Production models have been fitted individually to all the three regions, the results of which are given in Table 4.

The inputs 'fixed capital" and 'manure + fertiliser" are found to be insignificant in all the three regions. This implies that the variability in palm benefits within each of these regions is not due to the variability in the levels of application of these inputs in the respective regions. Hired human labour, on the other hand, contributes positively to palm benefits in all the regions illustrating that palm benefits could be augmented in all these regions by employing more labourers for cultural and/or agronomic practices in the farm. Spacing has a negative regression co-efficient in the northern region indicating that as spacing comes down palm benefit goes up within that region. Hence, a denser planting of palms for those farmers with low planting density could enhance palm benefit in the northern region. Hired human labour alone is found to be statistically significant in southern region showing that it would be possible to increase the palm benefit by 0.79 per cent by increasing the amount spent on human labour by 1 per cent. In problem regions too, hired human labour is the only input significantly influencing the output (regression co-efficient is 0.82). In the northern region, the regression co-efficients of hired human labour as well as spacing are found to be significant. As pointed out earlier, hired human labour has a positive co-efficient (0.96), whereas spacing has a significant negative regression co-efficient. A one per cent decline in spacing would result in 0.43 per cent increase in palm benefits in this region.

An overall assessment of the results emphasizes the fact that hired human labour is the only input, among the various variables considered for the study, having a significant bearing on palm benefits in all the three regions. A number of productivity studies also proclaim the importance of labour in the productivity of various crops (Misra 1992, Saini et.al 1991, Chandrasekharan and Bhavani 1993, Kumar and Mruthyunjaya 1992). Therefore, more labourers should be employed in coconut gardens for enhancing yield. Though coconut farmers have an impression that they can afford neglecting the crop to some extent and that the palm requires only low inputs of hired labour and management, results of the present study highlight the significance of hired labour in influencing palm benefits.

Since the error variances of Cobb–Douglas production function in respect of all the three regions, when tested for their homogeneity (Gomez and Gomez, 1984), is found to be significant ($\chi_1^2 = 7.540$, $p < .05$), suggesting that these three regions are not homogenous with regard to variables other than the inputs considered for

Table 5: Region-wise resource productivity of coconut farm-benefits in Kerala

Region[$]	constant	Elasticity coefficients of inputs[a]			Σb_i	R^2	Error d.f. (d)	$F_{3,d}$
		Land size	Intercrop cost	Fixed capital				
1	3.1534	0.8610** (0.1132)	0.2865** (0.0925)	0.0519 (0.0368)	1.1994	0.61	61	33.83**
2	4.3500	0.5499** (0.1239)	0.1920 (0.1353)	0.1537* (0.0685)	0.9956	0.47	32	10.74**
3	4.9679	0.5749 (0.1183)	0.1070 (0.1120)	-0.1038 (0.0748)	0.7857	0.44	35	10.22**
Kerala	4.2292	0.6586** (0.0665)	0.2117* (0.0626)	0.0782** (0.2940)	0.9485	0.51	136	48.69**

Notes: as in Table 4.

the model, a production for the state as a whole by pooling the samples of these regions, could not be legitimately attempted.

Being a study on the productivity of coconut cultivation, many of the coconut gardens in Kerala are found to be inter/mixed cropped (Marar, 1964; Thampan, 1996). The costs incurred and returns obtained from intercrops are also included for the measurement of productivity. As mono-cropped coconut gardens are found to be few in number in all the three regions, and these coconut farms are in general rich in crop diversity, they present a multi-tier cropping pattern of varying species of different ages and of divergent human utilities and agronomic demands. Thus costs incurred and benefits derived from each crop could not be practically recollected by the farmers. The total joint cost and benefits for the previous year collectively for all the crops other than coconut palms in the farm, were collected from the farmers. Fixed capital employed for cultivation of all the crops standing in the farm and the cropping intensity which is defined as the ratio of number of days intercropped per year (365 days) added with one (as these intercrops to a perennial crop), were also taken into consideration. These variables are included in the model for total benefit from unit area of the farm (farm benefit).

The efficacy of each of the input variables in capturing the variability of the output is ascertained by resorting to multiple linear regression technique. As the variable 'cropping intensity" was found having no significant relation to the farm benefit, this variable was excluded before proceeding to resource productivity analysis. As in the case of 'palm benefits" which was described early, Cobb-Douglas production function is fitted for 'farm benefits" with the three remaining independent farm-input variables (the estimates of the parameters of the model fitted for each region are given below).

Land size is positively related to farm benefits in all the regions as well as in the state. Intercrop cost, that is the variable cost incurred for the cultivation of intercrops, shows a significant positive association with farm benefit in the southern region, indicating that more farm benefits could be obtained by resorting to better cultural and agronomic practices of intercrops. Fixed capital is found to be positively related to farm benefits in the problem region, implying that more farm benefits could be obtained by the setting up of pump sets, irrigation structures and other fixed assets in the form of farm implements in the coconut gardens in this region.

Error variances of the Cobb–Douglas production function of all the regions is found to be homogeneous ($\chi^2 = 2.1661$ – not significant, $p < .05$), implying that these three regions are homogeneous with reference to factors other than the inputs considered. The model is, therefore, fitted to the whole sample, pooling of all the regions together, and its estimates are also presented in Table 5. When all the regions are taken together, the input-output relation of coconut cultivation reveals that increasing the use of fixed capital, adding more inputs to the intercrops and bringing more land under the cultivation of coconut farming system could enhance farm benefits.

Table 6: Mean and coefficient of variation (CV) of Kendrick index (based on farm benefits) by regions

Regions	Mean Kendrick index	CV (%)
Southern	0.0177[a]	79.62
Problem	0.0163[a]	50.29
Northern	0.0394[b]	67.08
χ_1^2	79.47 ($p < 0.01$)	

Source: Field survey

Note: [a, b] = means with the same superscript alphabet are on a par with each other, based on the ranks from Kruskal-Wallis test and critical ratios (Siegel and Castellan, 1988).

Region-wise, the TFP index using Kendrick"s method analysed the variability in productivity indices among the regions, the results of which are presented in the table 6.

Regional disparity in productivity index is computed with the help of one-way non-parametric analysis of variance (Kruskal-Wallis test). Significant regional (agro-climatic) disparities in productivity indices are observed from the analysis of the variance table. The Northern region is found to be the highest yielding region and the other two regions are on par with each other.

Conclusion

Coconut production in the country is largely determined by four southern states namely Kerala, Tamil Nadu, Karnataka and Andhra Pradesh. The performance of Kerala in coconut cultivation was found to be fluctuating and this state could not consolidate its stakes in coconut production over the decades. The study, however, could establish that Kerala began to show a productivity-based growth in coconut output. Farm inputs like hired labour, fixed-capital, spacing and use of manure and fertiliser were found to be true yield-determinants. The stake of 'labour" in making significant variations in coconut output all over Kerala in the present study vindicates that though coconut is commonly regarded as the 'lazy man's crop" with less labour requirement, coconut output could significantly be enhanced by employing sufficient labourers for regular agronomic and cultural practices. The study also highlights the fact that coconut-based farming system would be more productive in larger holdings, by giving more attention and care for the intercrops.

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Book Review

Supply Chain Management: *Edited by John T. Mentzer* Response Books, A division of Sage Publications, New Delhi, pages 512, Price Rs. 495.

The organizations survival and growth would depend on strategies adopted by the companies in the changing global economic environment. A large number of initiatives like TQM, JIT, Kaizen, BPR, SCM and benchmarking are implemented by the companies to enhance their competitiveness. SCM is gaining importance in Indian organizations as well. The present volume is edited by John T. Mentzer which is the work of several authors namely S/Shri William De Witt, Michael S. Garver, James S Keebler, John T.(Tom) Mentzer, Soonhong (Hong) Min, Nancy W. Nix, Carlo D. Smith and G. Zacharia. The book provides the clear understanding of Supply Chain Management (SCM). It describes the SCM and presents various important issues through charts, figures and diagrams including potential future research scope. A number of questions have been raised to provide framework for the researchers. The interviews of top supply chain executives provide the real life examples from twenty organizations. The book will be useful for students, practicing managers and research scholars.

The book is divided into seventeen chapters. Each chapter gives the summary of the chapter at the beginning of the chapter. Thus it would be a great help to the busy executives who want to develop quick understanding of various aspects dealt in each chapter. The details may be read during more leisure time.

First chapter deals with the concepts of Supply Chain Management. Various definitions of SCM as well as understanding of SCM is given in this chapter. It also provides the insight of SCM in twenty companies where they interviewed SCM executives. Finally, it provides the conceptual model and definition of SCM, which is used as a base for other chapters. The chapter also describes the difference between logistics and SCM. It deals with the functional and organizational scope of SCM.

Second chapter examines with various issues related to Globalisation and its implications for SCM. The drivers of economic globalization that have made the environment very competitive are discussed. How global diversity result in increased complexity and uncertainty in doing the business highlights the need for developing innovative strategy. Chapter provides four business models to deal with the problems of globalization. It identifies the differences in approach and objectives of SCM inherent in four business models. Global supply chain processes namely strategy, risk management, knowledge management, relationship management, financial management, organizational capability, information management & technology with various issues and objectives are described. A review of relevant literature is provided. Review of literature focuses on global strategy, global purchasing, channels in global context, global alliance, and global supply chain management. Chapter concludes that there is no coherent body of literature or research in the area of global supply chain management and a research programme to build knowledge in a systematic way and with greater clarity is required.

Chapter 3 deals with the consequences of supply chain management particularly creating value, satisfaction & differential advantage. It defines customer value, dimensions of customer value, as these are important for designing strategy for creating customer value. The important steps in implementing a value delivery strategy are defined. Chapter discusses various aspects of customer satisfaction and differential advantage. How to achieve differential advantages for ultimate customers and supply chain as a whole through SCM is described. The influence of customer satisfaction on customer behaviors is also examined. The chapter concludes that the objectives of SCM are to increase the differential or competitive advantage to the entire chain.

The Role of Marketing in the implementation of supply chain management is discussed in chapter 4. Marketing concepts, a marketing orientation, relationship

marketing etc. have vital role in supply chain management and this chapter develops these linkages. The chapter discusses the concept of marketing besides its impact on the management of a firm and supply chain. It provides the conceptualization of a market orientation and its impacts on management of a firm, management of inter-firm relationship and supply chain management, chapter explains relationship marketing, conceptualization of Relationship Marketing (RM) and its impacts on management of a firm and SCM. An integrated framework showing the relationship among the marketing concepts, RM and SCM leading to differential advantage to the supply chain is provided. Finally chapter concludes that understanding marketing concept, a marketing orientation and SCM leads to differential advantage for supply chain and its partners by reducing cost and investments and by improving Customer Satisfaction.

Across many industries the role of sales function is changing dramatically. It needs to be re-aligned and redesigned with the new business strategy. The chapter 5 examines the dynamic role of sales function in SCM. How selling orientation can be changed to service orientation meeting the needs and expectations of various supply chain partners thereby improving overall performance of the chain, is described here. What are sales force core competences for SCM are discussed. As the role of sales persons would be changing, evaluation, parameters, reward & recognition and training needs would be changing. Chapter is concluded with the remarks that more research is needed in this areas as new role of sales force will continue to evolve.

Chapter 6 deals with Research and Development in supply chain management. It describes R&D within the firm i.e. Intrafirm R&D in traditional context. It summarizes the survey of forty-five multinational companies where in Roger Miller (1995) identified four types of R&D management besides other important viewpoints. It describes R&D inputs, outputs and strengths then it deals with new product development and importance of new product development processes in the present environment an important concern of any business organization. Some important aspects of NPD, which are cycle time, parallel development; cross-functional development and integrated product development are described in this chapter. The cross-functional relationship of R&D marketing, manufacturing in achieving the corporate access is described. Further it emphasizes the need for interfirm R&D and involvement of customers and suppliers in R&d effort for getting the benefit of speed, cost, better quality & customer satisfaction. Four important concepts associated with R&D in a supply chain context globalization, postponement, speed to market and flexible NPD are explored. Chapter concludes making recommendation for management and researches for their use and for further development of R&D in supply chain management.

Effective roles forecasting management leads to improved supply chain performance. Chapter 7 describes sales forecasting practices having bearing on supply chain management. Chapter reviews the evaluation forecasting research from an early emphasis to techniques development to the recent considerations for behaviours and channel factors that affect forecasting creation and application. It defines forecasting management performance (FMP) and supply chain forecasting management performance (SCFMP) as broader measures of forecasting effectiveness. It provides a framework describing forecasting management performance improvement methodology and its impact on the performance of an organization and entire supply chain. Chapter also reproduces the result of a study of forecasting management best practices and has to use them for improvement in forecasting management performance. Finally chapter concludes with the four broad areas of understanding that can help practitioners improve forecasting performance.

In the present day turbulent economic environment characterized by increasing complexity of technology, demanding markets, explosion of knowledge, increasing global competition, the manufacturing strategy play an important role in helping companies become strategically competitive. Chapter 8 describes evolution and growth of production in SCM. It starts from production within the firm (Intrafirm) from craftsman production to mass production to lean production. Under interfirm production, it examines the role of production between firms, need for customer-supplier partnership It describes JIT and Tiered production systems. The trends towards forming partnerships with the suppliers and customers for meeting production goals for long term are also mentioned. The three types of supply chain production systems i.e. dispersed production, build to order production (mass-customized) and postponement are described. Author says that developing a supply chain production system and utilizing a supply chain orientation lead to greater opportunities for lower costs, improved customer values and differential advantage in future. Chapter concludes with managers and researchers recommendations.

Chapter 9 discusses the role of purchasing the supply chain context. It examines the traditional role of managing arms-length transactions (stage I), managing supplier relationships (stage 2), the operational supply chain approach of materials logistics management (stage 3) and strategic supply chain approach of integrated value added (stage 4). It discusses the organizational models

with advantages & disadvantages of each. The communication approaches in relations with customers vs. suppliers are described. The role of information technology (IT) in managing purchasing function in a supply chain context is examined. Chapter concludes with managerial and research implications.

The role of logistics in the supply chain including major functions constituting logistics, emerging logistics strategies and logistics competencies that drive competitive advantage for the firm are discussed in chapter 10. The functions and management of order processing, inventory, warehousing, network design and transportation are discussed in this chapter. Author also examines emergent logistics strategies and characteristics of successful logistics performance. The competences and capabilities of logistic organization and their potential contribution to competitive advantage of the firm are discussed. It concludes that further research is needed to develop and refine appropriate constructs of capabilities of logistics and supply.

Chapter 11 describes the evolution and growth of information system in SCM. Information Technology is at the centre of virtually every aspects of business especially in today's uncertain and highly competitive environment. It deals with several trends like functional integration; time-and quality based competition, increasing computer power in business environment and concludes that information systems are critical enablers. DSS, Expert Systems, Warehousing Management Systems, Transportation Management System, Intranet and ERP are described under intrafirm Information System. Intrafirm applications – MRP and DRP, Interfirm Information System, EDI and Internet are discussed in the context of improving efficiency & effectiveness of information flow between firms. JIT & Cross docking are described under Interfirm applications. Supply chain information system allow companies to coordinate production with demand, slash inventory, cycle times, better manage logistics, improve customer satisfaction and reduce overall costs. It also discusses the important applications of SCIM i.e. fast and efficient response, vendor managed inventory and automatic replenishment technology. It also concludes with the scope of future research in this area.

The chapter 12 discusses financial issues and opportunities confronting management in supply chain environment. The financial issues of supply chain constituencies, the significance and trends in logistic costs particularly in relation to US economy are examined. It describes the accounting model and DuPont model a reliable tool to aid to supply chain managers in identifying the impact of supply chain decisions on the financial performance of an organization. The historical approaches to logistic financial analysis and related financial measures are discussed in brief. The chapter also presently new technologies enabling financial improvements and evolution of supply chain costing. The presentation includes Activity Based Costing (ABC), Economic Value Added (EVA) concept besides other concepts. It also mentions research and managerial implications for further exploration.

Customer service is one of the main objectives of supply chain management through improving operational efficiency and effectiveness. However the role of customer service is not very evident in SCM. The chapter 13 deals in detail on the role of Customer Service Management in SCM cont. It defuse customer services, describes its strategy customer regenerating customer service interface and their importance in SCM context. The measurement of customer service outcomes as perceived by the customer and what performance outcomes valued most by customer at various levels of SCM are discussed in this chapter. Chapter concludes that the research is needed to determine what influence customer satisfaction has on the supply chain related behaviors of intermediate customers.

Chapter 14 describes the need and importance of inter functional coordination in addition to inter-firm cooperation across the firms in implementing SCM. It summarizes how concurrent Management leads to inter-functional coordination. How inter-functional coordination help accomplish common goals and then describe how it could be implemented. Organizations need to be flexible to implement SCM. The antecedents of coordination include – common goal, trust & commitment and support from top management. The successful implementation lead to competitive advantage, reduced cycle time, new product success improved profitability. Finally it provides gaps for future research work.

Chapter 15 deals with inter-firm cooperation. It suggests an integrative framework to understand the nature and the working mechanism of concept of cooperation in a supply chain concept. It discusses the characteristics of inter-firm cooperative relationship. The antecedents that hinder or promote cooperative behaviors like commitments, cooperative norms, interdependence, compatibility, and manager's perceptions of environmental certainly and extendedness of the relationship are explained. The expected results of inter-firm cooperation are described.

Chapter 16 discusses the issues related to performance measurement in supply chain. It provides the

summary of review of key literature and gives a conceptual model of measurement. It discusses the approaches to deal with the problems of measurements. It also provides scope for future research to improve supply chain performance measurement. Supply chain measurement is in its infancy. However, it will become more important in future.

Chapter 17 presents the management conclusions and research implications from the rest of the book and discusses additional conclusions. Supply chain management suggests to book beyond the traditional definition of a customer to all entities in supply chain because any of these "customers' and their value needs holds the key to differential advantage for the firm and the supply chain as a whole.

The book provides the summary to get the bird's eye view of whole chapter for busy executives. The book uses the infirm set of definitions of supply chain management to facilitate future supply chain managers and researchers to work on common understanding of concept.

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The world leaders in innovation and creativity will also be world leaders in everything else.

– Harold R. McAlindon

News & Notes

HIGHLIGHTS OF THIRD CENSUS OF SSI SECTOR

I. Registered SSI sector

- All the SSI units permanently registered up to 31-3-2001 numbering 22,62,401 were surveyed on complete enumeration basis, of which 13,74,974 units (61%) were found to be working and 8,87,427 units (39%) were found to be closed.
- Of the 13,74,974 working units, 9,01,291 were SSIs and 4,73,683 were SSSBEs. Thus, the proportion of SSIs was 65.55%. About 5.08% of the SSI units were ancillary units. The proportion of the units operating in rural areas was 44.33%.
- In terms of no. of working units, six States, viz., Tamil Nadu (13.09%), Uttar Pradesh (11.85%), Kerala (10.69%), Gujarat (10.08%), Karnataka (8.04%) and Madhya Pradesh (7.41%) had a share of 61.16%.
- With regard to closed units, six States, viz., Tamil Nadu (14.33%), Uttar Pradesh (13.78%), Punjab (9.32%), Kerala (8.43%), Madhya Pradesh (7.4%) and Maharashtra (6.11%) had a share of 59.37%.
- The per unit employment was 4.48. The employment per Rs. one lakh investment in fixed assets was 0.67.
- Rice milling industry topped the list in terms of gross output. In terms of exports, textile garments and clothing accessories industry was on top.
- Compared to Second Census, the Third Census brought out some structural changes in the registered SSI sector. While the proportion of working units remained the same by and large, the domination of SSIs among the working units has been reduced considerably from 96% to 66%. This is mainly due to the increase in the number of units engaged in services. The per unit employment has gone down from 6.29 to 4.48. The per unit fixed investment has gone up from Rs.1.60 lakhs to 6.68 lakhs. This could be due to technological upgradation.

II. Unregistered SSI sector

- This sector was surveyed using a two-stage stratified sampling design. Out of the 9,94,357 villages and urban blocks, 19,579 villages and urban blocks were surveyed to identify the units of unregistered SSI sector. Out of these, information was completely received in respect of 19,278 villages and urban blocks. In these villages and urban blocks, the enumerators selected 1,68,665 unregistered SSI units for survey, but they could actually survey 1,67,665 units.
- The size of the unregistered SSI sector is estimated to be 91,46,216. Of these, only 38.75% were SSIs and the rest were SSSBEs.
- The reasons for non-registration were elicited in the Third Census. Interestingly, 53.13% of the units informed that they were not aware of the provision for registration, while 39.86% of the units indicated that they were not interested.
- About 45.38% of the units were engaged in Services while 36.12% were engaged in manufacturing and the rest of the 18.5% in repair/ maintenance.
- Maximum number of unregistered SSI units (16.89%) were located in Uttar Pradesh. The other States having very high concentration of unregistered SSI units were Andhra Pradesh, West Bengal, Maharashtra, Madhya Pradesh, Tamil Nadu, Karnataka, Bihar, Rajasthan and Gujarat.

- 96.9% of the units were proprietary units and about 1.13% of the units were partnership units.
- The average employment was 2.05 and the employment generated per one lakh fixed investment was 3 persons.
- About 10.13% of the units were women enterprises and 57% of the units were managed by socially backward classes.

III. Total SSI sector

- The size of the total SSI sector is estimated to be over one crore (1,05,21,190). About 42.26% of these units were SSIs and the rest were SSSBEs. The number of ancillaries among SSIs were 2.98%.
- About 47.22% of the units were located in Uttar Pradesh, Andhra Pradesh, Maharashtra, Madhya Pradesh and Tamil Nadu.
- The Services Sector emerged as the dominant component in the Total SSI Sector with a share of 44% of the units.
- Although registration is voluntary in the SSI sector, the registered SSI sector was found to be the cream of the Total SSI sector. In terms of size, it was only 13%, but in terms of investment its share was 59% and it contributed to 59% of the total production.
- About 95.8% of the units were of proprietary type of ownership. Entrepreneurs belonging to socially backward classes managed about 56% of the units.
- The number of women enterprises was 10.11%. The number of enterprises actually managed by women was 9.46%.
- The number of women employees was of the order of 13.31%. The employees belonging to socially backward classes numbered 57.45%.

IV. Sickness in SSI sector

- Sickness was identified through the latest definition of RBI given by Kohli committee and incipient sickness was identified in terms of continuous decline in gross output.
- Sickness in the Total SSI sector was of the order of 1%, whereas in the registered and unregistered SSI sectors it was 3.38% and 0.64% respectively.
- The maximum number of sick units were located in West Bengal, Kerala, Maharashtra, Karnataka and Andhra Pradesh. About 59.53% of the sick units were located in these five States.
- Out of the units having loan outstanding with institutional sources like banks and financial institutions, sickness was about 19.6% in the registered SSI sector and 16.61% in the case of unregistered SSI sector. In the Total SSI sector, this percentage was 17.8.
- Incipient sickness identified in terms of continuous decline in gross output was 11.5% in the registered SSI sector and 6.48% in the unregistered SSI sector. In the Total SSI sector, this percentage was 7.4.
- Combining the three yardsticks used to measure sickness, viz., (a) delay in repayment of loan over one year, (b) decline in net worth by 50%, and (c) decline in output in last three years, about 13.98% of the units in the registered SSI sector were identified to be either sick or incipient sick, while this percentage was only 6.89 in the case of unregistered units. In the Total SSI sector, this percentage was 7.82.
- The States of Kerala, Tamil Nadu, Andhra Pradesh, Karnataka, and Maharashtra had maximum number of sick/ incipiently sick SSI units. These five States together accounted for 54.28% of the sick/ incipiently sick SSI units in the country.
- 'Lack of demand' and 'Shortage of working capital' were the main reasons for sickness/ incipient sickness in both the registered and unregistered SSI sectors.

Time Series data for SSIs in India

Year	No. of units (millions)	Fixed investment	Production	Employment	Export
		(at current prices) (Rs. billion)	(at current prices) (Rs. billion)	Nos. in million (Rs. Bn.)	
1973-74	0.416	22.96	72	3.97	3.93
1974-75	0.498	26.97	92	4.04	5.41
1975-76	0.546	32.04	110	4.59	5.32
1976-77	0.592	35.53	124	4.98	7.66
1977-78	0.67	39.59	143	5.4	8.45
1978-79	0.734	44.31	157	6.38	10.69
1979-80	0.805	55.4	216.35	6.7	12.26
1980-81	0.874	58.5	280.6	7.1	16.43
1981-82	0.962	62.8	326	7.5	20.71
1982-83	1.059	68	350	7.9	20.45
1983-84	1.155	73.6	416.2	8.42	21.64
1984-85	1.24	83.8	505.2	9	25.41
1985-86	1.353	95.85	612.28	9.6	27.69
1986-87	1.462	108.81	722.5	10.14	36.43
1987-88	1.583	126.1	873	10.7	43.72
1988-89	1.712	152.79	1064	11	54.89
1989-90	1.823	N.A.	1323.2	11.96	76.25
1990-91	1.948	N.A.	1553.4	12.53	96.64
1991-92	2.082	N.A.	1786.99	12.98	138.83
1992-93	2.246	N.A	2093	13.406	177.84
1993-94	2.388	35.376	2416.48	13.938	253.07
1994-95	2.571	40.799	2988.86	14.656	290.68
1995-96	2.658	49.62	3626.56	15.261	364.7
1996-97	2.803	54.698	4118.58	16	392.48
1997-98	2.944	60.549	4626.41	16.72	444.42
1998-99	3.08	86.106	5206.5	17.158	489.79
1999-00	3.212	72.633	5728.87	17.85	542
2000-01	3.312	79.703	6390.24	18.564	697.97
2001-02	3.442	84.329	6903.16	19.223	712.44
2002-03	3.572	90.45	7420.21	19.965	860.12

Source: Development Commissioner (SSI), Ministry of Small Scale Industries, Government of India

This information is complied from the website

http://www.laghu-udyog.com/ssiindia/

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There is nothing so useless as doing efficiently that which should not be done at all.

– Peter Drucker

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